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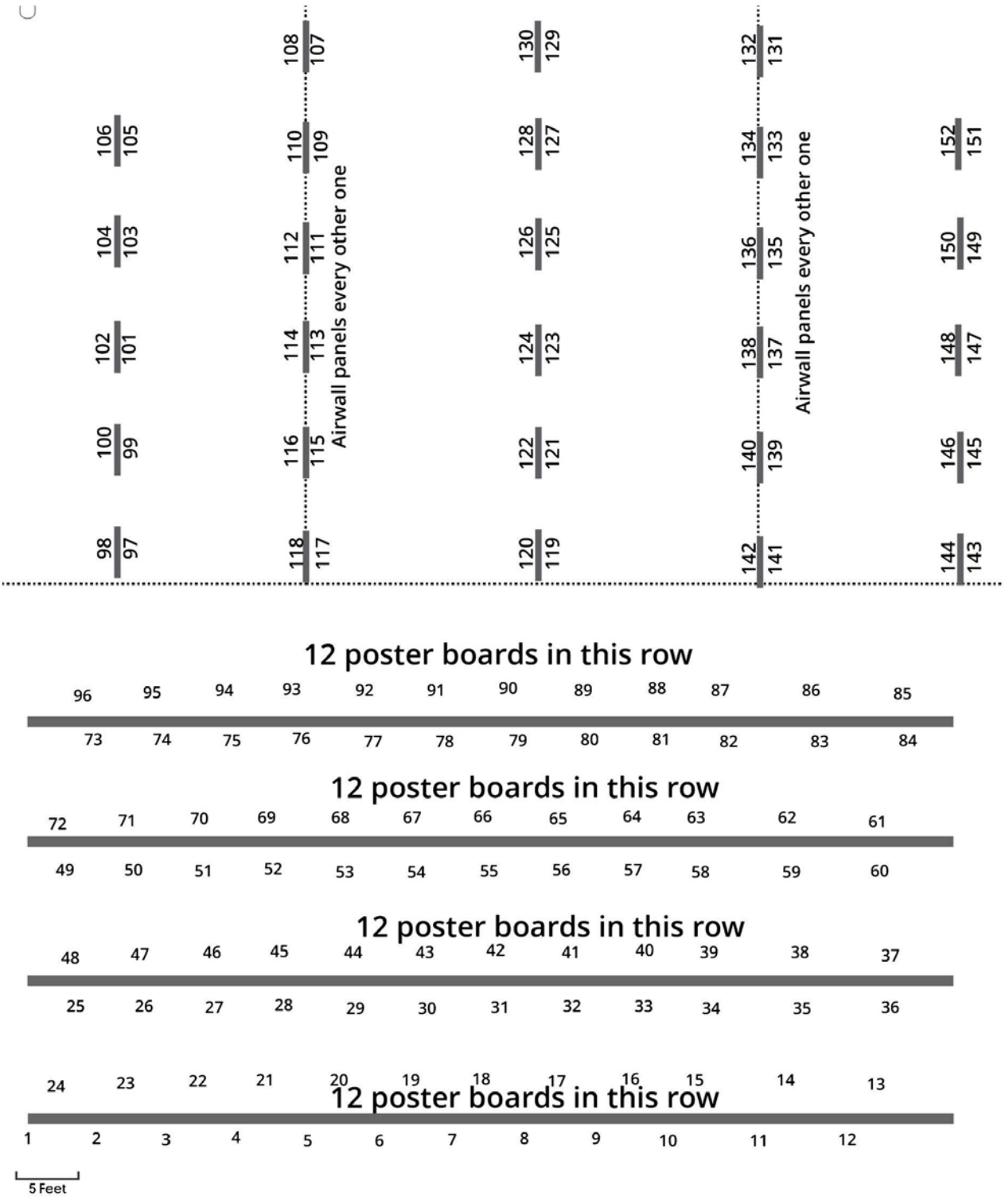

Ballroom ABCD, Ballroom Hallway, South Hallway and Southwest Lounge for Undergraduate Scholars Research Celebration 4-18-19 - April 18, 2019, 7:00 AM

Powered by Social Tables

Topical Sessions – SUB 233

April 18, 2019

MCNAIR SCHOLARS PROGRAM — 11:00 am – 12:30 pm

The essence of the McNair Scholars Program (MSP) at MSU is to successfully combine faculty mentoring, undergraduate research, and academic support services for students who are preparing themselves for success in graduate school. One important preparatory aspect of the program is to provide opportunities for scholars to share their research and creative projects at conference proceedings such as today. The collection of projects showcases the diversity of interests, as students in the MSP range from mathematics to psychology.

** Acknowledgement: This research is funded in part by the US Dept. of Education McNair Scholars Program, grant #P21A130148.*

Session moderator: Shelly Hogan, Director of McNair Scholars Program

11:00 – Amber Yates, Elementary Education (Mentor – Dr. Megan Wickstrom)
Title: Mathematical Modeling: Analyzing K-8 Perceptions of Mathematics, Identity, and Expertise

11:15 – Derek Judge, Electrical Engineering (Mentor – Dr. Anja Kunze)
Title: Magnetic Force Stimulation in COMSOL

11:30 – Mikayla Pitts, Health & Human Development (Mentors – Dr. Suzanne Held and Dr. Mark Schure)
Title: Messengers for Health Baa' Nnilah Program: Understanding community context when recruiting study participants in an American Indian community

11:45 – Nolan Grunska, Philosophy & Geography (Mentor – Dr. Bandyopadhyay)
Title: Are Scientific Models of Life Testable? A lesson from Simpson's Paradox

12:00 – Carter McIver, Mechanical Engineering (Mentor – Dr. Cecily Ryan)
Title: Sustainable Natural Fiber Composites for 3D Printing

12:15 – Faith Ellis, Psychology (Mentor – Dr. Mitch Vaterlaus)
Title: Relationship Expectations in High School Dating Relationships

Topical Sessions – SUB 235

April 18, 2019

PLANT SCIENCE & AGRICULTURAL RESEARCH 3:00 pm – 4:30 pm

The poster session will serve to highlight graduate student research in the disciplines of plant science, entomology, and agricultural science. Montana State was founded as a land grant institution, for which the purpose was to provide a hub of agricultural research for each state. Today, Montana's economy is still largely dependent on agriculture. Research done by graduate students at Montana State University within the Department of Plant Sciences and Plant Pathology directly impacts farmers in Montana and the United States. Moreover, this poster session will also highlight basic research being done in plant ecology and evolution, entomology, and other areas. Along with being a great professional development opportunity for MSU grad students, the poster session will allow students to practice communicating and presenting their research in a relatively low-stress environment. Judges from PSPP and other departments will provide feedback to student presenters, allowing for students to be able to hone their communication skills to a diverse audience.

Session moderators: Brian Ross & Emma Jobson, Plant Sciences and Plant Pathology

- **Traci Hoogland: Plant Sciences and Plant Pathology**
- **Joseph Jensen: Plant Sciences and Plant Pathology**
- **Emma Jobson: Plant Sciences and Plant Pathology**
- **Aishwarya Kothari: Plant Sciences and Plant Pathology**
- **Alex McMenamin: Microbiology**
- **Fenali Parekh: Microbiology**
- **Jeff Pashnick: Plant Sciences and Plant Pathology**
- **Brian Ross: Plant Sciences and Plant Pathology**
- **Jacob Tracy: Plant Sciences and Plant Pathology**
- **Justin Vetch: Plant Sciences and Plant Pathology**

2019 Student Research Celebration
April 18, 2019

MORNING POSTER PRESENTATIONS

SUB Ballrooms ABCD
9:30 am - 12:30 pm

Student, Mentor, Project	Poster Session	Poster Number
Joseph Carey, Ellie Smith, Carter Gall: Cell Biology & Neuroscience Mentor: Renee Reijo-Pera, Ninuo Xia – Cell Biology & Neuroscience *Neural Stem Cells; A Quicker Way To Make Neurons*	am	1
Haley Cox, Lillian Ball: Cell Biology & Neuroscience Mentor: Christa Merzdorf, Jennifer Forecki – Cell Biology & Neuroscience *Xfeb, A Direct Target of Zic1, is Involved in Neural Crest Development*	am	2
Britney Gibbs: Cell Biology & Neuroscience Mentor: David Millman, Brendan Mumey – Computer Science *Automation of Biofilm Research Workflows Linking Various Bioinformatics Tools*	am	3
Colin Hammock: Cell Biology & Neuroscience Mentor: Neha John-Henderson – Psychology *Diet-related mediation of increased inflammation in individuals of low socioeconomic status*	am	4
Kennan Hooker: Cell Biology & Neuroscience Mentor: Anja Kunze – Electrical & Computer Engineering *Optimization of Genetically Encoded Tau Indicator in E18 Cortical Rat Neurons*	am	5
Chelsea Koessel: Cell Biology & Neuroscience Mentor: Ada Giusti – Modern Languages & Literatures *Geriatric Care in Morocco*	am	6
Quinn Krause: Cell Biology & Neuroscience Mentor: Bernadette McCrory – Mechanical & Industrial Engineering *Systematic Literature Review of Currently Available and Emerging Intracorporeal Imaging Technologies*	am	7
Rebecca Schnabel: Cell Biology & Neuroscience Mentor: Steven Stowers – Cell Biology & Neuroscience *Investigating Vesicular Nucleotide Transporter (vNUT) Expression and Function in Drosophila*	am	8
Kole Tison: Cell Biology & Neuroscience Mentor: Steve Stowers – Cell Biology & Neuroscience *A novel epitope tag multimerization strategy utilizing the Gibson Cloning reaction for high sensitivity detection of proteins at endogenous expression levels*	am	9

Student, Mentor, Project	Poster Session	Poster Number
Hanbyul Cho: Microbiology & Immunology Mentor: Seth Walk – Microbiology & Immunology *Progressive Adaptation of Resident Escherichia Coli in Human Gut Microbiome*	am	10
Anders Enevoldsen: Microbiology & Immunology Mentor: Alice Running, Bernadette McCrory – Nursing, Mechanical & Industrial Engineering *Dust Mitigation System for Use in Sterile Human Foot Medical Care*	am	11
Myndi Holbrook: Microbiology & Immunology Mentor: Blake Wiedenheft – Microbiology & Immunology *Determining the role of the AP-complex in C. trachomatis pathogenesis*	am	12
Katrina Lyon: Microbiology & Immunology Mentor: Diane Bimczok, Mandi Roe – Microbiology & Immunology *Examining the Proliferative Behavior of Helicobacter Pylori-Infected Gastric Epithelial Organoids Treated with the Extracts of Black Raspberries*	am	13
Anna Mounsey: Microbiology & Immunology Mentor: Margaret Eggers – Microbiology & Immunology *Investigation of Wastewater Contamination from Septic Systems on Bozeman and Matthew Bird Creeks Using a Multi-Tracer Approach*	am	14
McKay Reed, Ashley Voegele: Microbiology & Immunology Mentor: Margaret Eggers – Microbiology & Immunology *Investigation of Human-Sourced Contamination in Bozeman Creek and Matthew Bird Creeks: Optical Brightener Approach*	am	15
Paige Tolleson, Lexi Kyro: Microbiology & Immunology Mentor: Margaret Eggers – Microbiology & Immunology *E. Coli and Coliform in Bozeman and Matthew Bird Creeks*	am	16
Paige Tolleson: Microbiology & Immunology Mentor: Margaret Eggers, Lori Christenson – Microbiology & Immunology *Research and development of a roadmap for a septic maintenance district for permitted and unpermitted wastewater treatment systems along Bozeman and Matthew Bird Creeks*	am	17
Tillie Stewart: Microbiology & Immunology Mentor: Ellen Lauchnor, Margaret Eggers – Civil Engineering, Microbiology & Immunology *Characterization of Arsenic Distribution on the Crow Reservation*	am	18
Garrett Peters: Microbiology & Immunology Mentor: Seth Walk – Microbiology & Immunology *Metabolic Fitness Allows Escherichia coli to Reside in the Human Gut*	am	19
Sage Schiller: Microbiology & Immunology Mentor: Valerie Copie – Chemistry & Biochemistry *Investigating the metabolic and gene expression changes in human macrophages co-cultured with Pseudomonas aeruginosa biofilms*	am	20

Student, Mentor, Project	Poster Session	Poster Number
Megan Robinson: Ecology Mentor: David Willey, John Winnie, Erik Beever – Ecology *Investigation of the Distribution of the American Pika (Ochotona princeps) of Southwest Montana in Relation to Potential Climate Changes*	am	21
Herlin Kadriu: Microbiology & Immunology Mentor: Carl Yeoman **–** Animal & Range Sciences *Does Spontaneous Oxidation of Biogenic Amines Alter Their Inhibition of Bacterial Growth?*	am	22
Ethan Harbo, Jaron Reynolds: Biology (Flathead Community College) Mentor: Mirabai McCarthy, Ruth Wrightsman – Biology *Antibiotic Potential of Flathead Fungi and Flora*	am	23
Skye Hatfield, Keith Moore, Shannon Cushing: Field Botany (Flathead Community College) Advisor: Ruth Wrightsman – Biology *Antibiotic Potential of Lichens, Fungi, and Bryophytes in Northwest Montana*	am	24
Kyle Montgomery, Chase Skelton: Biology (Flathead Community College) Mentor: Ruth Wrightsman – Biology *Cytotoxicity Testing of Antibiotic Extracts from Northwest Montana Lichens, Bryophytes, and Fungi*	am	25
Raser Powell: Biology (Flathead Community College) Mentor: Mirabai McCarthy, Ruth Wrightsman – Biology *Fungal Morphology in the Flathead*	am	26
Courtney Stinger: Life Sciences (Salish Kootenai College) Mentor: Wendy Westbroek – Life Sciences *Workflow Development for Exosome Isolation of A549 Lung Cells*	am	27
Kyle Pickens: Chemistry (Montana State University – Billings) Mentor: Matt Queen – Biological and Physical Sciences *Exploration of Ligand Lability in Carbon Tetrachloride Dechlorination Technologies*	am	28
Emily Entz: Chemistry & Biochemistry Mentor: Sharon Neufeldt **–** Chemistry & Biochemistry *Nickel-Catalyzed Stille Cross-Coupling of Phenolic Electrophiles*	am	29
Leidy Hooker: Chemistry & Biochemistry Mentor: Sharon Neufeldt **–** Chemistry & Biochemistry *Chemodivergent Nickel-Catalyzed Suzuki Cross-Coupling*	am	30
Luke MacHale, Rebecca Hanscam: Chemistry & Biochemistry Mentor: Robert Szilagyi, Eric Shepard – Chemistry & Biochemistry *Ab Initio Study of Aqueous [Fe-S] Clusters: Computational Modelling of Stepwise Fe-S Cluster Building*	am	31

Student, Mentor, Project	Poster Session	Poster Number
Seth Putnam: Chemistry & Biochemistry Mentor: Nicholas Stadie – Chemistry & Biochemistry *Hydrogen Storage in Bulk Boron-Doped Graphitic Carbon*	am	32
Jenna Severson: Chemistry & Biochemistry Mentor: Michelle Flenniken – Plant Sciences & Plant Pathology *Efficacy of putative antiviral treatments for laboratory-based honey bee deformed wing virus experiments*	am	33
Max Yates: Chemistry & Biochemistry Mentor: Patrik Callis – Chemistry & Biochemistry *Unbiased Quantum and Molecular Dynamics Simulations of Triosephosphate Isomerase*	am	34
Dana Kramer: Chemistry & Biochemistry Mentor: Kristin Juliar, Amy Royer – Montana Office of Rural health and Area Health Education Center *A Comprehensive Assessment of Needs in Rural and Underserved Communities for Behavioral Health Workforce Development*	am	35
Tayler Songer: Biology (Montana State University – Billings) Mentor: Matt Queen – Biological & Physical Sciences *Dechlorination of carbon tetrachloride by Cu(PDTC)Br in environmentally relevant conditions*	am	36
Bekah Anderson: Chemical & Biological Engineering Mentor: Christine Foreman, Markus Dieser – Chemical & Biological Engineering, Center for Biofilm Engineering *Characterization of Microplastics in Precipitation*	am	37
Alex Cuevas: Chemical & Biological Engineering Mentor: Bernadette McCrory – Mechanical & Industrial Engineering *Single-Site Laparoscopic Surgical Tool Optimization*	am	38
Simone Paul: Chemical & Biological Engineering Mentor: Wan-Yuan Kuo – Health & Human Development *Improving the Textural Stability of Gluten-Free Granola: A Collaborative work with the MSU Farm to Campus Initiative*	am	39
Jacob Rotert: Chemical & Biological Engineering Mentor: James Wilking, Phil Stewart – Chemical & Biological Engineering *Fabrication of Custom Microfluidics for Biofilm Investigation in Crevices*	am	40
Petria Russell: Chemical & Biological Engineering Mentor: Connie Chang – Chemical & Biological Engineering *Encapsulation of Single Bacterial Cells in Alginate Hydrogels*	am	41
Mikayla Wood: Chemical & Biological Engineering Mentor: Stephanie McCalla – Chemical & Biological Engineering *Investigation of Heat Transfer in Microfluidic Devices for PCR Reactions*	am	42

Student, Mentor, Project	Poster Session	Poster Number
Canberk Kayalar, Matthew Magoon: Chemical & Biological Engineering, Chemistry & Biochemistry Mentor: Stephanie McCalla – Chemical & Biological Engineering *Transduction of Antigens into Amplifiable DNA Signals Using Structure Switching Aptamers*	am	43
Anna Martinson: Chemical & Biological Engineering Mentor: Adrienne Phillips, Arda Akyel – Civil Engineering, Chemical & Biological Engineering *pH Controlled UICP*	am	44
Zoe Benedict, Madisen McCleary: Mechanical & Industrial Engineering Mentor: Roberta Amendola – Mechanical & Industrial Engineering *The Effect of Aluminum Titanate (Al2TiO5) Doping by Infiltration Method on the Mechanical Properties of Solid Oxide Fuel Cell Anodes*	am	45
Isaac Copeland: Mechanical & Industrial Engineering Mentor: Cecily Ryan **–** Mechanical & Industrial Engineering *Plasticization of Bio-Degradable Polymers*	am	46
Evan Gilbert: Mechanical & Industrial Engineering Mentor: Walter Knighton, Randal Larimer – Chemistry & Biochemistry, Electrical & Computer Engineering *Imaging of Water Droplets and Particulates at High Altitude*	am	47
Keaton Harmon: Mechanical & Industrial Engineering Mentor: Randy Larimer, Berk Knighton – Electrical & Computer Engineering, Chemistry & Biochemistry *Ballast Drop and Vent Construction*	am	48
Francis Loviska: Mechanical & Industrial Engineering Mentor: Joseph Seymour, Sarah Codd – Chemical & Biological Engineering, Mechanical & Industrial Engineering *NMR Investigation of the Microphysical and Structural Properties of Ice*	am	49
Eli Sutherland, Luke Middelstadt, Brendan Gleason: Mechanical & Industrial Engineering Mentor: Brock LaMeres **–** Electrical & Computer Engineering *Radiation and Material Interaction Research for use in Housing for Space Based FPGA Random Number Generators*	am	50
Jiahui Ma: Mechanical & Industrial Engineering Mentor: Bernadette McCrory **–** Mechanical & Industrial Engineering *Predicting Surgeon Workload Using the NASA- and SURG-TLX Instruments*	am	51
Embla Hagensen: Civil Engineering Mentor: Katey Plymesser **–** Civil Engineering *Velocity Profiles in a Denil Fishway and the Implications for Fish Passage*	am	52
Keola Jamieson: Civil Engineering Mentor: Michael Berry **–** Civil Engineering *Feasibility of Non Proprietary Ultra-High Performance Concrete*	am	53

Student, Mentor, Project	Poster Session	Poster Number
Katie MacLeod: Civil Engineering Mentor: Kevin Hammonds – Civil Engineering *A comparison of snow density measurement techniques for hydrological research and remote sensing applications*	am	54
Austin Anderson: Architecture Mentor: Steven Juroszek, Jaya Mukhopadhyay – Architecture *Education and the Future*	am	55
Jakub Galczynski: Architecture Mentor: Steven Juroszek – Architecture *Convergent Future for School, Ecology, and Architecture.*	am	56
Dylan Kish: Architecture Mentor: Steven Juroszek, Jaya Mukhopadhyay – Architecture *The Story of Third Nature: Participatory Learning Through a Series of Cultivated Ecologies.*	am	57
Hannah Christofferson: Education Mentor: Ann Ellsworth – Education *Comparing Finnish and American Approaches to Writing in the Elementary Classroom*	am	58
Heide Arneson: Education Mentor: Bryce Hughes, Carrie Myers, Sarah Maki – Education, Other *Reading Manuals: Questions are the Key*	am	59
Amber Yates: Elementary Education Mentor: Megan Wickstrom – Mathematical Sciences *Mathematical Modeling: Analyzing Elementary Studentsâ€™ Perceptions of Mathematics, Identity, and Expertise*	am	60
Lillie Hawkins, Nicholas Johnson: Health & Human Development Mentor: Colleen McMilin – Health & Human Development *Management of Type 2 Diabetes and Hypertension Through Medical Nutrition Therapy*	am	61
Lindsay Haynes, Nettie Caine: Health & Human Development Mentor: Colleen McMilin – Health & Human Development *Hyperlipidemia and the role of genetics*	am	62
Tyla Herbst, Carly Hart: Health & Human Development Mentor: Colleen McMilin – Health & Human Development *Low FODMAP Diet Related to Improvements in Irritable Bowel Syndrome*	am	63
Lori Lindgren: Health & Human Development Mentor: Mentor J. Mitchell Vaterlaus, PhD, LMFT Vaterlaus, PhD, LMFT – Health & Human Development *Smartphone Acquisition in Adolescence: A Case Study Approach*	am	64

Student, Mentor, Project	Poster Session	Poster Number
Erika Murray, Rachel Walker: Health & Human Development Mentor: Colleen McMilin – Health & Human Development *Consuming a vegan diet while managing rheumatoid arthritis*	am	65
Mikayla Pitts: Health & Human Development **Mentor: Suzanne Held, Mark Schure – Health & Human Development** *Messengers for Health: Baa' Nnilah Program*	am	66
Kaeli Pyles, Maria Bertha: Health & Human Development Mentor: Colleen McMilin – Health & Human Development *Diet Implementation in Chronic Kidney Disease*	am	67
Erica Zarilng, Kaitlyn Schlangen: Health & Human Development Mentor: Colleen McMilin – Health & Human Development *Roux-en-Y Gastric Bypass Diet Implementation*	am	68
Cierra Tredway: Health & Human Development Mentor: Vanessa Simonds – Health & Human Development *Engaging Apsáalooke youth as active co-researchers evaluating water quality*	am	69
Keegan Diehl: Psychology Mentor: Brandon Scott – Psychology *Investigating the Behavioral Health-Emotion Connection in College Students: Are Physiological Indices of Emotion Regulation Associated with Both Anxiety and Aggression?*	am	70
Faith Ellis: Psychology Mentor: J. Mitchell Vaterlaus – Health & Human Development *Relationship Expectations in High School Dating Relationships*	am	71
Trevor Hawks: Psychology Mentor: Keith Hutchison – Psychology *Transcranial Direct Current Stimulation Effects on Attentional Control.*	am	72
David Holzer: Psychology Mentor: Neha John-Henderson, Cara Palmer – Psychology *Sleep Quality in College Students*	am	73
Lucca Reiter: Psychology Mentor: Ian Handley – Psychology *Explaining Gender-Biased Reactions to Findings of Gender Bias in STEM*	am	74
Summer Whillock: Psychology Mentor: Michelle Meade – Psychology *The Influence of Collaboration and Repeated Testing on a Memory Task*	am	75

Student, Mentor, Project	Poster Session	Poster Number
Austin Altman: Business Mentor: Eric Van Steenburg **–** Business *The Wall Street Journal Strategic Marketing Plan*	am	76
Keegan Grady: History & Philosophy Mentor: Susan Cohen **–** History & Philosophy *Once and Future Kings: Searching for King Arthur and Jesus in England*	am	77
Nolan Grunska: History & Philosophy Mentor: Prasanta Bandyopadhyay **–** History & Philosophy *Are Scientific Models of Life Testable? A Lesson from Simpson's Paradox*	am	78
Briana Gillet: Music Mentor: Sarah Stoneback **–** Music *Globalization and Traditional Music*	am	79
Jimmy Kelsey: Music Mentor: Sarah Stoneback, Gregory Young – Music *Vocal Health for Music Educators: A Trumpeter's Perspective*	am	80
Joshua McIntyre: Music Mentor: Jason Bolte **–** Music *The Future of Immersive Music*	am	81
Gregory M. Chorak, Gillian Reynolds: Plant Sciences & Plant Pathology Mentor: Ryan Thum, Jennifer Lachowiec – Plant Sciences & Plant Pathology *Identifying watermilfoil gene expression differences to improve adaptive management outcomes*	am	82
Paysen McKeehan: Chemical & Biological Engineering Mentor: David Hodge – Chemical & Biological Engineering *How Crystallinity Impacts the Kinetics of Acid Hydrolysis of Cellulose*	am	83
Gillian Reynolds: Plant Sciences & Plant Pathology Mentor: Jennifer Lachowiec, Jamie Sherman, Veronika Strnadova-Neeley – Plant Sciences & Plant Pathology, Computer Science *How Advances In Computer Science Are Aiding Global Efforts For Secure, Sustainable Crop Production*	am	84
Ramandeep Sandhi: Plant Sciences & Plant Pathology Mentor: Gadi Reddy **–** Entomology/ Ecology, Plan Sciences & Plant Pathology *Exploring Entomopathogenic Nematdoes for Wireworm Management (COLEOPTERA: ELATERIDAE)*	am	85
Anna French: Ecology Mentor: Ryan Thum **–** Plant Sciences & Plant Pathology *Identification of hybridization between native and invasive aquatic floating hearts (Nymphoides aquatica and N. cristata)*	am	86

Student, Mentor, Project	Poster Session	Poster Number
Vanessa Orcutt: Land Resources & Environmental Sciences Mentor: Michelle Flenniken – Plant Sciences & Plant Pathology *Investigating the efficacy of putative antiviral treatments in honey bees*	am	87
Naomi Redfield: Animal & Range Sciences Mentor: Shelly Hogan – Animal & Range Sciences *STEM Research on the North American Beaver (Castor Canadensis) researched on the Blackfeet Reservation*	am	88
Rudolph Hummel: Earth Sciences Mentor: Chris Organ – Earth Sciences *Origin and Dispersal of Gorgonopsia: A Phylogenetic Approach to Permian Therapsid Biogeography*	am	89
Chance Ronemus: Earth Sciences Mentor: Devon Orme – Earth Sciences *Detrital zircon geochronology of Mesozoic strata exposed in the Bridger Range, SW Montana*	am	90
Jason Carr: Physics Mentor: Charles Thiel, Rufus Cone – Physics *Rare-Earth Doped Material Synthesis for Optical Cooling*	am	91
Dakota Chapman: Physics Mentor: Brian D'Urso – Physics *Processing of SiC Micro-Crystals*	am	92
Micah Johnson: Physics Mentor: Charles Kankelborg – Physics *Confocal microscopy for high-precision non-contact optical measurements*	am	93
Deanta Kelly: Physics Mentor: Amy Reines, David Nidever – Physics *Color Selection of Quasars in a SMASH Data Field*	am	94
Erin Kimbro: Physics Mentor: Amy Reines – Physics *A Survey of AGNs in the NSC Using Optical Variability*	am	95
Katherine Lee: Physics Mentor: Charles Kankelborg, Berk Knighton Angela Des Jardins – Physics, Chemistry & Biochemistry, Physics *High-Altitude Solar Observations with Raspberry Pi*	am	96
Claire Leindecker Lundberg: Physics Mentor: Keith Johnson – Physics *Nature of Science Implementations with Changing Epistemological Beliefs*	am	97

Student, Mentor, Project	Poster Session	Poster Number
Elizabeth Vinson: Physics Mentor: Recep Avci **–** Physics *Investigation of Graphitic Coatings as an Anticorrosive on Copper and Nickel Foils*	am	98
Brock Butcher: Mathematical Sciences Mentor: Andrew Hoegh **–** Mathematical Sciences *Predicting Feet of Beef Cattle*	am	99
Marisa Flores: Mathematical Sciences Mentor: Katharine Banner, Dominique Zosso – Mathematical Sciences *An Investigation of Penalized Logistic Regression with Imaging Data*	am	100
Griffin Smith: Mathematical Sciences Mentor: Dominique Zosso **–** Mathematical Sciences *Geometric Data Analysis*	am	101
Jeremy Tate: Mathematical Sciences Mentor: Mark Greenwood, Yiyi Wang – Mathematical Sciences, Civil Engineering *Ridership: a Computational Approach to Estimating Origin Destination Flows of Bus Passengers*	am	102
Mercy Amankwah: Mathematical Sciences Mentor: Jing Qin, Lisa Davis – Mathematical Sciences *Modeling and Simulation of In-crib drying of Ear Maize: A Case Study in the Sunyani-West District*	am	103
Emmanuel Barton Odro: Mathematical Sciences Mentor: Derek Andrew Williams – Mathematical Sciences *Student Engagement while Establishing Classroom Mathematical Practices*	am	104
Robert Nerem, Peter Crawford-Kahrl: Mathematical Sciences Mentor: Breschine Cummins, Tomas Gedeon – Mathematical Sciences *Theoretical and Numerical Investigation of Regulatory Network Evolution*	am	105
Moses Obiri: Mathematical Sciences Mentor: John Borkowski **–** Mathematical Sciences *Space-filling designs for mixture experiments*	am	106
Giovany Addun, Conner McCloney, Ryley Rodriguez: Computer Science Mentor: Clemente Izurieta – Computer Science *Comparison of Machine Learning Techniques for Land Use Classification*	am	107
Mitchell Black, Amelia Gerry, Kyle Melton: Computer Science Mentor: Clemente Izurieta, Kayte Kaminski – Computer Science, Education *The Compassion Project*	am	108

Student, Mentor, Project	Poster Session	Poster Number
Brian Foley, Brandon Klise, Chad Johnerson: Computer Science Mentor: Clemente Izurieta **–** Computer Science *SmartParkU*	am	109
Jazzlyn Pulley: Computer Science Mentor: Clem Izurieta **–** Computer Science *VibeTribe*	am	110
Logan Vining, Ethan Malo, Derek Wallace: Computer Science Mentor: Clemente Izurieta – Computer Science *NuMo - A Better Diet A Better Life*	am	111
Khristian Jones, Erik Gilbertson, Abigail Stroh: Electrical & Computer Engineering Mentor: Bradley Whitaker – Electrical & Computer Engineering *The Application of Machine Learning in Disease Detection and Diagnosis*	am	112
Timothy Wells, Cesar Cruz: Computer Science Mentor: Clemente Izurieta – Computer Science *Cluest: An interactive GPS-driven game*	am	113
Uciel Garcia: Electrical & Computer Engineering Mentor: Randal Larimer, Walter Knighton – Electrical & Computer Engineering, Chemistry & Biochemistry *Sun Photometer for High Altitude Aerosol Profilinh*	am	114
Julius Scott: Computer Science (Great Falls College – Montana State University) Mentor: Chris Mee – Computer Technology *Ares Space Grant CNC Plasma Table Abstract*	am	115
Derek Judge: Electrical & Computer Engineering Mentor: Anja Kunze – Electrical & Computer Engineering *Neural Network Communication Alteration from Neurite Growth Guidance*	am	116
Hammad Khan: Electrical & Computer Engineering Mentor: Anja Kunze **–** Electrical & Computer Engineering *Fine-tuning Agarose Concentrations for Soft-gel Neuro-microfluidics*	am	117
Andy Kirby: Electrical & Computer Engineering Mentor: Anja Kunze **–** Electrical & Computer Engineering *Verification of Synchronous Microelectrode Array Recording and Calcium Imaging of Neuronal Activity*	am	118

Student, Mentor, Project	Poster Session	Poster Number
Collin Lindeman: Electrical & Computer Engineering Mentor: Randal Larimer – Electrical & Computer Engineering *Improvement of Ground station Tracking*	am	119
Tristan Running Crane: Electrical & Computer Engineering Mentor: Randal Larimer, Berk Knighton – Electrical & Computer Engineering, Chemistry & Biochemistry *Sun Photometer for High Altitude Aerosol Profiling*	am	120
Cammy Agrimson: Mathematical Sciences Mentor: Lisa Davis, Tomas Gedeon – Mathematical Sciences *Distribution of Spacing Patterns in Elongating RNAPs for high through-put genes.*	am	122

2019 Student Research Celebration
April 18, 2019

AFTERNOON POSTER PRESENTATIONS

SUB Ballrooms ABCD
1:30 pm – 4:30 pm

Student, Mentor, Project	Poster Session	Poster Number
Keith Andrews: Cell Biology & Neuroscience Mentor: Susy Kohout, Vamsee Rayaprolu – Cell Biology & Neuroscience *The Translocation of Hs-VSP to the Cellular Membrane*	pm	1
Katelyn Henningsen: Cell Biology & Neuroscience Mentor: Frances Lefcort – Cell Biology & Neuroscience *The Role of the ELP1 Gene in the Development of the Enteric Nervous System of the Stomach*	pm	2
Isbah Khan: Cell Biology & Neuroscience Mentor: Jason Cook – Plant Sciences & Plant Pathology *Validation of QSnh.mst-4A for Seed Number per Spike in Biparental Spring Wheat Mapping Population*	pm	3
Scott Killian: Cell Biology & Neuroscience Mentor: Susy Kohout, Will Ratzan – Cell Biology & Neuroscience *Localizing endogenous VSP in the brains of African clawed frogs and mice.*	pm	4
Haley Rogers: Cell Biology & Neuroscience Mentor: Ganesh Balasubramanian, Margaret Eggers, Lori Christenson – Chemistry & Biochemistry, Center for Biofilm Engineering, Other *Mass Spectrometry Based Water Quality Assessment: a community based approach*	pm	5
Alpha Scheel: Cell Biology & Neuroscience Mentor: Frances Lefcort – Cell Biology & Neuroscience *Investigating the Role of the Gut-Brain Axis in a Mouse Model of Familial Dysautonomia*	pm	6
Zariah Tolman: Cell Biology & Neuroscience Mentor: Catherine Woods, Margaret Eggers – Liberal Studies Degree, Microbiology & Immunology *Contribution of Resource Deficits to Compassion Burnout of Ugandan Health Care Workers*	pm	7
Jocelyn Waggoner: Cell Biology & Neuroscience Mentor: Christa Merzdorf – Cell Biology & Neuroscience *Zic transcription factors that influence convergent extension*	pm	8
Cody Walters: Cell Biology & Neuroscience (Montana State University – Billings) Mentor: Lynn George, David Butler – Cell Biology & Neuroscience *Generation of a High Throughput Screening System for Small Molecules Capable of Rescuing Axonopathy*	pm	9

Student, Mentor, Project	Poster Session	Poster Number
Katelin Hancock: Microbiology & Immunology Mentor: Lauren Kerzicnik – Plant Sciences & Plant Pathology *Exclusion of ants as a biological control for aphids in western Montana apple orchards*	pm	10
Ozzie Indreland: Microbiology & Immunology (Montana Tech – The University of Montana) Mentor: Joel Graff – Biology *Identifying Proteins that Interact with the Really Interesting New Gene Protein RNF166*	pm	11
Margaret Branine: Microbiology & Immunology Mentor: Sara Branco – Microbiology & Immunology *Investigating ecological trade-offs in endophytic insect pathogenic fungi*	pm	12
Brianna Bull Shows: Microbiology & Immunology Mentor: Suzanne Held – Health & Human Development *Evaluation of culturally consonant incentives used in a community-based chronic illness self-management program*	pm	13
Sage Chase: Microbiology & Immunology Mentor: Douglas Kominsky – Microbiology & Immunology *Defining the Mechanism of Salmonella Virulence Modulation by CD73 in the Intestinal Epithelium*	pm	14
Lauren Crose: Microbiology & Immunology Mentor: Micheal Franklin – Microbiology & Immunology *Characterizing Dormancy Factors in Pseudomonas aeruginosa*	pm	15
Laina Hall, Pushya Krishna: Microbiology & Immunology Mentor: Blake Wiedenheft, Paul Van Erp – Microbiology & Immunology *Activation of the CRISPR system in Escherichia coli under Acid Stress*	pm	16
Verena Lawrence: Microbiology & Immunology Mentor: Michelle Flenniken – Plant Sciences & Plant Pathology *Natural Infection of Hemocytes in Honey Bee Antiviral Defense*	pm	17
Zach Hart: Microbiology & Immunology (Montana Tech – The University of Montana) Mentor: Joel Graff – Biology *Investigating the Function of TRIM22 and TRIM34 with a Yeast-Two-Hybrid Screen*	pm	18
Camille McEwen, Kristine Jordan: Microbiology & Immunology (Montana Tech – The University of Montana) Mentor: Joel Graff – Biology *Fluorescent and Bioluminescent DNA Labeling to Determine TRIM Protein Interaction in Signaling Pathways and Roles in Innate Immunity*	pm	19
Allison Perez: Microbiology & Immunology Mentor: Ed Schmidt, Colin Miller, Justin Prigge – Microbiology & Immunology, Chemistry & Biochemistry, Microbiology & Immunology *Understanding Redox Balance Disruptions: Synthesis, Characterization, and Biological Validation of an Isotopically Labeled Amino Acid, 34S-L-Cysteine*	pm	20

Student, Mentor, Project	Poster Session	Poster Number
Hagan Vincent: Microbiology & Immunology Mentor: Matthew Taylor – Microbiology & Immunology *Visualizing and Quantifying Intercellular Spread of Pseudorabies Virus*	pm	21
Madison Hebner: Microbiology & Immunology Mentor: Eric Boyd, Eric Dunham – Microbiology & Immunology *Traditional Approaches for Life Detection When Modern Approaches Fail*	pm	22
Chelsea Coons, Kyler Pawlowski: Biology (Montana State University – Billings) Mentor: David Butler, Kurt Toenjes – Biology *Investigating the Binding of BH3I-1 Derivatives to Anti-Apoptotic Bcl-2 Proteins*	pm	23
Aaron Sharp: Biology Medical Laboratory Science (Montana State University – Billings) Mentor: Kurt Toenjes *Small molecule Gram-Positive Bacterial Inhibition.*	pm	24
Joshua Davisson: Chemistry & Biochemistry Mentor: Susy Kohout, Vamseedhar Rayaprolu – Cell Biology & Neuroscience *Dimerization of the Voltage Sensing Phosphatase from Xenopus laevis*	pm	25
Matthew Magoon, Canberk Kayalar: Chemistry & Biochemistry, Chemical & Biological Engineering Mentor: Stephanie McCalla – Chemical & Biological Engineering *Using DNA Aptamers to Detect Vascular Endothelial Growth Factor*	pm	26
Gavin O'Boyle: Chemistry & Biochemistry Mentor: Jennifer DuBois – Chemistry & Biochemistry *Identifying Thermophilic Enzymes Capable of Catabolizing Poly(ethylene terephthalate)*	pm	27
Willis Pullman: Chemistry & Biochemistry Mentor: Jovanka Voyich, Tyler Nygaard – Microbiology & Immunology *Phosphorylation of SaeR*	pm	28
Veronika Shchepetkina: Chemistry & Biochemistry Mentor: Matthew Cook – Chemistry & Biochemistry *Novel Synthesis of Nitrile-Containing Molecules for Pharmaceutical Applications*	pm	29
Hans Swenson: Chemistry & Biochemistry Mentor: Nicholas Stadie – Chemistry & Biochemistry *Measuring the Extent of Helium Adsorption in Microporous Materials*	pm	30
Shelby Towe: Chemistry & Biochemistry Mentor: William Dyer – Plant Sciences & Plant Pathology *The Linkage Between Heat Shock Proteins and Herbicide Resistance*	pm	31

Student, Mentor, Project	Poster Session	Poster Number
Elizabeth Waymire: Chemistry & Biochemistry Mentor: Brian Bothner – Chemistry & Biochemistry *Characterization of the Effects of the Binding of anti-CRISPR AcrF9 to the CRISPR Type IF Surveillance Complex*	pm	32
Dakota Wise: Chemistry & Biochemistry Mentor: Patrik Callis – Chemistry & Biochemistry *Water - An Obligatory Cofactor of Orotidine 5'-phosphate Decarboxylase*	pm	33
Mona Abdelgaid: Chemical & Biological Engineering Mentor: Wan-Yuan Kuo – Health & Human Development *Analysis of both Improved Cream of the West 7-Grain Pancake Texture and the Particle Size of the Pancake Mix*	pm	34
Nickolas Avila: Chemical & Biological Engineering Mentor: Robin Gerlach – Chemical & Biological Engineering *A model to quantify the enhanced mass transfer of CO2 into high alkalinity algae culture medium*	pm	35
Martina Du: Chemical & Biological Engineering Mentor: Ross Carlson – Chemical & Biological Engineering *Applying Synthetic Biology Techniques to Engineer Microbial Ecology Systems*	pm	36
Kendra Hergett: Chemical & Biological Engineering Mentor: Anja Kunze – Electrical & Computer Engineering *Optimizing surface coating on poly(dimethyl-siloxane) for neuronal cell shape studies*	pm	37
Ethan John: Chemical & Biological Engineering Mentor: James Wilking – Chemical & Biological Engineering *Coalescence of Human Gastric Organoids*	pm	38
Whitney Kieffer: Chemical & Biological Engineering Mentor: Ellen Lauchnor – Civil Engineering *Bacterially influenced leaching of metals from mine tailings*	pm	39
Dylan Ladd: Chemical & Biological Engineering Mentor: Nick Stadie – Chemistry & Biochemistry *Decaborane as a Precursor in Boron-Doped Graphitic Carbon Synthesis*	pm	40
Christian Lewis: Chemical & Biological Engineering Mentor: Brent Peyton – Chemical & Biological Engineering *Nutrient-Induced Accelerated Growth of Microalgae*	pm	41
Alexis Ostwalt: Chemical & Biological Engineering Mentor: Joseph Menicucci, Stephanie McCalla – Chemical & Biological Engineering *Exploring the Effects of Point Defects in Self-Assembled Monolayer Systems*	pm	42

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Anthony Savoy: Chemical & Biological Engineering Mentor: David Hodge – Chemical & Biological Engineering *The Effect of Varying Alkaline Pretreatment Reaction Coordinates on Woody Biomass*	pm	44
Tara Sundsted: Chemical & Biological Engineering Mentor: Stephanie Wettstein – Chemical & Biological Engineering *Heterogeneous catalysts for lignocellulosic biomass upgrading*	pm	45
Kelsey Moorhouse: Mechanical & Industrial Engineering Mentor: Sarah Codd, Joseph Seymour – Mechanical & Industrial Engineering, Chemical & Biological Engineering *Ripening of Ice crystals in Ice-Brine Systems*	pm	46
Brandon Bess: Mechanical & Industrial Engineering Mentor: Randal Larimer, Walter Knighton – Electrical & Computer Engineering, Chemistry & Biochemistry *Zero pressure balloon design and construction*	pm	47
Caitlin Carmody: Mechanical & Industrial Engineering Mentor: Jim Wilking, Scott McCalla – Chemical & Biological Engineering, Mathematical Sciences *Chickensplash! Exploring the Health Concerns of Washing Raw Chicken*	pm	48
Benjamin McHugh: Mechanical & Industrial Engineering Mentor: Roberta Amendola – Mechanical & Industrial Engineering *Influence of Redox Cycling on the Mechanical Properties of Solid Oxide Fuel Cell Anodes*	pm	49
Carter McIver: Mechanical & Industrial Engineering Mentor: Cecily Ryan – Mechanical & Industrial Engineering *Sustainable Natural Fiber Composites for 3D Printing*	pm	50
Dean Ricker: Chemical & Biological Engineering Mentor: Christa Merzdorf – Cell Biology & Neuroscience *Does aquaporin 3b affect the number and characteristics of calcium waves in the neural plate of Xenopus laevis embryos?*	pm	51
Matthew Trzinski: Mechanical & Industrial Engineering Mentor: Bernadette McCrory, Alice Running – Mechanical & Industrial Engineering, Nursing *Comparative Assessment of the NASA-TLX and SURG-TLX*	pm	52
Joseph Tschida, Hayden Frederick: Mechanical & Industrial Engineering, Business Mentor: Maggie Thorsen, Andreas Thorsen – Sociology and Anthropology, Business *An Investigation of Service Characteristics and Chronic Disease Management at Community Health Centers in Montana*	pm	53
Janae Vasatka: Mechanical & Industrial Engineering Mentor: Cecily Ryan, Flynn Murray – Mechanical & Industrial Engineering, Graduate Departments and Degrees *Material Properties of Biopolymers and Bio-composites used in Fused Deposition Modeling*	pm	54

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Rebecca Wolfe: Architecture Mentor: Ralph Johnson, Jaya Mukhopadhyay – Architecture *Accessory Dwelling Units and Urban Sociology*	pm	56
Mary Burr: Civil Engineering Mentor: Ellen Lauchnor – Civil Engineering *Characterizing Unique Methanotrophs from the Deep Subsurface*	pm	57
Joseph Golichnik: Civil Engineering Mentor: Jean Dixon – Earth Sciences *Quantifying sediment transport in mountainous catchments of W. Montana*	pm	58
Megan Guinn: Civil Engineering Mentor: Joel Cahoon – Civil Engineering *Development and Hydraulics Testing of a Modified Denil Fishway*	pm	59
Derek Snyder: Civil Engineering Mentor: Otto Stein – Civil Engineering *Cold Temperature Nitrification in Constructed Wetlands*	pm	60
Mark Poston, Scotty Tilton: Mathematical Sciences Mentor: David Ayala, Eric Berry – Mathematical Sciences *Homologies of Grassmannians via Exit-Path Categories*	pm	62
Rachel Ulrich: Mathematical Sciences Mentor: Scott Powell – Land Resources & Environmental Sciences *A Bayesian modeling approach for improved land use classification*	pm	63
Stefan Andersson, Connor Edling: Electrical & Computer Engineering Mentor: Brock LaMeres – Electrical & Computer Engineering *Pseudo Random Number Generation for Use in Encryption*	pm	64
Xingzi Xu: Electrical & Computer Engineering Mentor: Anja Kunze, Dominique Zosso – Electrical & Computer Engineering, Mathematical Sciences *Simulation-Based Study of Vesicle Motion*	pm	65
Ryan Hansen: Computer Science Mentor: Brittany Fasy – Computer Science *Assessing Model Fitness Using Sheaves*	pm	66

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Benjamin Holmgren: Computer Science Mentor: David Millman, Brittany Fasy – Computer Science *Updating the R Package TDA*	pm	67
Brett Layman: Computer Science Mentor: Clemente Izurieta – Computer Science *Artificial Life Agents*	pm	68
Alec Dinerstein: Physics Mentor: Randy Babbitt – Physics *Automated particle detection in optical tweezers*	pm	69
Alisa Drenner: Physics Mentor: John Neumeier – Physics *Physical Properties and Superconductivity of $SrTa_2S_5$ and $BaTa_2S_5$*	pm	70
Will Early, Mark Sargent: Physics Mentor: John Sample – Physics *Observing Terrestrial Gamma Ray Flashes using a Light and Fast Detector*	pm	71
Breanne Hodgson: Physics Mentor: Recep Avci – Physics *The Effects of Graphene Coatings in Protection Against Biocorrosion in Suboxic Environments*	pm	72
Ashland Knowles: Physics Mentor: Anton Vorontsov – Physics *Resolving Anomalies of Third Sound Modes in Thin Films of Superfluid Helium-3*	pm	73
Emilyn Kracher: Physics Mentor: Brian D'Urso – Physics *Photoluminescence of Silicon Carbide with Silicon Defects*	pm	74
Madalynne LaLanne: Physics Mentor: John Sample – Physics *Debris Recycler for Low Earth Orbit*	pm	75
Elizabeth Rehbein: Physics Mentor: Joseph Shaw – Electrical & Computer Engineering *Determination of cloud thermodynamic phase using artificial neural networks*	pm	76
Gavin Pirrie: Earth Sciences Mentor: Drew Laskowski – Earth Sciences *Early insight into lithium prices with respect to the electric vehicle industry*	pm	77

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Stewart Cook: Earth Sciences Mentor: David Varricchio, Colin Shaw – Earth Sciences *A Lost World: A New Amber Bearing Lignite Deposit in the Hell Creek Formation of Southeastern Montana*	pm	79
Devan Driscoll-Roach: Earth Sciences Mentor: David Varricchio **–** Earth Sciences *Wood Bore Traces of the Late Cretaceous, Two Medicine Formation of Montana: Ichnotaxomic Description and Interpretation*	pm	80
Rudolph Hummel, Travis Ball, Calvin Eden, Fiona Lewis: Earth Sciences, Chemistry & Biochemistry, Ecology Mentor: Dave Varricchio **–** Earth Sciences *Digestive Taphonomy: Equifinality in Corroded Bones*	pm	81
Michael Laase: Earth Sciences Mentor: Dr. Colin Shaw **–** Earth Sciences *Three-Dimensional Reconstruction of Carbonate Reservoir Rock Pore Networks Using Confocal Laser Scanning Microscopy*	pm	82
Thomas LaBarge: Earth Sciences Mentor: Chris Organ **–** Earth Sciences *The Interrelationships of Phorusrhacidae and the Evolution of Gigantism*	pm	83
Rudi Lien: Earth Sciences Mentor: Eric Boyd **–** Microbiology & Immunology *Mechanisms of Microbially Mediated Dolomite Formation in the Great Salt Lake*	pm	84
Solange Dubreuil: Ecology Mentor: Amy Apprill **–** Chemistry & Biochemistry *DNA-based sequencing approach to identify microbial community diversity from Cuban Coral Tissue*	pm	85
Ian McRyhew, Ashley Gervais, Stephanie Thomas, Marcy Mead, Virgil Dupuis (Salish Kootenai College) Mentor: Selena Ahmed, Carmen Byker-Shanks: Health and Human Development *Advancing Healthy and Sustainable Diets for All through a Social Media and Nutrition Education Intervention on the Flathead Reservation of the Confederated Salish and Kootenai Tribes*	pm	86
Athena Erickson: Agricultural Economics & Economics Mentor: Vincent Smith **–** Agricultural Economics & Economics *Charter School Enrollment & Authorization Exploration*	pm	87

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McCall Voy: Sociology and Anthropology Mentor: Elizabeth Rink, Ada Giusti, Shelly Hogan – Health & Human Development, Modern Languages & Literatures, McNair Scholars Program *Sexual and Reproductive Health in Greenland and the Colonization Mindset of the French*	pm	89
Eli Snyder: English Mentor: Allison Wynhoff Olsen, Nigel Waterton – Education *The Vocational Lens: Generating a Sense of Critical Vocational Literacy*	pm	90
Natalie Sturm: Land Resources & Environmental Sciences Mentor: Selena Ahmed **–** Health & Human Development *Characterization and Mitigation of Elevated Carbon Dioxide-Driven Impacts on the Nutritional Quality of Spinach*	pm	91
Brody Wallace, Briana Whitehead: Land Resources & Environmental Sciences Mentor: William Kleindl **–** Land Resources & Environmental Sciences *Sensitivity Analysis of Multiple Regulatory Tools for Riparian Wetland Assessment to Disturbance Gradients within SW Montana*	pm	92
Amanda Leckband: Animal & Range Sciences Mentor: David Sands, Ed Dratz – Plant Sciences & Plant Pathology, Chemistry & Biochemistry *Plasmid Curing by an Ethiopian Barley: A Natural Feed/Food Approach to Reduce Plasmid Mediated Antibiotic Resistance*	pm	93
Arden Engel: Ecology Mentor: Ryan Thum **–** Plant Sciences & Plant Pathology *Microsatellites distinguish morphologically similar native and invasive water primroses (Ludwigia hexapetala and L. grandiflora)*	pm	94
Maggie LaRue: Ecology Mentor: Lindsey Albertson **–** Ecology *Impact of Beaver Dam Analog Structures on Secondary Production in the Centennial Valley of Montana.*	pm	95
Ashley Micklewright: Ecology Mentor: Christopher Guy, Hayley Glassic – Ecology *Diet Analysis of Invasive Lake Trout (Salvelinus namaycush) in Yellowstone Lake*	pm	96
Austin Simonpietri: Ecology Mentor: Amy Trowbridge **–** Land Resources & Environmental Sciences *Assessing the interactive effects of drought and herbivory on defensive volatiles from ponderosa pine*	pm	97
Angela Bear Claw: Plant Sciences & Plant Pathology Mentor: Tracy Dougher, KayAnn Miller Julian Collins – Agricultural Education, Other *TRiO: Propagation of Wild Prairie Turnip Pediomelum Esculentum*	pm	98

Student, Mentor, Project	Poster Session	Poster Number
Lilianna Bento: Plant Sciences & Plant Pathology Mentor: William Dyer, Barbara Keith – Plant Sciences & Plant Pathology, Land Resources & Environmental Sciences *The Effect of Plant Volatiles on Herbicide Efficacy and Resistance*	pm	99
Jared Lile: Plant Sciences & Plant Pathology Mentor: Jennifer Lachowiec **–** Plant Sciences & Plant Pathology *Genetic Interactions Underlying Variation in Hsp90 Function*	pm	100
Randy Taylor: Plant Sciences & Plant Pathology Mentor: Mac Burgess **–** Plant Sciences & Plant Pathology *Identifying Crop Nutrient Stress from Soil pH Extremes Utilizing UAVs*	pm	101
Sorcha Brooks: Art Mentor: Regina Gee **–** Art *Emperors, Angels, and Barbarians: Roman, Christian, and Germanic Syncretism in the Franks Casket*	pm	102
Christopher Cunningham, et al.: Music Mentor: Kristin Harney **–** Music *Stand Up and Cheer: The relationship between the MSU Bobcat Fight Song and social engagement at MSU*	pm	103
Schon Long: Music Mentor: Jason Bolte **–** Music *Time-Signatures in Electronic Dance Music*	pm	104
Andrew Calderhead: Liberal Studies Degree Mentor: Jennfier Woodcock-Medicine Horse **–** Native American Studies *Pacific Northwest Native American Salmon Fishing*	pm	107
Jamie Woolman, Summer Whillock: Psychology Mentor: Michelle Meade, Brandon Scott – Psychology *The Effects of Anxiety on Age Differences in Memory*	pm	108
Joe Poteat: Liberal Studies Degree Mentor: Jennifer Woodcock-Medicine Horse **–** Native American Studies *Native Americans of the Yellowstone region*	pm	109
Ashley Brown: Health & Human Development Mentor: James Becker – Health & Human Development *Biomechanical Differences Of The Standing Long Jump Performed With An Internal Vs. External Focus Of Attention: A Systematic Analysis*	pm	110
Dillon Sleichter: Business Mentor: Jennifer Woodcock-Medicine Horse **–** Native American Studies *Contemporary Art of The Pacific Northwest Native Nations*	pm	111

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Donata Bercier: Native American Studies Mentor: Jennifer Woodcock-Medicine Horse – Native American Studies *First Nation People of British Columbia/ Pacific Northwest Precontact*	pm	113
Austin Barnhardt: Health & Human Development Mentor: Colleen McMilin – Health & Human Development *Prevalence and Management of Childhood Food Allergy in Montana Schools: a Pilot Study*	pm	114
Kevin Goodan: Native American Studies Mentor: Jennifer Woodcock-Medicine Horse – Native American Studies *Indigenous Nations of Central American: Contemporary Art Movement*	pm	115
Cesar Cruz: Psychology Mentor: Neha John-Henderson – Psychology *Technology and Well-being in College Students*	pm	116
Elizabeth Hamilton: Native American Studies Mentor: Jennifer Woodcock-Medicine Horse – Native American Studies *Washoe Native American Survival Precontact*	pm	117
Emily Askey: Sociology and Anthropology Mentor: Mike Neeley – Sociology and Anthropology *Analysis of Chipped Stone at the Baxter Creek Site (24GA1551): A Multicomponent Hunter-Gatherer Site in Southwest Montana*	pm	118
Blackshear Bryan: Education Mentor: Jennifer Woodcock-Medicine Horse – Native American Studies *Pre-Contact and Contemporary Life of East Coast United States Native Americans and Canadian First Nations Peoples*	pm	119
Madeline Field: Political Science Mentor: Jennifer Woodcock-Medicine Horse – Native American Studies *Intersectionality between white and native cultures as seen through the game of Lacrosse*	pm	120
Vanessa Fahlgren: Education Mentor: Jennifer Woodcock-Medicine Horse – American Studies *The Indigenous People of Canada Before European Contact*	pm	121
Siebe Meindertsma: Psychology Mentor: Jennifer Woodcock-Medicine Horse – Native American Studies *Pre-Contact Arctic Architecture*	pm	122

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James Callahan: Earth Sciences Mentor: Jennifer Woodcock-Medicine Horse – Native American Studies *Contemporary Mexico: Religious Practices*	pm	123
Sarah Barr: Sociology and Anthropology Mentor: Jennifer Woodcock-Medicine Horse – Native American Studies *The Influence of the United States on Centeral American Indigenous Peoples*	pm	124
Jackson Nagy: Agricultural Economics & Economics Mentor: Jennifer Woodcock-Medicine Horse – Native American Studies *Issues in Contemporary Arctic Culture*	pm	125
Faith Beard: Sociology and Anthropology Mentor: Jennifer Woodcock-Medicine Horse – American Studies *A Comparison of Contemporary U.S. and Historic Mayan Forms of Body Modification*	pm	126
Emily Zirkle: Agricultural Economics & Economics Mentor: Jennifer Woodcock-Medicine Horse – Native American Studies *Changes in traditional food systems of post-contact indigenous North American Arctic peoples*	pm	127
Benjamin Hulme: Sociology and Anthropology Mentor: Jennifer Woodcock-Medicine Horse – Native American Studies *Causal Factors of Intimate Partner Violence of the Plains Indians*	pm	128
John Katzenberger: Economics Mentor: Jennifer Woodcock-Medicine Horse – Native American Studies *The Pre-Contact Lifestyles and Diets of Southwestern Indigenous Tribes*	pm	129
Elizabeth Pacella: Sociology and Anthropology Mentor: Jennifer Woodcock-Medicine Horse – Native American Studies *Language Revitalization Comparison Between Plains Tribes*	pm	130
Jacie Meldrum: Health & Human Development Mentor: Kalli Decker – Health & Human Development *Parents' Reports of Montana's Early Intervention Services: Alignment with Recommended Practices and Challenges Associated with a Large, Rural State*	pm	131
Cassie Merten: Health & Human Development Mentor: Mitch Vaterlaus, Dawn Tarabochia Katie DesLauriers-Heiser – Health & Human Development *Romantic Relationships and Romantic Experiences: Late Adolescent Perspective*	pm	132
Chloe Nease: Cell Biology & Neuroscience Mentor: Kalli Decker, Christine Lux – Health & Human Development *Mindfulness within Early Childhood Settings: The Creation of a Curriculum and Research Project Using Teacher Feedback*	pm	133

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Megan Strong: Health & Human Development Mentor: Jody Bartz – Health & Human Development *How Media Representation Influences Personal Perception of Disability*	pm	134
Makenzie Fry: Cell Biology & Neuroscience Mentor: Kalli Decker – Health & Human Development *Parents' and Therapists' Reports of Early Intervention: Comparing Ideal Services with Reality*	pm	135
Vanessa Tuffs: Health & Human Development Mentor: Jody Bartz – Health & Human Development *Children and Youth with Special Health Care Needs Program... What do our stakeholders have to say?*	pm	136
Hannah Vining: Health & Human Development Mentor: Colleen McMilin – Health & Human Development *Managing food allergy in Montana schools: findings from key informant interviews*	pm	137
Samantha Bessert: Health & Human Development Mentor: Colleen McMillin – Health & Human Development *Case Study: The effects of a hypo-caloric diet on gastroesophageal reflux disease*	pm	138
Morgan Craig, Jacey Anderson, Rachel Dunlap, Emma Folkerts, Elanor Nolan: History & Philosophy, Liberal Studies Degree, Interdisciplinary Studies, Modern Lanuages & Literatures Mentor: Molly Todd – History & Philosophy *Object Lessons: Making History at MSU*	pm	139
Mehmet Turker: Health & Human Development Mentor: Wan-Yuan Kuo, Mary Miles – Health & Human Development *Sensory and Structural Properties of Crackers Developed by Using Red Lentils (Lens esculenta) and Heat Treatment*	pm	140
Rachel Dunlap, Morgan Craig, Jacey Anderson, Emma Folkerts, Elanor Nolan: Liberal Studies Degree, History & Philosophy, Interdisciplinary Studies, Modern Language & Literatures Mentor: Molly Todd – History & Philosophy *Project Solidarity: Constructing Narratives from the Past to Inform the Future*	pm	141
Brenna Christopherson: American Studies Mentor: Jennifer Woodcock-Medicine Horse – Native American Studies *Central American Religion*	pm	142
Hunter Pauley, Ryan Davies: Health & Human Development Mentor: Colleen McMilin – Health & Human Development *A Low-Carbohydrate Approach to Hypertension and Type 2 Diabetes*	pm	143
Katherine Hernandez: History & Philosophy Mentor: Maggie Greene – History & Philosophy *The Imperialist Mindset: Race in British Victorian Fairy Tales*	pm	144

2019 STUDENT RESEARCH CELEBRATION

GRADUATE ABSTRACTS

Sorted by Student Major

COLLEGE OF AGRICULTURE

Gregory M. Chorak, Gillian Reynolds: Plant Sciences & Plant Pathology
Mentor: Ryan Thum, Jennifer Lachowiec – Plant Sciences & Plant Pathology
Identifying watermilfoil gene expression differences to improve adaptive management outcomes

Aquatic plant managers are increasingly concerned about herbicide tolerance and resistance. Identifying the genetic basis of herbicide tolerance is tricky because it could be due to genetic mutations that impact either the gene or genes in a functional process that the herbicide targets (target site), or genes that are not directly targeted by the herbicide (non-target genes; e.g. uptake, translocation, metabolism, detoxification). One promising approach when the basis of tolerance is unknown is RNA-Seq, which quantifies the levels of all genes actively being used by an organism in a set of conditions. This project focused specifically on Eurasian watermilfoil (Myriophyllum spicatum L.; including hybrids with northern watermilfoil, Myriophyllum sibiricum Komarov), one of the most highly managed invasive aquatic weeds in the Midwest and Great Lakes region. We aimed to identify gene expression differences between control and 500ppb 2,4-D treatment, between times after treatment, and between two clones varying in their apparent sensitivity to 2,4-D. This approach has potential to lead to genetic assays that predict herbicide control outcomes, allowing managers to adapt control tactics to specific populations.

Acknowledgements: The Midwest Aquatic Plant Management Society

Gillian Reynolds: Plant Sciences & Plant Pathology
Mentor: Jennifer Lachowiec, Jamie Sherman, Veronika Strnadova-Neeley – Plant Sciences & Plant Pathology, Computer Science
How Advances In Computer Science Are Aiding Global Efforts For Secure, Sustainable Crop Production

Since the development of the human genome project, computer scientists and biologists have forged fruitful collaborations that have furthered our understanding of and facilitated developments in a range of biological specialisms. Perhaps one of the most challenging of these is that of crop genomics. Many crops have very large and complex genomes, making the analysis of their genomic information challenging, time consuming and expensive. In addition untangling the complex nature of crop genotype-phenotype relationships has proved to be immensely challenging on many fronts. However, forecasted changes in regional and global climates in addition to changing demands for crop production have made it clear that progress must be made in the understanding of agronomically important traits to ensure a productive, secure and sustainable crop supply. Advances in computer sciences are aiding in this endeavor in a number of ways including the development of increasingly efficient algorithms that enable the quick and accurate analysis of large swaths of data, in addition to hardware developments that are enabling the development of high-throughput phenotyping methods. This study presents an overview of these exciting new developments and how they are being implemented to make progress towards sustainable and secure crop production.

Ramandeep Sandhi: Plant Sciences & Plant Pathology
Mentor: Gadi Reddy – Entomology/ Ecology, Plan Sciences & Plant Pathology
Exploring Entomopathogenic Nematdoes for Wireworm Management (COLEOPTERA: ELATERIDAE)

Wireworms, the larval stages of click beetles can cause serious damage to cereals, vegetables and other field crops by boring into stems, roots, and tubers. The increasing wireworm number and crop damage have become a major problem for growers in the Golden Triangle region of Montana because of their cryptic behavior in soil. This study was aimed to evaluate the efficacy of Entomopathogenic nematodes (EPN's) against wireworms. EPN's of the families Steinernematidae and Heterorhabditidae are lethal pathogens of insects. They are biocontrol agents with broad host range and are safer to humans and environment. This study involved laboratory and indoor experiments to evaluate 10 EPN strains against sugarbeet wireworm, *Limonius californicus* (Mannerheim) in spring wheat. In laboratory bioassay, EPN's with four concentrations were tested and time taken by these strains to cause wireworm larval mortality was observed. *Steinernema carpocapsae* (All and Cxrd) and *S. riobrave* (355 and 7-12) strains were found effective causing 40-50% and about 70% mortality after 3 weeks and 4 weeks, respectively in laboratory. The selected six effective EPN strains from laboratory bioassay were tested in a shade house experiment. Out of six tested strains, *S. carpocapsae* (A11) and *S. riobrave* (355) were found causing average 50% wireworm larval mortality after 4 weeks. The shade house experiment will be repeated again with more doses for the confirmation of results. The effective EPN strains found from these experiments will be evaluated against wireworms under field conditions. This will provide us in-depth knowledge about pathogenecity of EPN's against wireworms along with their behavior in soil.

Acknowledgements: Montana Wheat and Barley Committee and USDA NIFA

COLLEGE OF ARTS & ARCHITECTURE

Austin Anderson: Architecture
Mentor: Steven Juroszek, Jaya Mukhopadhyay – Architecture
Education and the Future

Education, in one form or another, has been a part of societies for thousands of years. The development of knowledge and the learning of skills has been a means for continuity between generations. It has provided societies with the opportunity for continued advancements in all areas of life-economic, cultural, political, spiritual, and technology. Education is typically seen as essential to the well-being and growth of most societies. The changing climate of our public education system has called for the reintroduction of collective explorations of what being human means to the individual. At the elementary educational level the design of the school should aim to introduce levels of experience through the introduction of a variety of scales of collaborative learning. The organization of malleable modules around a set of key traditionally collaborative spaces will extrude such experiences through each module and into the classroom. This approach to the Woodland Park Elementary School design was centered around the ten AIA COTE sustainability measures along with ensuring that the building operates as net-zero for energy and water consumption. The school's site is located in a developing region of Bozeman, MT while serving about 500 children from kindergarten to the fifth grade.

Jakub Galczynski: Architecture
Mentor: Steven Juroszek, Jaya Mukhopadhyay – Architecture
Convergent Future for School, Ecology, and Architecture.

Woodland Elementary is a conceptual design project that explore the convergent future for school, ecology, and architecture. A space for youth to explore their humanness and individual reference to the natural world. The objective is to foster a new generation of community members, by providing a deeply rooted foundation for environmental consciousness, at an early age. Woodland Elementary, a 100,000 sqft school would be located in rural Bozeman, Montana. The project focuses on a local issue of displaced habitat diversity presented by new neighborhood development. The school will support new wildlife habitat and integrate nature observation into the curriculum, by means of Discovery Spots. These spaces are an extension of the classrooms and teach lessons pertaining to sustainable strategies. Design plays a significant role in framing ways that community can enjoy and learn from nature. Designated areas at Woodland Elementary celebrate the Ten Sustainability Measures by providing public access to passive systems and their collected data. The experience of the building seeks to influence gradual cultural effect.

Dylan Kish: Architecture
Mentor: Steven Juroszek, Jaya Mukhopadhyay – Architecture
The Story of Third Nature: Participatory Learning Through a Series of Cultivated Ecologies.

This design project for an elementary school stands as the culmination of research into the future of primary educational practice and net zero energy building design. The work studies new theories in education with emphasis on Social Emotional Learning. Research into net zero energy design was done in concert with the AIA Committee on the Environment's ten measures for sustainability. Design decisions integrated energy modelling software, precedent and pedagogy research, and the design iteration process. Aspirations of strong community connectivity and an intrinsic relationship to the land that we occupy help to guide these decisions.
The relationship a building forms with its' place, the landscape, and social context led to an organization around the social and natural ecologies derived from the surrounding Montana Landscape. The nature of education is changing from the recitation of facts to active and interactive hands on learning. The formative school years have a profound impact on how we view the world. By embracing and supporting future pedagogy through thoughtful building design, we can foster the next generation of environmental stewards. The presentation boards also seek

to embrace new ways of teaching by acting as an educational tool for any age through the form of illustrated storytelling.

Rebecca Wolfe: Architecture
Mentor: Ralph Johnson, Jaya Mukhopadhyay – Architecture
Accessory Dwelling Units and Urban Sociology

This project explores the intersection of urban sociology and accessory dwelling unit (ADU) policy, "ADU" meaning a secondary housing unit on a traditionally single-family lot. My primary interest is in how city ADU policies instigate changes in the urban fabric with regards to density and character of the built environment, as well as how they commingle urban inhabitants with differences of income, race, age, and household size. I investigate the common portrait of ADU policy as an affordable housing strategy and consider how this might be affected by the various uses of ADUs: housing for elderly relatives or aging in-place, affordable living for students, short-term vacation rentals, and more. This investigation tracks ADU policy over time, beginning with historical precedents of ADUs as housing for the working-class members of urban society. The study moves on to the current state of ADU policy, supplementing existing research with my own survey of planners in the 70 fastest-growing cities in the American West, including recent policy changes, common community concerns, and the primary barriers to ADU development. Lastly, I explore the future of ADUs, identifying costs of permitting and construction as a major barriers and addressing these with current promising case studies and the potential benefits of ADU prefabrication. I argue that the addition of ADU homes and their inhabitants to single-family neighborhoods is an equity-minded, minimally-disruptive, and unconventionally market-driven way to address affordable housing shortages in cities nationwide, particularly when prefabrication techniques are employed to maximize the constructability of projects with tight lots and limited construction budgets.

COLLEGE OF EDUCATION, HEALTH & HUMAN DEVELOPMENT

Heide Arneson: Education
Mentor: Bryce Hughes, Carrie Myers, Sarah Maki – Education, Other
Manual Reading: Questions are the Key

Gallatin College workforce development courses have been teaching alternate ways to learn complex information, including the use of websites and videos, but that doesn't match the workplace requirements. Students require the ability to read long, complex technical texts, also known as manuals. The purpose of my research is to identify strategies to help students read and understand the information in manuals in a short time frame, as they must in their future careers. The research will highlight a potential strategies that are used and effective by both current and former students. The presentation would include the results and the strategies that were effective in improving the ability to comprehend manuals in a short time frame, such as that used in workforce occupations, including aviation.

Samantha Bessert, Morgan Chamberlin: Health & Human Development
Mentor: Colleen McMillin – Health & Human Development
Case Study: The effects of a hypo-caloric diet on gastroesophageal reflux disease

Gastroesophageal reflux disease (GERD) is a common disorder affecting approximately 20% of the United States population. In conjunction with increasing obesity trends, GERD diagnosis has increased six-fold since 1975. Symptoms of GERD include a feeling of acid in the throat or mouth and regurgitation. Long-term complications include erosive esophagitis, Barrett's esophagus, and esophageal adenocarcinoma. Although GERD is frequently diagnosed, treatment methods are highly variable and include a wide range of nutritional and surgical interventions. In order to better understand current nutritional guidelines and their effectiveness in the treatment of GERD, my team developed a nutrition care plan based on the following case study. Mateo is a 25-year old male who has been experiencing increased indigestion over the last year. He has been taking tums several times daily as well as the herbs fenugreek and turmeric for the relief of symptoms. He has gained approximately 30 pounds since he had knee surgery three years ago. Mateo states he has probably been eating and drinking more over the last year which he attributes to stress and starting a new job. After reviewing the literature, my team established that weight loss via a hypocaloric diet would be the most effective nutrition intervention for this patient. Over the course of five days, we followed the prescribed diet in order to better understand the dietary changes that could be made to meet the requirements of our treatment plan. This project provided us the opportunity to improve our understanding of this disease and potential nutrition treatments that may be effective in future dietetic practice.

Hunter Pauley, Ryan Davies: Health & Human Development
Mentor: Colleen McMilin – Health & Human Development
A Low-Carbohydrate Approach to Hypertension and Type 2 Diabetes

Hypertension (HT) and type 2 diabetes (T2D) are growing health problems in the US affecting approximately 75 million and 30 million people respectively. Both diseases are costly and increase the risk of developing other health complications such as stroke and heart disease. Given the continuing rise in incidences of these conditions, a review of literature on the current nutritional interventions, specifically for HT with T2D, was conducted. The literature review, while not comprehensive, included original research, meta-analyses, and other literature reviews. After reviewing the recent literature on nutritional strategies for managing HT with T2D, our team created a nutritional meal plan to follow for three days based on the following case. John is a 56 year old male with T2D who has recently been diagnosed with HT. Although John has lost 10kg since his T2D Dx five years ago, his diet still includes regular consumptions of high carbohydrate foods and alcohol. Our team developed a nutrition care plan based on a low-carbohydrate diet, which has been shown to improve both T2D and HT, which focused on nutritional education. The nutritional education was focused on alcohol and carbohydrate consumption, their role in the development of T2D, HT and how a low-carbohydrate diet can be used to manage these conditions. We

chose not to focus on the traditional low sodium (Na+) diet after conducting the literature review due to low Na+ diets causing worse outcomes for some individuals with T2D.

Cierra Tredway: Health & Human Development
Mentor: Vanessa Simonds – Health & Human Development
Engaging Apsáalooke youth as active co-researchers evaluating water quality

Introduction: Children acting as co-researchers has begun to generate valuable knowledge about children's lived experiences. Adults guide children in designing and conducting their own research projects where the child serves as the primary investigator through the entire research process, from identifying a research topic to the dissemination of the results. The Guardians of the Living Water (GLW) program, a community-based participatory research project established in 2014, aims to increase environmental health literacy skills necessary to understand and protect water-related resources on the Apsáalooke reservation. The purpose of the 2017-18 GLW afterschool program was to use a co-researcher model to promote ownership of water-related research projects. This presentation describes the formative evaluation of the 2017- 18 GLW afterschool program. Methods: We recruited participants from previous GLW programs. There were 12 participants enrolled in the program. The program consisted of 7 afterschool (1-1.5 hr) sessions. The evaluation used included surveys from participants and written reflections from facilitators for each session. Students completed a five-question, four-star rating measuring self-assessed enjoyment, interest, comprehension, attentiveness, and work quality. Project staff also discussed project implementation with a community advisory board each month to make additional improvements to the program. Results: Overall, students rated each session as being very or mostly enjoyable, mostly or very interesting, mostly and very easy to understand. They rated themselves as mostly paying attention and working very hard. Our greatest challenge was keeping students fully engaged throughout the sessions and having sufficient time to cover planned activities.

Acknowledgements: Christine Martin (Non-MSU/Other), Marilla Harris-Vincent (MSU Graduate Student) – Health & Human Development, Debbie Laveaux (MSU Graduate Student) – Health & Human Development, CAIRHE

Mehmet Turker: Health & Human Development
Mentor: Wan-Yuan Kuo, Mary Miles – Health & Human Development
Sensory and Structural Properties of Crackers Developed by Using Red Lentils (Lens esculenta) and Heat Treatment

Introduction This study aims to develop lentil-enriched crackers as healthier alternatives to high-glycemic wheat crackers using roasted lentil flours and to evaluate the sensory and structural properties of the developed crackers. Methods Red lentil flour was roasted at 350F for 5 or 10 minutes and then incorporated into a cracker recipe to replace 0%, 50%, and 100% (w/w) of regular wheat flour. A nine-point hedonic scale was used to assess the consumer acceptance of the prepared crackers by 120 adults. The cracker made of 50%, 5-minute-roasted lentil flour was repeated in the sensory test with an additional label of "Organic" to test organic labeling effect. ANOVA with Fisher's least significant difference analysis (alpha = 0.05) was used to analyze the sensory results. The crystalline structure of the starch within the crackers was observed using powder X-Ray diffraction (XRD). The surface and cross-sectional morphology of the cracker samples were examined using field-emission scanning electron microscopy (FESEM). Results Compared to the 100% wheat cracker (average acceptance score of 6.0), enriched with 50% and 100% native lentil flour led to non-significant and significant decrease in the acceptance scores. Roasting the lentil flour for ten minutes, however, significantly increased the acceptance score of the 100% lentil crackers from 3.9 to 5.3(P-value =0.00014). Organic labeling received significantly higher acceptance score for the cracker with 50%, 5-minute-roasted lentil flour (P value = 3.81x10-8). While the wheat cracker had A-type diffraction pattern, lentil-wheat blend crackers had a mix of A-Type and B-Type diffraction patterns. The FESEM characterization revealed spherical and elliptical lentil starches, approximately 30 μm in size, in irregular formation in the lentil cracker matrix, and a bimodal particle size around 10 μm or 30 μm of the wheat starch in the wheat cracker. Significance Lentil-enriched snacks are within one of the fastest growing food product trends. To the best of our understanding, no literature is available concerning the effect of lentil flour roasting on the sensory and

structural properties of lentil crackers. The roasting effect revealed in this study can provide foundational knowledge for improving the sensory qualities and engineering the structure-functionality of novelty crackers.

Acknowledgements: Undergraduate Scholars Program (USP)

COLLEGE OF ENGINEERING

Canberk Kayalar, Matthew Magoon: Chemical & Biological Engineering, Chemistry & Biochemistry
Mentor: Stephanie McCalla – Chemical & Biological Engineering
Transduction of Antigens into Amplifiable DNA Signals Using Structure Switching Aptamers

Treatment of infectious diseases and cancer has one vital step in common, detection of biomarkers. Point-of-care diagnostic testing that is rapid and reliable is unavailable in limited resource and rural settings. Lack of proper refrigeration and shipping renders clinical samples useless and adds additional complexity to the problem of accessible healthcare. For example, an on-site diagnostic test for malaria would potentially help to save ~ 2.2 million lives and prevent ~ 447 million unnecessary treatments. It is evident that there is a large gap between clinical needs and current technology. The solution to this need must be simple, inexpensive, robust, rapid and not require highly trained personnel to operate. The goal of the proposed work is to develop a robust and rapid method that minimizes false positives while detecting various target biomarkers. Various proteins and antigens are types of biomarker molecules that the proposed method aims to detect. Being able to detect a wide variety of biomarkers benefits early diagnosis of diseases and being able to accurately diagnose diseases with similar symptoms is an important tool for clinicians. This project will combine some of the proven applications of aptamers together and to create an inexpensive detection method that is capable of being utilized in limited resource settings. In addition to specifically detecting antigens, the proposed assay's modular nature allows it to be utilized under different environments. Conformational change that aptamers will undergo, after binding their target, will be utilized as a primer for a novel isothermal amplification reaction to generate a signal.

Jiahui Ma: Mechanical & Industrial Engineering
Mentor: Bernadette McCrory – Mechanical & Industrial Engineering
Predicting Surgeon Workload Using the NASA- and SURG-TLX Instruments

Surgeons are under increasing demand for productivity and efficiency while maintaining high quality of care. The Surgery Task Load Index (SURG-TLX) and the National Aeronautics and Space Administration Task Load Index (NASA -TLX) are both subjective and validated workload assessment instruments. Both the SURG-TLX and NASA-TLX have six subscales, which are evaluated on a 100-point range with 5-point increments and two verbal anchors at the range minimum and maximum. Since the SURG-TLX was developed from the NASA-TLX there are three subscales from the NASA-TLX (Mental Demand, Physical Demand and Temporal Demand) that are closely mimicked in the SURG-TLX (Mental Demands, Physical Demands and Temporal Demands). The final three subscales differ between the SURG-TLX (Task Complexity, Situational Stress and Distractions) and the NASA-TLX (Performance, Effort and Frustration). The objective of this study was to compare and assess the differences between the NASA-TLX and SURG-TLX for surgical workload under different simulated conditions and tasks. Both TLX instruments were provided to 25 surgeons, who completed two simulated laparoscopic surgery tasks. Descriptive and inferential statistical analysis were completed using Minitab and SAS. The NASA-TLX scales and overall workload were rated higher (generally greater workload) compared to all SURG-TLX scales and overall workload. On average, SURG-TLX scales were reduced 15-20 points. The SURG-TLX subscale Distractions assessed workload differently and not clustered with any other subscales. Major groupings were observed that included 1) Stress and Temporal Demand; 2) Physical Demand, Mental Demand, Frustration and Task Complexity; and, 4) Effort and Performance.

Dean Ricker: Chemical & Biological Engineering
Mentor: Christa Merzdorf – Cell Biology & Neuroscience
Does aquaporin 3b affect the number and characteristics of calcium waves in the neural plate of Xenopus laevis embryos?

Early in the development of the nervous system, vertebrate embryos undergo neural tube closure. During this process, the cells in the dorsal part of an embryo, the neural plate, constrict on their outward facing side (apical

constriction) to form a tube. The Merzdorf lab has found that expression of the Aquaporin 3b (Aqp3b) protein in Xenopus laevis (African clawed frog) embryos is critical for neural tube closure, specifically for apical constriction of the cells of the neural plate. While aqp3b is only expressed in a well-defined line along the outer edge of each side of the neural plate, it affects a pan-neural plate process. Thus, the question my study attempts to answer is how Aqp3b signals to the rest of the neural plate. A likely candidate for the signal is calcium, a common intercellular and cellular signal. I hypothesize that the neural plate in embryos with inhibited Aqp3b expression will have fewer calcium waves and/or calcium waves with different characteristics. To test this hypothesis, the number and characteristics of calcium activity will be compared between control embryos and embryos that have been inhibited from expressing Aqp3b. This is accomplished by injecting a morpholino oligonucleotide, which inhibits Aqp3b expression, and GCaMP6, which is fluorescent in the presence of calcium, into frog embryos at the four-cell stage. I then collect time lapses of calcium activity that occurs during neural tube closure and analyze them for differences in the length, period, intensity, etc. of calcium signaling events using a variety of software.

Acknowledgements: Montana Academy of Sciences

Timothy Wells, Cesar Cruz: Computer Science
Mentor: Clemente Izurieta – Computer Science
Cluest: An interactive GPS-driven game

Mobile games have long since been a dominating force in mobile applications. In total, around 190 billion applications have been downloaded on personal devices and this number is only expected to go up. Thus, creating mobile games that are engaging is a difficult feat. Cluest aims at combining and connecting both the physical and the virtual world. Cluest is a treasure hunt game in which users plant virtual treasures in the real world and have their friends use GPS to locate the treasures. This allows users to create their own games while using their surroundings as part of the game. Users have the chance to leave a trail of notes and hints so that their friends can have fun by going around town to complete treasure hunts. Future add-ons can include Augmented Reality to create a deeper immersive experience.

COLLEGE OF LETTERS & SCIENCE

Mercy Amankwah: Mathematical Sciences
Mentor: Jing Qin, Lisa Davis – Mathematical Sciences
Modeling and Simulation of In-crib drying of Ear Maize: A Case Study in the Sunyani-West District

This study was aimed at improving the store-drying of maize in cribs, specifically in the Sunyani-West district in the Brong Ahafo Region of Ghana. A model containing three differential equations developed from the drying rate equation, the mass balance equation and the energy balance equation was used to explain the drying process. These equations were solved numerically and simulated with data from the Sunyani-West district. The algorithm used was written in Python 2.7. The study provided information on the appropriate time for drying and duration for the drying periods. The work specified that maize harvested in the minor and major harvest season takes 2-3 months and 5 months to dry respectively. It also investigated the range of the drying rate constant for the Sunyani-West district as 0.0004-0.0008. This was achieved using the relative humidity data from the area of study.
Keywords: In-crib drying, mass balance, energy balance

Acknowledgements: Emmanuel Appiah-Kubi (Non-MSU/Other) – Mathematical Sciences

Emmanuel Barton Odro: Mathematical Sciences
Mentor: Derek Andrew Williams – Mathematical Sciences
Student Engagement while Establishing Classroom Mathematical Practices

There is a significant connection between student engagement and performance achievement. Klem and Connell write, "student engagement has been found to be one of the most robust predictors of student achievement and behavior in school, a conclusion which holds regardless of whether students come from families that are relatively advantaged or disadvantaged economically or socially" (2004, p. 5). However, student engagement is complex, and currently relationships to outcomes such as mathematical understanding and learning are elusive (Fredricks, Blumenfeld, & Paris, 2004; Middleton, Jansen, & Goldin, 2017). This study investigates student engagement while learning through use of an app that collected student engagement reported by participants during a classroom teaching experiment. This paper discusses preliminary results on students' engagement in the process of learning. Though not anticipated, we observed differences between male and female students' engagement while working in mixed-pairs worthy of investigation. In particular, we observed differences between male and female students' engagement while working in mixed-pairs surrounding important mathematical contributions from female partners. Female students described situations in which they perceived of male partners overlooking valuable contributions towards completing tasks, resulting in dips in engagement. With regards to data collection, the app and survey effectively gathered information on student engagement, which was triangulated by students' descriptions in recall interviews.
Keywords: Student engagement, Classroom mathematical practices, Preservice teachers

Acknowledgements: Jonathan Lopez (Non-MSU/Other) – Mathematical Sciences

Dana Kramer: Chemistry & Biochemistry
Mentor: Kristin Juliar, Amy Royer – Montana Office of Rural health and Area Health Education Center
A Comprehensive Assessment of Needs in Rural and Underserved Communities for Behavioral Health Workforce Development

The Montana Area Health Education Center (AHEC) developed the Montana Behavioral Health Workforce Network (MBHWN) project to address the critical shortage of healthcare workforce to provide mental health, substance abuse, and behavioral health services in rural and underserved areas of Montana. This project completed the first comprehensive needs assessment of the behavioral health needs of rural and underserved communities in Montana. In the assessment, community health needs assessments (CHNAs) and implementation plans (IPs) from critical access hospitals (CAHs), public health departments, community health centers, and tribal communities

were analyzed to identify top health issues related to behavioral health. The resulting environmental scan of behavioral health needs in Montana communities will drive MBHWN strategic planning for future workforce development.

Acknowledgements: IDeA Network of Biomedical Research Excellence (INBRE)

Robert Nerem, Peter Crawford-Kahrl: Mathematical Sciences
Mentor: Breschine Cummins, Tomas Gedeon – Mathematical Sciences
Theoretical and Numerical Investigation of Regulatory Network Evolution

Regulatory networks, which describe interactions between genes, proteins, and other biological systems, possess many statistically significant characteristics not found in randomly generated networks. We investigate which of these characteristics are products of the process through which regulatory networks evolve. In particular, we show which quantities are conserved under evolution and we observe characteristics of networks which underwent numerically simulated evolution. Regulatory networks evolve via two primary processes: either an edge in the network is deleted, or a node is doubled creating a copy of a previously existing node. We show that in undirected networks the size of the largest fully connected subgraph or clique is conserved, whereas in directed graphs, the size of the largest clique whose adjacency matrix has non-zero determinate is conserved. The value of these conserved quantities is calculated for E. coli and yeast regulatory networks. In addition, we present several additional conserved quantities. Using these results, we suggest connections between regulatory networks of current organisms and those of their evolutionary ancestors. It has been previously observed that bi-fan and feed-forward loop subgraphs occur far more frequently in real regulatory networks than in randomly generated networks. We show, in part through numerical simulation, that the edge deletion and node doubling model of evolution is not enough to account for these concentrations. This implies higher order processes, such as those occurring from natural selection, are needed to create the skewed subgraph concentrations.

Moses Obiri: Mathematical Sciences
Mentor: John Borkowski – Mathematical Sciences
Space-filling designs for mixture experiments

A space-filling design is an experimental design for which the experimental runs are uniformly scattered in the appropriate experimental design region which permits the fitting of many potential models and exploring the region for optimal design factor combinations.
Experiment with mixtures often appear in product formulation and process engineering. Optimal computer-generated designs, the simplex lattice designs introduced by Scheffe (1958) and the simplex centroid, and axial designs have been used for mixture experiments. The experimental points from these designs are, however, not uniformly scattered on experimental regions and most design points are placed on the boundary of experimental regions. Therefore, these designs provide little to no information for mixtures in the interior of the mixture design space. Space-filling designs adapted from methods proposed in Borkowski and Piepel (2009) are presented for mixture experiments in the full simplex and subspaces of the simplex mixture design regions. Distance-based criteria taken from Borkowski and Piepel (2009) are used to evaluate the uniform scatter of the mixture design points.

Acknowledgements: MTPEAKS program

Lucca Reiter, Summer Whillock: Psychology
Mentor: Ian Handley – Psychology
Explaining Gender-Biased Reactions to Findings of Gender Bias in STEM

Mounting evidence reveals a gender bias in STEM fields that disfavors women. Further, men tend to evaluate research showing a gender bias in STEM less favorably than women. Two possible explanations for this discrepancy in evaluations were explored. First, according to social identity theory, people are motivated to see their in-group favorably, and defend it against threat. If true, then mitigating threat should decrease gender differences in

evaluation. Alternatively, it could be that people view belief-consistent information more favorably, a phenomena known as confirmation bias. If true, then instilling a belief in gender bias should decrease gender differences in evaluations. These competing explanations were tested in two experiments. In the first experiment, participants either had their sense of self affirmed (i.e., reducing threat), or did not, prior to reading an abstract purporting to show a bias against women in STEM, and evaluated the research. The second experiment was identical to the first, except that the self-affirmation manipulation was replaced with a procedure to increase participants' belief in a gender bias in STEM. Contrary to social identity theory, reducing threat in men did not bring their evaluations in line with women. However, changing participant's initial beliefs in gender bias in STEM did remove the gender difference in evaluations. Future directions and potential implications are discussed.

Acknowledgements: Ashley Kerkaert (Non-MSU/Other) – Psychology, Jessi Smith (Non-MSU/Other), Undergraduate Scholars Program (USP)

Rachel Ulrich: Mathematical Sciences
Mentor: Scott Powell – Land Resources & Environmental Sciences
A Bayesian modeling approach for improved land use classification

Low-density land use is a threat to ecological connectivity and farmland security in the mountain West. This type of land use has shown explosive growth in the last several decades but has proven difficult to map as it lacks a physically based definition and is unsuitable for classification at the pixel level. To improve understanding and quantification of low-density land use, we propose two regionally specific typologies, and an object-oriented, remote sensing approach to classification. Implementing a two-part methodology, we intend to 1) better explain the drivers and account for spatial variation in low-density subclasses using a spatial generalized linear model, and 2) within a Bayesian framework, assess the predictive ability of remotely sensed data in differentiating between subclasses. This proposal draws upon expert knowledge of the subject matter and region, a novel application of an object-oriented classification approach, and the use of a Bayesian classifier in conditions well-suited to enhance accuracy. While results are generalizable to a larger region, this modeling approach represents a potential framework for all types of land use classification, is a solid foundation for land use change detection, and is the next step in harnessing satellite-based information to create continuously updated land use maps.

Acknowledgements: Andrew Hansen (MSU Faculty Member) – Ecology, David Theobald (Non-MSU/Other) – Other, MT Space Grant Consortium (MSGC)

Summer Whillock, Amber Lucas: Psychology
Mentor: Michelle Meade – Psychology
The Influence of Collaboration and Repeated Testing on a Memory Task

In the present experiment, we examined how collaboration and repeated testing influence performance on a memory test. We tested for collaborative inhibition, which is the idea that nominal groups (the non-redundant pooled recall of individuals recalling individually) recall significantly more information than collaborative groups (the recall of two individuals working together), by randomly assigning participants to either collaborate with a partner or not. Additionally, participants were randomly assigned to either take an individual recall test prior to collaboration or to complete a filler task instead of taking the initial test. The filler task was meant to equate the amount of time that passed between study and collaboration for both groups. We predict that collaborative inhibition will be present in both the initial testing and no testing groups. Further, the magnitude of the collaborative inhibition effect will be reduced in the initial testing condition because recalling first individually may more strongly solidify an individual's recall strategy such that they are less disrupted during collaboration. Finally, the reduced collaborative inhibition in the initial testing condition will have carryover effects resulting in higher levels of recall on subsequent individual recall tests.

2019 STUDENT RESEARCH CELEBRATION

UNDERGRADUATE ABSTRACTS

Sorted by Student Major

COLLEGE OF AGRICULTURE

Angela Bear Claw: Plant Sciences & Plant Pathology
Mentor: Tracy Dougher, KayAnn Miller Julian Collins – Agricultural Education, Other
TRIO: Propagation of Wild Prairie Turnip Pediomelum Esculentum

My objective for this project is to grow Wild turnip *Pediomelum esculentum* domestically, and to develop a viable procedure for anyone wanting to grow Wild turnip. Wild turnip is an indigenous food, that is still being used by the Crow today, and was important in the survival of many plains Indian tribes of the past. In this study, the question being addressed is: Can Prairie turnip be a viable crop for food production, and can the seeds be grown domestically to meet a possible demand in the future? Methods such as vernalization and scarification were used to determine which would be better suited to break dormancy. During the study it was observed that vernalization wasn't a factor for breaking dormancy as both vernalized and non-vernalized seeds did germinate. The only treatment that effected germination was mechanically scarifying seeds, specifically duration of time. Scarifying seeds over 5 seconds did not survive. Various soil medias were used to determine which if any, would support Wild turnip seeds. It was observed that all soil media supported the seeds from both treatment groups. The study found that Wild turnips can be grown domestically in a greenhouse setting and if mechanical scarification is used to break dormancy it should not exceed more than 5 seconds. Further research can determine if other scarification methods can increase plant productivity without increasing processing time.

Acknowledgements: Undergraduate Scholars Program (USP)

Lilianna Bento: Plant Sciences & Plant Pathology
Mentor: William Dyer, Barbara Keith – Plant Sciences & Plant Pathology, Land Resources & Environmental Sciences
The Effect of Plant Volatiles on Herbicide Efficacy and Resistance

Volatiles are a vital part of the plant stress response, and are known to activate signaling pathways that allow plants to communicate with each other. More specifically, monoterpene volatiles are implicated in plant innate immune signaling (Dong et. al, 2016) and are released in response to abiotic and biotic stresses. Sublethal herbicide injury is perceived by plants much the same as other abiotic stresses, and so collaborative work between the Dyer and Weaver laboratories used GC/MS to detect over 75 volatiles emitted from Avena fatua (wild oat) plants, of which several monoterpene alcohols (including linalool and limonene) were released at significantly higher levels in untreated multiple herbicide resistant (MHR) compared to herbicide sensitive (HS) lines. For my experiments, MHR and HS Avena fatua were grown to the 3-leaf stage and exposed to low doses of linalool, limonene, or pinene for 24 hours in plastic enclosures, then sprayed with either an ACCase-inhibiting (pinoxaden) or an ALS-inhibiting (flucarbazone) herbicide at 0.75x or 1x field rates (HS) or 2x or 3x field rates (MHR). Volatile pre-exposure did not change herbicide efficacy on either plant line. I also used qPCR analysis to determine the effects of low volatile exposure on glutathione S-transferase phi and ATP-binding cassette transporter gene expression in MHR and HS plants. There were no significant differences between expression levels of either gene in either plant line after volatile treatment. These experiments are currently being repeated using higher volatile doses.

Acknowledgements: Undergraduate Scholars Program (USP)

Katelin Hancock: Microbiology & Immunology
Mentor: Lauren Kerzicnik – Plant Sciences & Plant Pathology
Exclusion of ants as a biological control for aphids in western Montana apple orchards

Aphids and ants have been observed to have intricate mutualistic relationships. Aphids are the most significant honeydew producers in temperate climates and benefit the ants by excretions of sugar-packed honeydew. In the presence of ants, aphids will receive protection from their natural enemies. Natural enemies that commonly feed on apple aphids include syrphids, lady beetles, earwigs, lacewings, parasitoid wasps, and spiders. Ants can physically remove syrphid and lacewing larvae from aphids. Exclusion of ants can reduce mutualistic interactions, reducing aphid populations and damage to apple trees. Damage from the rosy apple aphid, *Dysaphis plantaginea*, a common apple aphid pest, can include leaf rolling and undeveloped or deformed apples. Exclusion of ants from aphid colonies on apple trees can increase natural enemy densities, ultimately decreasing damage from large aphid populations. The purpose of this study was to determine whether excluding ants decreases aphid populations due to an increase in the number of natural enemies. Twelve trees, six ant-excluded and six control, were sampled weekly for aphids and bi-weekly for natural enemies by beat sheet, pitfall, and sweep net sampling. Natural enemy density and diversity were low for all sampling methods. Excluding ants from trees resulted in lower aphid densities and ants were successfully excluded with sticky traps

Acknowledgements: McNair Scholars Program

Amanda Leckband: Animal & Range Sciences
Mentor: David Sands, Ed Dratz – Plant Sciences & Plant Pathology, Chemistry & Biochemistry
Plasmid Curing by an Ethiopian Barley: A Natural Feed/Food Approach to Reduce Plasmid Mediated Antibiotic Resistance

Bacterial plasmids are the messengers that carry genes for antibiotic resistance from one bacterium to another and it is this plasmid transfer that results in so many cases of antibiotic therapy failure. We propose a "kill the messenger, not the bacterium" approach to tackle the problem of increasing antibiotic resistance. An emphasis in health research is to find new antibiotics, as the current arsenal against bacteria is depleted. Our hypothesis is that a cultivar of Ethiopian barley has plasmid curing activities that can be used to mitigate plasmid mediated antibiotic resistance. Notably, we have several sets of experimental trials on animals suggesting that this approach is effective. We target the removal of the plasmids in the bacteria that carry the genes for bacterial antibiotic resistance, using a powerful activity carried in an heirloom Ethiopian cultivar of barley. When leaf extracts of this cultivar are assayed for plasmid curing properties, using a green fluorescent protein (GFP) carrying plasmid in E. coli, we demonstrated that extracts from this specific barley cultivar successfully resulted in the loss of the GFP plasmid, yet the bacteria remained viable. Plasmid mediated multivalent antimicrobial-resistance is a very large problem in livestock industries, where preventative care is far preferable to the existing system of treating symptoms.

Acknowledgements: Bill and Melinda Gates Foundation Grant

Jared Lile: Plant Sciences & Plant Pathology
Mentor: Jennifer Lachowiec – Plant Sciences & Plant Pathology
Genetic Interactions Underlying Variation in Hsp90 Function

Hsp90 is a chaperone protein, functioning to correctly fold other proteins, especially under environmental stress. Hsp90 interacts with specific proteins; however, very few genes that encode these interacting proteins are known in plants. Our goal was to identify the genes that encode proteins interacting with Hsp90 in the model plant *Arabidopsis thaliana*. Previous quantitative genetics studies observed that when Hsp90 was inhibited, different genotype-specific responses occurred, but these responses have not been mapped to the resolution of genes. With improved quantitative genetics tools in *A. thaliana*, we can now utilize worldwide genome-sequenced A. thaliana

ecotypes to identify genes with putative Hsp90 interaction with higher resolution. In the experiment, 78 ecotypes of A. thaliana were grown under controlled conditions and in the presence of geldanamycin, a specific and potent Hsp90 inhibitor. As each plant of an ecotype was genetically identical and grown under the same environmental conditions, responses could be traced to the loss of Hsp90 function. Dark-grown root and hypocotyls demonstrated the expected outcome of differential responses across ecotypes to Hsp90 inhibition. With these data, a genome-wide association study demonstrated statistically probable genes of interest. A total of seven genes of interest have been identified; four of which were on chromosome three, and the other three on chromosomes one, two, and five respectively. Further work in this study is to examine the relationship between the genes of interest and Hsp90 through using mutant lines and gene editing.

Acknowledgements: Undergraduate Scholars Program (USP)

Jackson Nagy: Agricultural Economics & Economics
Mentor: Jennifer Woodcock-Medicine Horse – Native American Studies
Issues in Contemporary Arctic Culture

I am going to portray important issues taking place in the contemporary cultures of the Arctic and Canada. My goal is to bring light to the situation's Native American's are still forced to deal with. These issues range from a variety of things that put pressure on cultural preservation. One of my focal points will be oil pipeline construction causing destruction to the land, as well as the possible outcomes that could occur if things went wrong. I am going to do so by portraying images in a display case inside Wilson Hall at MSU. This display case is donated to the Native American studies department at MSU, allowing students to display artwork or writings to promote the department here at Montana State.

Vanessa Orcutt: Land Resources & Environmental Sciences
Mentor: Michelle Flenniken – Plant Sciences & Plant Pathology
Investigating the efficacy of putative antiviral treatments in honey bees

Honey bees (Apis mellifera) are pollinators of agriculturally essential crops and important producers of honey. Since 2006, US honey bee colony losses have averaged 33% annually. There are numerous elements that contribute to colony deaths, including agrochemical exposure and pathogenic infections. One common honey bee pathogen is deformed wing virus (DWV), which is in the Iflaviridae family. Recent studies indicate honey bees (naturally infected with viruses in the field setting) had reduced viral abundance after feeding on sugar syrup containing fungal extracts (i.e., Fomes fomentarius (Amadou), Ganoderma lucidum (Reishi), and Laricifomes officionalis (Agarikon)). To further investigate the role of putative antiviral treatments on viral abundance, we performed controlled laboratory-based experiments in which honey bees (n=12 per treatment) were inoculated with 3.5x10^8 Genomic Equivalents of DWV for half of the 6 treatments: DWV alone, DWV + 1% v/v Amadou, DWV + 16 ppm thyme oil, which were then compared to mock-infected (i.e., buffer-injected) control treatments, buffer + 1% v/v Amadou, or buffer + 16 ppm thyme oil; each treatment was performed in triplicate. Honey bee mortality was monitored at 24, 48, and 72 hours post-infection, viral prevalence was determined by PCR, and virus abundance was quantified using qPCR. The differences in virus abundance in bees that consumed putative antiviral extracts were not statistically significant from those that were only fed sugar syrup. Overall this series of experiments suggests that these putative antiviral treatments are not effective at reducing DWV viral abundance.

Acknowledgements: Jenna Severson (MSU Undergraduate Student) – Plant Sciences & Plant Pathology, Fenali Parekh (MSU Graduate Student) – Plant Sciences & Plant Pathology, Cayley Faurot-Daniels (Non-MSU/Other) – Plant Sciences & Plant Pathology, Katie Daughenbaugh (MSU Postdoc/Research Scientist) – Plant Sciences & Plant Pathology, Undergraduate Scholars Program (USP)

Naomi Redfield: Animal & Range Sciences
Mentor: Shelly Hogan – McNair Scholars Program
STEM Research on the North American Beaver (Castor Canadensis) researched on the Blackfeet Reservation

The research that was done was to observe network formation of North American Beaver (Castor Canadensis) dams. Specifically, the research is called "Beaver Dam Structure and Logic." This research is observing how beavers display a unique, broad range of constructive behaviors. In order to build their dams, beavers further alter their environment through the excavation of canals and pond bottoms. Methods used in this study required the use of a drone in order to get images of the rivers; this allowed us to see how the beavers were changing the rivers and to see where they were building dams, lodges, and canals. Over the summer, we would study maps that would document the changes over the summer. Another method was to measure the depths and velocity of the rivers using a wading rod. The purpose of this project is to see how building behavior can serve as a function to the builder or the surrounding environment. This relates to beavers because we want to know if they build for their own well-being or if they just want cram locations in the rivers. As of now, data is still being collected for result purposes. Beavers have been building at three sites this summer and fortunately data has been collected from each individual site once a week. Some accomplishments have been particularly of how research data was coming together smoothly and our team's ability to get to the field sites every week. Some challenges were the unpredictable weather patterns, as well as other wildlife besides the beavers.

Acknowledgements: Harvard University

Natalie Sturm: Land Resources & Environmental Sciences
Mentor: Selena Ahmed – Health & Human Development
Characterization and Mitigation of Elevated Carbon Dioxide-Driven Impacts on the Nutritional Quality of Spinach

According to the Intergovernmental Panel on Climate Change, atmospheric CO2 levels could reach approximately 550 parts per million (ppm) by 2050. An increased CO2 concentration of this magnitude could have wide-ranging impacts not only on the environment, but also on agriculture and human nutrition. An emerging area of research is investigating how increased CO2 levels will impact food security and human nutrition. Previous studies have shown that elevated CO2 levels cause an increase in crop plant biomass and soluble sugars (glucose and fructose) and may increase antioxidants and phenolics. However, elevated CO2 has also been associated with a decrease in other important plant nutrients such as nitrogen (an indicator of protein content), zinc, and iron. Identifying and mitigating these losses in nutritional quality is vital; over 2 billion people worldwide are deficient in micronutrients such as iron and zinc. Nutrient deficiencies can have a significant impact on human health and well-being. This research project aims to determine the impacts of elevated CO2 concentrations on the nutritional quality of spinach – a widely consumed, nutrient dense vegetable. Additionally, this project investigates potential strategies to mitigate losses to nutritional quality due to elevated CO2. Spinach was grown in a greenhouse under ambient (400 ppm) and elevated (550 ppm) CO2 concentrations. The spinach groups were further divided into fertilizer treatments (compost and synthetic nitrogen) and harvest time treatments (early harvest and standard harvest). Spinach samples will be analyzed for their mineral, vitamin, total phenolic, and total antioxidant contents. Findings from this research will inform researchers and producers who seek to meet the nutritional demands of a growing population in the face of increased atmospheric CO2 concentrations.

Acknowledgements: Food and Health Lab

Randy Taylor: Plant Sciences & Plant Pathology
Mentor: Mac Burgess – Plant Sciences & Plant Pathology
Identifying Crop Nutrient Stress from Soil pH Extremes Utilizing UAVs

Precision agriculture is the science of collecting, interpreting, and applying spatial data to address problems and maximize efficiency within agricultural practices. One developing problem facing Montana farmers and ranchers is soil acidification. In this research project, Unmanned Aerial Vehicles (UAVs) were utilized as a platform for multispectral analysis of crop stress related to nutritional deficiencies caused by extremes in soil pH. The goal of this research project was to explore the possibilities for aerial data collection of soil pH for precision agriculture as

opposed to soil grid sampling. The methods were to collect images of alfalfa and spring wheat fields that have known soil pH problems and compare them with control fields with a neutral pH. Soil and plant tissue samples were to be collected to determine soil pH induced nutrient deficiencies. These images would be analyzed to determine if multispectral imaging can be utilized to detect unique spectral stress responses based on pH induced nutrient deficiencies in alfalfa and spring wheat. However, due to repeated equipment failure not enough data was collected during the growing season and the project could not be completed in full. The outcomes were less scientific in nature and more educational. A lot of experience was gained in understanding the limits and benefits of UAVs in precision agriculture and matching the right equipment to the task. Other educational outcomes include a greater knowledge of sensors and plant reflectance, practical understanding of UAVs in agribusiness models, and the increasing problem of soil acidification in Montana.

Acknowledgements: Undergraduate Scholars Program (USP)

Brody Wallace, Briana Whitehead: Land Resources & Environmental Sciences
Mentor: William Kleindl – Land Resources & Environmental Sciences
Sensitivity Analysis of Multiple Regulatory Tools for Riparian Wetland Assessment to Disturbance Gradients within SW Montana

Wetland assessment has been designed to meet multiple goals of federal, state and local agencies such as the Clean Water Act (CWA) 404(b)(1) regulatory guidelines for mitigation, the CWA §305(b) guidelines for states report aquatic conditions, BLM guidelines to manage grazing allotments, and local governments managing non-point pollution sources. In some cases, tools developed to address one regulatory agency have been applied to meet the needs of other unrelated regulatory drivers. This history of ecological assessment across multiple agencies have created a multitude of assessment approaches with various degrees of sensitivities to disturbance. For instance, within Montana, there are eight separate approaches to assessing riparian areas. As our attention moves toward ecological goods and services and the economic benefits those provide to Montana, future tools to assess these services will be built upon existing tools used for assessment of ecological condition. However, without a meta-analysis of these multiple riparian condition's tools, it will be difficult to choose the best and most cost-effective approach that provides the best distinction of ecological condition and the best means to inform the assessment of ecosystem service. In our meta-analysis study, we develop a land disturbance index (LDI) for SW Montana to select riparian wetlands across a range of disturbance. We will then apply the existing riparian assessment approaches that are in current use within our region, across this gradient. From this, we can test the sensitivity of the assessment approaches to disturbance. Ultimately, this meta-analysis will inform future ecological assessment development or refinement.

Acknowledgements: IRAEA

Emily Zirkle: Agricultural Economics & Economics
Mentor: Jennifer Woodcock-Medicine Horse – Native American Studies
Changes in traditional food systems of post-contact indigenous North American Arctic peoples

Indigenous peoples of the North American Arctic have lived in a land that most people use such words to describe as "barren" and "inhospitable" since Time Immemorial. Cultures including the Inuit, Yupiit and others have utilized the highly seasonal but surprisingly abundant resources around them to subsist through traditional methods and knowledge passed down by previous generations. The traditional ways of life, though far from gone, have faced numerous conflicts and pressures with the arrival of non-indigenous settlers to North America. Most notably, traditional indigenous Arctic food systems have faced pressure from numerous factors, which include transition towards European good consumption, cultural disconnect due to Western residential schools, environmental change and pollution, and animal rights activism. This transition away from traditional foods has led to increased health complications among indigenous Arctic peoples, as well as an erosion of overall traditional culture. This research presentation will locate and describe the factors that have impacted traditional Arctic food systems with the hope of raising awareness of these issues to protect and promote traditional foods.

COLLEGE OF ARTS & ARCHITECTURE

Sorcha Brooks: Art
Mentor: Regina Gee – Art
Emperors, Angels, and Barbarians: Roman, Christian, and Germanic Syncretism in the Franks Casket

For many historians studying the circumstances of Western Europe's emergence from the "Dark Ages," the first Holy Roman Emperor and Frankish king Charlemagne perfectly embodies the syncretism between Roman, Christian, and Germanic peoples. A unique 8th century whale bone box, called the Franks Casket, reveals how both Christianity and Roman culture was adopted as a natural part of the Germanic and Frankish peoples' already vast and complicated mythology. This small, intricately carved box was found in southern France but probably created in Northumbria by a monastic workshop. The Franks Casket is one answer to an early Christian problem: How can a peaceful ideology reconcile with a warrior culture? This study is an examination of why the casket's designer chose to depict images of the Adoration of the Magi at Christ's birth, the Roman origin story of Romulus and Remus, and the Germanic legend of Weyland the Smith. To better understand this casket and the culture in which it was created, it would be useful to know the purpose, origin, and intended audience of the casket, but little documentary evidence currently exists. I intend to examine the casket's iconography with a view to understanding possible visual and/or material hierarchy, labeled figures or events, which "moments" the creator chose to depict, and "moral lessons" of those chosen scenes. The Franks Casket's inscriptions and subject matter implies that Christianity and "barbarian paganism" were not necessarily diametrically opposed in the minds of an 8th century audience, and presents a fascinating case study of how Christianity was adopted and changed by the contemporary Germanic, Frankish, and Anglo-Saxon people.

Christopher Cunningham, Mary Grothaus, Olivia Hewston, Jackson Hughston, Zacarias Masiba, Hannah Petry, Sadie Teilborg, Lisa Turley, Lauren Vandette: Music
Mentor: Kristin Harney – Music
Stand Up and Cheer: The relationship between the MSU Bobcat Fight Song and social engagement at MSU

All undergraduates at Montana State University are required to generate a scholarly project and participate in a research/creative experience. We participated in a semester-long project designed to introduce us (second year, pre-service music education students) to the tools we will need to successfully design, carry out, and complete research during our senior year. Ten students who were enrolled in MUSE 383, Assessment in Music Education, participated in the study. As a way to explore a variety of research strategies in a safe, supportive environment, students engaged in a collaborative research study exploring the MSU Bobcat Fight Song, Stand Up and Cheer. We created research questions, created and administered a survey, interviewed participants, coded qualitative data, performed simple statistical analyses of quantitative data, created tables and graphs, and drew conclusions. Individually, each student developed a literature review, made observations, kept a journal, interviewed a student, and transcribed the interview. Products from individual tasks were all brought back to the large group for discussion and analysis. Although the focus of the study was on the rehearsal of research, rather than on the generation of a specific research product, our conclusions point toward a positive relationship between confidence singing the fight song and engagement at MSU.

Briana Gillet: Music
Mentor: Sarah Stoneback – Music
Globalization and Traditional Music

Throughout history, international trade has played a vital role in the development of arts and culture. Recent advancements in travel and communication have created a free flow of ideas and information, bringing cultures closer together. This research explores the effects of modern economic globalization on cultural identity and

traditional styles of music. Economics and culture are interconnected, benefiting many of the world's developed countries. From this new economy, the cultural ramifications are relatively unexplored. Artistic examples will shed light on this interconnectedness. This research focuses on the importance of music as a form of cultural identity and explores concepts of musical appropriation, assimilation, and inspiration.

Jimmy Kelsey: Music
Mentor: Sarah Stoneback, Gregory Young – Music
Vocal Health for Music Educators: A Trumpeter's Perspective

For one year, I suffered under the stress and pain of, unbeknownst to me, a benign cyst that had developed on my left anterior vocal fold. This cyst was the root cause of many problems that plagued my life as a naturally loud voiced trumpet performer. This inspired me to ask the question, "Do music educators know how much they're using their voices?" The purpose of this of research is to contribute to the pool of existing evidence that shows that teachers have a higher risk of losing their voices to vocal injuries. Speech pathologists are constantly receiving teachers into their medical care because of the abuse the teachers' unknowingly inflict upon their own vocal folds. Due to the nature of music education, and how music educators not only speak a large amount, but also perform on their instrument, music educators could be at an even higher risk of vocal injury. Through compiling my discoveries I made throughout the journey of eventually getting the cyst surgically removed, this research provides supporting evidence of the connection between vocal health and teaching music. Additionally, this research aims to bring further awareness to music educators and how they can maintain a healthy vocal regime. Methods of research include recording my personal obstacles to teaching and performing, compiling my recorded visits to various hospital services such as Bridger ENT, and Billings Clinic, and recording the delicate process of vocal recovery post operation. In connection with my vocal therapist, trumpet professor, primary doctor and surgeon, and various other sources on vocal health and wind playing, this study shall provide many music educators with a new supplement towards healthier vocal habits.

Schon Long: Music
Mentor: Jason Bolte – Music
Time-Signatures in Electronic Dance Music

Electronic dance music, known as EDM, is a category of music containing countless genres or styles of music. Persistent throughout this category of music is a metric form that takes its roots in American and other Western popular music. The 4/4 time signature has not always been the only common meter in dance music throughout history. Other variations including 3/4, 9/8 and more have been popularized in cultures throughout the world for centuries, but with EDM there is a noticeable lack of anything other than the standardized 4/4 meter. This is a result of many different factors coming together, including the genres this music evolved from, the significance of the DJ as a method of delivery of these many genres to the people, the approach many artists take when emulating the genres they love, the way the music business operates, and the way the technology is designed to be operated in most cases. I have spoken with several artists that are not following the standardized metric form and are instead exploring new rhythmic combinations to create music that still fits the other stylistic aspects of EDM while not conforming to the metric standards. These artists are discovering new ways to make EDM interesting, and are tackling difficulty with their arrangements in different ways.

Joshua McIntyre: Music
Mentor: Jason Bolte – Music
The Future of Immersive Music

The question that this research is going to attempt to answer is; will we see music being mixed for an immersive environment for the average consumer in the near future? To answer that question, I will research pre-existing and developing formats of decoding immersive audio as well as recent technological developments in VR gaming and cinema. Based on what I find, I'll be able to hypothesize whether or not the recent technological

developments and decoding formats will be adopted by the music industry and will be used to create commercial music for the average consumer. There will be a specific focus on the research of reproducing immersive audio environments on headphones because that would be the most accessible listening format for the average consumer. Because of how current the topic is, I'm expecting that most of the supporting research material will come from internet sources, journals and magazines, such as AES. The final product will be a research paper that that will discuss my findings and my hypothesis. So far, my research is suggesting that the music industry is starting to adopt immersive audio technology for music aimed at the average consumer, mostly due to Sony's recent development of their 360 Reality Audio system.

COLLEGE OF BUSINESS

Austin Altman, Paige Desatoff, Jamie Kenison, Cameron Erickson: Business
Mentor: Eric Van Steenburg – Business
The Wall Street Journal Strategic Marketing Plan

The purpose of our research was to determine the perceptions of Generation Z and Millennials toward the Wall Street Journal (WSJ). We developed a strategic marketing plan designed to increase the number of collegiate subscribers and help the WSJ maintain these subscribers when they graduate. Our research questions were: • RQ1: Why do college students stop subscribing to the WSJ upon graduation? • RQ2: Are college students unaware of product and promotional offers of WSJ? • RQ3: Why do college students believe the WSJ is a useful news source, but only for business students? We developed two online surveys. The purpose of our first survey was to better understand the target market's views of the Journal's self-identified key words it uses to describe the brand and gain insight on other possible key words that could be used for the brand. The purpose of the second survey was to better understand our target market's view on the Journal's key words, validate other alternative key words, identify variables for use in market segmentation, and gain insight to better understand target consumers' preferred mediums for receiving news. Our findings answered our research questions and provided us with insight as to how the Journal could modify their marketing strategy in order to alter consumers' perspective of the WSJ. Statistical analysis showed that consumers' identification with the brand, attitude toward the brand, and emotional associations with the brand predict purchase intentions. This significant finding, along 11 others, helped conceptualize and support our recommendations for the WSJ.

Acknowledgements: Matthew Hronek (MSU Undergraduate Student) – Business

Dillon Sleichter: Business
Mentor: Jennifer Woodcock-Medicine Horse – Native American Studies
Contemporary Art of The Pacific Northwest Native Nations

In the world today there are countless famous artists such as Banksy, whose works of art stand out among the rest. Yet, hardly any of the phenomenal artists from the Native Nations of the United States are recognized outside of their fellow Nation members. The purpose of my research is to study the many different traditional styles of art from the Pacific Northwest Nations are how members of these Nations are keeping their culture alive through their modern twists on these styles. I will be conducting this research through a multitude of online data bases that are specifically for Native American artists as well as companies that have been set up by already famous Native American artists that are designed to help younger artists get their work recognized on an international level. In all I hope my research will shed light on how truly amazing these artists are at bringing a modern twist to their traditional styles of art. I also hope that doing so will make their pieces of art more recognizable here in the United States as well as on the international level.

COLLEGE OF EDUCATION, HEALTH & HUMAN DEVELOPMENT

Austin Barnhardt: Health & Human Development
Mentor: Colleen McMilin – Health & Human Development
Prevalence and Management of Childhood Food Allergy in Montana Schools: a Pilot Study

The epidemiology of childhood food allergy in Montana is insufficient compared to more urban states with no published data on the subject. However, it not uncommon to hear of an apparent increase of food allergy in Montana children from teachers and parents. Previous research has shown an increasing prevalence worldwide with 8% of children in the United States reporting a food allergy based on a national survey. Within the school setting families are relying on others to consistently maintain a safe environment for their student and be prepared to act when a student has a severe, possibly life-threatening, allergic reaction. Limited information exists about how to manage food allergy in Montana schools, especially in schools with limited access to school nurses. A pilot survey was distributed to a quarter of schools across Montana as the first step in collecting data to determine the prevalence of food allergy and current management strategies. This pilot addressed the effectiveness of the survey as well as collecting data on: (1) the prevalence of food allergy in schools; (2) the use of stock epinephrine autoinjectors; (3) training practices related to food allergy, anaphylaxis and the use of an epinephrine autoinjector; and (4) food allergy management plans. Results from the pilot study will contribute to future research focused on reaching all schools in Montana to assist in the development of outreach to continue to provide a healthy and supportive environment for children with food allergy in Montana schools.

Ashley Brown: Health & Human Development
Mentor: James Becker – Health & Human Development
Biomechanical Differences Of The Standing Long Jump Performed With An Internal Vs. External Focus Of Attention: A Systematic Analysis

The standing long jump (SLJ) is a tool often used to assess and predict athletic performance. Studies have shown that the distance of a SLJ increases significantly when performed with an external focus of attention (FOA) compared to an internal FOA, but the mechanistic basis for this difference is not fully understood. The purpose of this study is to systematically explore the potential biomechanical cause(s) for the performance improvement seen in SLJ with an external FOA. This study aims to undertake a comprehensive analysis of the multiple variables that impact SLJ performance, including but not limited to: changes in center of mass (COM) distance traveled throughout three phases of a SLJ (take-off, flight, landing) between FOA conditions, vertical and horizontal ground reaction forces (GRFs), take-off/landing angle, velocity, and height. 20 collegiate participants performed SLJs under baseline, internal and external FOA conditions. Throughout this experiment, three jumps from each condition will be examined to explore the phases of SLJ in which distance may be significantly affected by FOA. If found, biomechanical components of the significant phase(s) (i.e. take-off height, landing COM, GRFs) will be analyzed for impact. Continued systematic work may potentially lead to the discovery of a biomechanical basis for improvements seen in the SLJ and allow for a more complete understanding of components that change with FOA and impact performance. Research is ongoing.

Blackshear Bryan: Education
Mentor: Jennifer Woodcock-Medicine Horse – Native American Studies
Pre-Contact and Contemporary Life of East Coast United States Native Americans and Canadian First Nations Peoples

Contemporary talk and research regarding the Indigenous peoples of North America commonly regard those people who lived in the midwest and west. A great deal of modern understanding and initiatives taken to inform people about indigenous peoples often forgets the peoples who live on the eastern coast of North America. The goal of this project is to provide people an idea of who the indigenous peoples of the United States Northeast and Canadian West were and are. The indigenous people of New England, Nova Scotia, Quebec, Newfoundland, and

Labrador are often not mentioned in contemporary dialogue. This is both true regarding their pre-contact life as well as their contemporary life. Even worse people get inaccurate representations of pre-contact United States East Coast tribes. This can be through films like Pocahontas. The lack of representation in modern literature and culture is also apparently due to the lack of Indian reservations and land in the East Coast. Alongside this, in the United States, there is very little education about the Canadian First Nations, even though they have very close ties with the indigenous people of the United States of America. This project will teach people about the pre-contact and contemporary lives of the Canadian and United States eastern coastal tribes that are often ignored in contemporary literature.

Hannah Christofferson: Education
Mentor: Ann Ellsworth – Education
Comparing Finnish and American Approaches to Writing in the Elementary Classroom

Writing is directly tied to critical thinking and presenting arguments with evidence - skills that must be developed to yield a society of capable thinkers and communicators. Therefore, it is of the utmost importance that American citizens are educated to be strong writers. However, this is not the current reality, and the reason for this reality is often traced back to the foundational years of elementary school instruction. Teaching writing effectively to young learners is a lofty task, and students can become overwhelmed, discouraged, and face frustration during the learning process. This study sought to observe several aspects of the Finnish approach to writing instruction as practiced in their elementary classrooms in order to compare them with traditional writing instruction carried out in elementary classrooms within Bozeman School District #7. By looking at the highly respected Finnish education system, this project sought to understand what Finnish teachers do in the area of writing instruction that results in their students' astounding performance on international assessments. While the conclusion that a complete transplant of the Finnish education system into America is not practical, observed strategies and perspectives may be worth incorporating in order to implement more successful methods for teaching writing in American elementary classrooms.

Acknowledgements: Undergraduate Scholars Program (USP)

Vanessa Fahlgren: Education
Mentor: Jennifer Woodcock-Medicine Horse – American Studies
The Indigenous People of Canada Before European Contact

The Indigenous people of Canada include the Inuits, the Métis, and the First Nations. Before the Europeans came to North America, they lived very different lives. These aboriginal people had an entire way of life that was taken away from them when Europeans arrived. Oftentimes in the United States, we discuss what has happened to the Native tribes in the boundaries of the US, but that conversation stops at the border. Before Europeans arrived, there was no border. Indigenous people were all over this continent and the Europeans who created lines also tore apart families. Cultures were changed forever and tradition amongst the aboriginal peoples of Canada has a story to be told. This paper will include ways of life of the Inuits, the Métis, and the First Nations before the contact of European settlers. This will include what they lived in, what they wore, what they ate, how they survived the cold, their religions, family and tribal structures, and language.

Lillie Hawkins, Nicholas Johnson: Health & Human Development
Mentor: Colleen McMilin – Health & Human Development
Management of Type 2 Diabetes and Hypertension Through Medical Nutrition Therapy

Type two diabetes mellitus is the most common form of diabetes, with around 29 million people affected in the United States. Additionally, hypertension is a common comorbidity with diabetes. Thankfully, these conditions can be controlled with methods including diet. Using a case study approach is useful for addressing these issues.

Rebekah is a 30-year-old woman with a history of type two diabetes and hypertension. She has experienced weight gain and subsequent obesity along with rising blood sugars, which has caused concern for the risk of more chronic conditions. After referral to nutrition consultation, the Mediterranean Diet and carbohydrate counting have been considered as dietary intervention strategies. Research on the Mediterranean Diet and carbohydrate counting supporting these methods as effective medical nutrition therapy for diabetes and hypertension. By converging the two diets, we hypothesized that regulation of blood glucose will be enhanced more so than if carbohydrate counting was the sole intervention. To investigate the challenges Rebekah might face while following these diets in convergence, we followed the diet prescription for five days while recording our experiences and a food log. We would like to share our findings with other future dieticians so that we can be more effective in helping clients like Rebekah.

Lindsay Haynes, Nettie Caine: Health & Human Development
Mentor: Colleen McMilin – Health & Human Development
Hyperlipidemia and the role of genetics

The patient in our case study is a 30 year old female who recently took a predictive genetic test which stated a possible risk of developing cardiovascular disease (CVD). The mother of the patient recently suffered a heart attack which has made the patient concerned for her own health. The patient has no other past medical history, lab values show elevated blood lipids and she has been referred for lifestyle management session. The medical nutrition therapy plan will include decreasing total fat intake, eliminating saturated and trans fats, limiting dietary cholesterol, and monitoring triglyceride levels. Reducing saturated fats to 7% of total calories and decreasing cholesterol intake to 200 mg a day can ultimately decrease LDL levels.In addition, education on how genetics can play a role in hyperlipidemia will be addressed and an increase in physical activity will be recommended. The education component of the medical nutrition therapy will include a list of foods that are relatively low in dietary cholesterol and overall fat intake. First being aware of what foods have a higher fat content and recognizing subtle changes to lower the overall fat intake throughout the day. The five day meal plan will not include foods that contain saturated and trans fat. It is important for to maintain some dietary fat throughout the day, primarily focusing on healthier fat alternatives. Over the course of the five days there will be a reflection on the experience including how the typical and routine diet was altered to match the prescribed diet. Taking note of the level of difficulty to maintain a prescribed diet while recognizing the challenges that were overcome to stay on track for five days.

Tyla Herbst, Carly Hart: Health & Human Development
Mentor: Colleen McMilin – Health & Human Development
Low FODMAP Diet Related to Improvements in Irritable Bowel Syndrome

Irritable bowel syndrome is a chronic condition that typically causes severe abdominal pain, bowel dysfunction, and bloating without any structural abnormalities. It is related to the brain-gut interaction and food intolerances. Mental health plays a role in the diagnosis and severity of the disease. It is 1.5-3 times more likely for females to have this condition than males. The case presented is a 35 year old female complaining of abdominal bloating, heartburn, burping and diarrhea. The patient is lactose intolerant. She had an appendectomy when she was 11, and her father died of colorectal cancer. A gastroscopy showed a small hiatus and bowel irritability. The medical nutrition therapy for this patient is a low FODMAP diet to reduce symptoms and bowel irritability. She will be prescribed this diet for five days. A low FODMAP diet is specifically low in fermented carbohydrates. FODMAP stands for fermentable oligo, di, mono-saccharides and polyols. The main dietary sources avoided on this diet include wheat, rye, various fruits/veggies, milk, yogurt, and sweeteners such as honey and agave nectar. The research will work to follow a low FODMAP diet, as prescribed to the patient above, over the course of five days. This diet will be tracked and challenges will be noted. Over the course of the five days, the team will reflect on our experience including how we changed our typical diet to match the diet prescribed as part of the case study.

Nicholas Johnson: Health & Human Development
Mentor: Carmen Byker Shanks – Health & Human Development
Health Profiles of The Un-Processed Pantry Project (UP3) Study Participants

Consumption of ultra-processed foods contributes to development of nutrition-related chronic diseases including obesity, hypertension, and diabetes. Conversely, intake of less processed fresh foods is related to prevention of nutrition-related chronic diseases. Due to factors including cost, convenience, and accessibility, ultra-processed foods are more frequently consumed by individuals of lower socioeconomic status. Food pantries frequently serve low-income populations, and thus have the opportunity to provide clients with health promoting and less processed diets. In Montana, the Gallatin Valley Food Bank and Livingston Food Resource Center have partnered with the MSU Food and Health lab to conduct the Un-Processed Pantry Project (UP3), a 16-week intervention designed to provide the resources for food pantry clients to consume a less processed diet. Survey instruments and health measures will assess the effectiveness of the intervention at three timepoints during the ongoing research; the research herein uses data from the first timepoint. Specifically, the research aims to: (1) generate health profiles of study participants and (2) determine relationships between psycho-social variables (food security, income, last doctor's visit, consumption of fruits, vegetables, and whole grains) and health biomarkers (BMI, waist circumference, blood pressure, non-fasting cholesterol, and A1C) among study participants. Data generated from these aims will provide further evidence to tailor UP3 to meet 43 study participants' dietary and health needs and support organizational change towards improvement in the food supply and food environment over time.

Acknowledgements: IDeA Network of Biomedical Research Excellence (INBRE), Center for American Indian and Rural Health Equity (CAIRHE)

Lori Lindgren: Health & Human Development
Mentor: Mitchell Vaterlaus – Health & Human Development
Smartphone Acquisition in Adolescence: A Case Study Approach

Most adolescents in society today are rarely seen without a cell phone in their hand, engaged in a variety of activities. This has had an impact on the social lives of adolescents, raising questions among parents if there is a right or wrong time for their child to acquire a personal smartphone. Using a qualitative case study design, a cross-case synthesis analysis approach was implemented. Ten individual case descriptions were created for each family dyad or triad. One researcher wrote each case study, and another reviewed them. Two researchers independently immersed themselves in case studies looking for similarities and differences. The two researchers then reviewed raw data, uniform categories were identified, and findings documented in the word tables and agreed upon themes that represented the participants' experiences were developed. Three themes were identified during the qualitative analysis: Age and maturity, practicality, and positive and negative aspects regarding granting a smart phone. 13 was the average age to receive a basic phone and 15 average age for smartphone. Practical reasons for granting a smartphone were discussed with functionality being the top response. The positive and negative aspects surrounding the granting of a smartphone found that positive aspect for granting a smartphone was peer acceptance followed by social networking and connection. The negative views on granting a smartphone were inappropriate conversations, perceived judgement for not having a smartphone, hurt social relationships, and spending too much time using the smartphone. Most participants felt there was an appropriate age for smartphone acquisition.

Acknowledgements: McNair Scholars Program

Siebe Meindertsma: Psychology
Mentor: Jennifer Woodcock-Medicine Horse – Native American Studies

Pre-Contact Arctic Architecture

This research paper focuses on the architecture of Arctic dwellings in the Pre-Contact era. While we are all familiar with the typical igloo, these were only constructed in a small part of the Arctic region. Different peoples made use of different techniques to construct their dwellings and had to take into account the changing seasons. Conditions were harsh and resources limited, so there was a great deal of ingenuity required. For this paper I make use of written accounts by early Arctic explorers and present-day articles discussing what made these dwellings so effective. Maybe we will even learn something from it ourselves (maybe don't use flat roofs, for example).

Jacie Meldrum: Health & Human Development
Mentor: Kalli Decker – Health & Human Development
Parents' Reports of Montana's Early Intervention Services: Alignment with Recommended Practices and Challenges Associated with a Large, Rural State

This poster reports recently analyzed data from parent surveys and interviews about Montana's early intervention services. This project is part of the only research that has focused on how Part C of the Individuals with Disabilities Education Act is implemented in Montana. Over 100 hours of video and audio recorded interviews were transcribed into nearly 700 pages of data which was analyzed for this project using Content Analysis. To determine how these services align with research-based recommended practices for the field, codes were developed to identify different qualities of services. Research clearly demonstrates that the most effective way to provide intervention for children from birth to age three who have delays or disabilities is following a family-centered service model. This poster describes results including how parents report being involved in their child's services, the environments in which services are provided, and how parents are supported and empowered in various ways to help their children develop. Results indicate that services include many opportunities to discuss, but that many families are not regularly invited to actively participate in their children's services. The majority of specialized services, such as physical and speech therapies, are being provided in a clinic setting rather than in a natural environment such as the child's classroom or home. While parents report a variety of experiences with the professionals they work with, there are significant challenges associated with accessing evidence-based practices in a large, rural state.

Acknowledgements: Alexandra Corcoran (MSU Graduate Student) – Health & Human Development, Kami Cole (MSU Undergraduate Student) – Sociology and Anthropology, Ellery Jorgensen (MSU Graduate Student) – Health & Human Development, Makenzie Fry (MSU Undergraduate Student) – Cell Biology & Neuroscience, Undergraduate Scholars Program (USP), IDeA Network of Biomedical Research Excellence (INBRE)

Cassie Merten: Health & Human Development
Mentor: Mitch Vaterlaus, Dawn Tarabochia Katie DesLauriers-Heiser – Health & Human Development
Romantic Relationships and Romantic Experiences: Late Adolescent Perspective

Romantic relationships are an important feature of adolescent development, but what constitutes a romantic relationship is not consistent in the literature. The current qualitative study examined late adolescent perspectives (n = 263) regarding romantic experiences and romantic relationships. Presently, there are emerging definitions of romantic relationships and romantic experiences, but these vary across different studies. The purpose of this qualitative study was to identify how late adolescents conceptualize romantic relationships and romantic experiences. Consulting people who have experience with romantic relationships and experiences may assist in the process of solidifying empirical definitions of these two relational phenomena.

Acknowledgements: Whitney Whittecar (MSU Graduate Student) – Health & Human Development

Erika Murray, Rachel Walker: Health & Human Development
Mentor: Colleen McMilin – Health & Human Development

Consuming a vegan diet while managing rheumatoid arthritis

Rheumatoid arthritis (RA) is known as a chronic inflammatory autoimmune disease affecting between 0.3 - 2.1 % of the world population. RA is characterized by the immune system initiating an inflammatory response causing swelling, pain, stiffness, fatigue, and muscle wasting near the joints. This disease state currently has no known cause or absolute cure. As someone who sees a future working in the dietetics practice, it is possible that I will work with individuals who have been diagnosed with RA. In working with these individuals, it is essential to understand dietary preferences to manage this disease state. My team has developed a nutrition care plan based on a vegan diet to better understand the effect this can have on RA. This meal plan was originally created for Wendy who is a 32-year old female recently diagnosed with RA. It will include increased intake of omega-3 fatty acids, foods high in antioxidants, and several micronutrients. These macro and micronutrients are able to alleviate symptoms from RA due to their ability to decrease homocysteine levels and oxidative stress.

Chloe Nease: Cell Biology & Neuroscience
Mentor: Kalli Decker, Christine Lux – Health & Human Development

Mindfulness within Early Childhood Settings: The Creation of a Curriculum and Research Project Using Teacher Feedback

This project focuses on the early steps in designing a research study to better understand the benefits of using mindfulness-based practices within early childhood settings. The study of mindfulness in early childhood settings within Western cultures is relatively new and there is limited research on its use with children ages five years and younger. There also appears to be a gap in the research literature related to what mindfulness can do to promote children's mental health, as well as their interactions with others, including peers and educators within the classroom. Based on these gaps, this project focused on: 1) holding a focus group with teachers from the MSU Child Development Center(CDC) to gather their ideas about developmentally appropriate ways in which mindfulness could be used, 2) implementing four mindfulness lessons in the CDC based on the focus group data, 3) holding a second focus group to gather information about teachers' perceptions of the mindfulness lessons that were piloted,and 4) outlining future steps, including a curriculum to be used at the CDC and ways in which its effectiveness could be studied. Through an intensive literature review, I investigated different methods being used with young children and identified what themes are most common among these published resources. Based on my findings from the initial focus group, literature review, and lessons in the CDC, I will finalize a curriculum outlining how to implement mindfulness within the preschool and plan for future steps that may include additional research in the CDC.

Acknowledgements: Savannah Johnson (MSU Undergraduate Student) – Health & Human Development, Makenzie Fry (MSU Undergraduate Student) – Health & Human Development, Undergraduate Scholars Program (USP)

Mikayla Pitts: Health & Human Development
Mentor: Suzanne Held, Mark Schure – Health & Human Development

Messengers for Health: Baa' Nnilah Program

Many American Indian communities face continued social and economic conditions that may impact participation in many community health studies. Researchers at Montana State University are collaborating with Messengers for Health, a non-profit Apsaalooke (Crow) organization, in order to implement a culturally-appropriate chronic illness program, called *Baá nnilah*, which is designed to successfully improve health care behaviors and outcomes for tribal members living with chronic illnesses. This study uses a randomized waitlist controlled trial design with community members as program leaders. Ten program leaders were assigned the responsibility of recruiting 20 community members each to participate in the trial (n =200). We are focusing how the actual recruitment process unfolded and reflect on lessons learned; we are interested in the ethical implications of using traditional based recruitment methods in American Indian communities. This will inform researchers on alternative methods for culturally-consonant recruitment of American Indian to chronic illness management studies.

Kaeli Pyles, Maria Bertha: Health & Human Development
Mentor: Colleen McMilin – Health & Human Development
Diet Implementation in Chronic Kidney Disease

The kidneys function to filter the blood, form urine, excrete wastes from the body, and maintain physiologic blood pH. The kidney can become stressed by factors including high blood pressure, diabetes, and obesity which can lead to chronic kidney disease (CKD), renal failure, and the eventual failure of other vital organs including the heart. Current data suggests that 13.1% of Americans are suffering from some form of CKD. The incidence of CKD in the US is largely associated with rising rates of diabetes and hypertension linked to increased rates of obesity in younger populations. The case study presented in this research is of Enez Joaquin (EJ), a 24-year-old Pima Indian who has had type 2 diabetes mellitus since age 13, and has been admitted for kidney replacement therapy due to progressively declining kidney function. The use of medical nutrition therapy (MNT) in kidney failure benefits the patient by decreasing stress to the kidney, slowing the progression of the disease, and maintaining good nutritional status. Key components of MNT in renal disease focus on blood pressure control through limiting salt intake, reducing nitrogenous waste removal through controlled protein intake, and maintaining a diet high in fruits and vegetables and low in saturated fats to benefit cardiovascular health. For the purposes of our research, the diet we prescribed to EJ during renal replacement therapy was followed for 5 days with the intent to investigate and reflect upon the challenges of diet implementation for CKD patients.

Megan Strong: Health & Human Development
Mentor: Jody Bartz – Health & Human Development
How Media Representation Influences Personal Perception of Disability

The purpose of this research was to explore how media representations may or may not influence personal perceptions of persons with disabilities (PWD). Eighty-eight pre-service teachers from Montana State University completed a pre- and post-survey which asked them to identify 13 'statements' about PWD as a 'myths' or 'facts'. The post-survey also asked participants to give short qualitative responses (specifically asking them to share how their perceptions about PWD have/have not shifted) to each of the 13 statements. Over the course of the semester, students were also asked to view and respond to multiple media representations of PWD--news articles, TED Talks, documentaries, magazine articles, etc. Preliminary results from the pre-survey indicate that nearly ½ of the participants felt the statements were facts--when in actuality, all 13 statements within the survey were myths. More in-depth analyses will be conducted to identify common themes within the qualitative responses among the participants. We recognize these finding are not representative of the entire Montana State student body; however, this project is an ideal initial springboard to further conversations examining perceptions, attitudes, and assumptions about PWD across our MSU campus.

Vanessa Tuffs: Health & Human Development
Mentor: Jody Bartz – Health & Human Development
Children and Youth with Special Health Care Needs Program... What do our stakeholders have to say?

The purpose of this Community Based Participatory Research (CBPR) project was to gather information from the 34 stakeholders of the Community Advisory Council (CAC) for the Children and Youth with Special Health Care Needs (CYSHN) Program in Montana. In conjunction with the Department of Public Health and Human Services (DPHHS), we crafted a survey that was sent to all stakeholders. We asked CAC participants to identify and rank specific challenges in their communities across Montana related to providing and/or receiving services and support for CYSHCN. Preliminary analyses indicate some similarities across the state; more in-depth analyses will be completed and reported back to the CAC stakeholders so that we move the DPHHS CYSHCN Project in Montana forward by directly responding to the needs across the state.

Acknowledgements: SEED Grant

Hannah Vining: Health & Human Development
Mentor: Colleen McMilin – Health & Human Development
Managing food allergy in Montana schools: findings from key informant interviews

Today approximately one in thirteen children, or roughly two in every classroom, have been diagnosed with a food allergy. The incidence of reactions in schools are becoming more common, occurring in 16-18% of school age children. Unlike many urban states, Montana, has yet to develop a clear understanding of the prevalence and burden of childhood food allergy. Simultaneously, there is little known about how food allergy is managed in Montana schools, especially those schools with limited access to school nurses. As a result, we conducted exploratory research, beginning with a pilot survey distributed across Montana, to initiate documentation of food allergy in schools, as well as assess the resources and strategies put in place to manage these allergies. The survey lead to the identification of school personnel interested in completing a key informant interview allowing us to capture a more in depth look at current practices in schools. Results from the key informant interviews were categorized based on the following themes: (1) training provided to authorized personnel related to food allergy, anaphylaxis, and the use of an epinephrine autoinjector; (2) food allergy management plans currently in place; (3) best practices that are currently working; (4) barriers/challenges faced when managing food allergy; and (5) resources needed to improve management. Ultimately, the results will lead to further research which could help with the development of more consistent guidelines and procedures to provide schools with more support in the management of food allergy.

Amber Yates: Elementary Education
Mentor: Megan Wickstrom – Mathematical Sciences
Mathematical Modeling: Analyzing Elementary Students' Perceptions of Mathematics, Identity, and Expertise

Mathematical modeling is a process that allows students to investigate real-world, meaningful questions through mathematical exploration. Mathematical modeling is often structured differently than traditional mathematics, where, historically, speed and accuracy are often valued above other skills. While modeling, students engage in practices that may enrich how they know and do mathematics and their beliefs about themselves as mathematical learners. In this chapter, we consider how elementary students define mathematics and view themselves as learners while doing mathematical modeling and also during traditional instruction. This was done through qualitative analysis of interviews and classroom observations with seven, second-grade students to understand their experiences in both settings. Findings suggest that the students conceptualized math primarily as computations and either compared themselves to peers or considered how quickly and accurately they could solve problems to determine success in mathematics. In contrast, mathematical modeling pressed on students' notions of what it meant to know and do mathematics and their mathematical identities. We identified and discussed four themes that arose as both challenges and affordances when students discussed modeling in relation to mathematics: responsibility, difficult mathematics, group dynamics, and real world application.

Acknowledgements: McNair Scholars Program

Erica Zarilng, Kaitlyn Schlangen: Health & Human Development
Mentor: Colleen McMilin – Health & Human Development
Roux-en-Y Gastric Bypass Diet Implementation

World Health Organization (WHO) estimates that more than 1.9 billion adults aged 18 years and older were overweight in 2016. Over 650 million of these adults were obese. In total, approximately 13% of the world's adult population were obese in 2016. Bariatric surgery is simply defined as a surgical procedure on the stomach or intestines to induce weight loss. Gastric bypass is conducted to help patients lose excess weight and reduce the risk of developing potentially life-threatening weight related health problems. Roux-en-Y gastric bypass is known

to be the most effective stomach stapling procedure since the 1980s. As future dietitians, developing a post-operative nutrition plan will be a prominent practice. We have put together a 5 day nutrition care plan to follow based off the following case. Bob is a 32 year-old-male who has been referred to the dietitian for a gastric bypass follow-up. The patient has a medical history of obesity since age 10 and was diagnosed with type II diabetes 3 years ago. Currently, he is struggling to understand the prescribed diet given to him after the surgery. We have created a nutrition care plan that is easy to understand and maintain that consists of small and frequent meals. Over the course of 5 days we followed this plan and assessed our experience and findings concerning this particular diet. In conclusion, this project equipped us with first-hand experience on implementing a diet that we may be educating a client on in the future.

COLLEGE OF ENGINEERING

Mona Abdelgaid: Chemical & Biological Engineering
Mentor: Wan-Yuan Kuo – Health & Human Development
Analysis of both Improved Cream of the West 7-Grain Pancake Texture and the Particle Size of the Pancake Mix

Our MSU Food Product Development Lab has an ongoing project with the MSU Farm to Campus Initiative and Montana food businesses to improve the quality of local foods served on campus. Our lab has successfully improved the sensory acceptance of a seven-grain pancake mix made by Cream of the West (Harlowton, MT) of which the pancake made was previously described as "dry" and thus unpopular in the Miller Dining Hall. However, we are lacking scientific evidence to explain such an improvement. We hypothesize that the reduced grain size in the mix provided finer microstructure and softer texture, which was perceived as "less dry" by the consumers. Thus, this project aims to analyze the particle size of the pancake mix and the microstructure and texture of the improved pancake. In the long term, such scientific knowledge in local food manufacturing will strengthen Montana's value-added agriculture. To prepare the pancakes, three different mixes were prepared in which the Cream of the West grains were either crushed in the food processor for 15 seconds, 30 seconds or run through the mill. The pancake was then prepared according to the procedure of the Culinary Services. A texture analyzer was used to evaluate the texture profile analysis (TPA) parameters, namely hardness, cohesiveness, springiness, and chewiness of the pancake in triplicates. The average hardness of the Run Through Mill 7-Grain mix pancake was 1253+/-277.1 g, significantly lower compared to the control pancake (Original recipe; Whole 7-Grain mix, 2057+/-207.1 g, P

Acknowledgements: Undergraduate Scholars Program (USP)

Giovany Addun, Conner McCloney, Ryley Rodriguez: Computer Science
Mentor: Clemente Izurieta – Computer Science
Comparison of Machine Learning Techniques for Land Use Classification

In natural resource management, land cover and land use are terms used to describe what types of natural and man-made features compose an area of land. This information is typically presented as land cover/land use (LCLU) maps, which are typically created using machine learning techniques on remotely sensed data. These maps are important to professionals like city planners when investigating growth, ecologists when tracking invasive species, or agronomists when deciding what crops to plant or soil treatments to apply. Since 1972, the Landsat program has launched 8 observational satellites. These satellites continuously orbit the earth, collecting ground reflectance values for different wavelengths of light. Because the Landsat program has been continuously making observations for so long, it is a great source of data for creating LCLU maps. Although tools for converting Landsat data to LCLU maps currently exist, a vast majority of these tools are quite expensive and many of the free tools have strong limitations. This makes it difficult for citizen scientists to conduct studies using LCLU data or remotely sensed data in general. Giventhis difficulty, we have chosen to implement several LCLU classification techniques using free and open-source software. We have chosen 5 classification techniques to implement and compare their relative strengths in terms of precision, recall and accuracy while making LCLU classifications on 3 different geographic locations.

Bekah Anderson: Chemical & Biological Engineering
Mentor: Christine Foreman, Markus Dieser – Chemical & Biological Engineering, Center for Biofilm Engineering
Characterization of Microplastics in Precipitation

The modern lifestyle is consumed by plastic. From disposable bottles to packaging to modern appliances, plastic is nearly impossible to avoid in the West. A rapidly growing area of research is focused on microplastics, which are small plastic particles either directly produced to be small or are derived from the weathering of larger plastic

pieces. Extensive research has been conducted on the characterization of marine microplastics, but relatively less is known about freshwater systems and especially transport throughout the water cycle. Due to the ubiquitous nature of plastic, there are likely microplastics in precipitation and they can be found in remote environments. This research project aims to characterize microplastics presence in Montana precipitation, and we believe this project is the first of its kind. To complete this task, precipitation samples (i.e. rain, snow, hail) were taken, filtered, and observed using epifluorescence microscopy to count and categorize plastic particles. Raman spectroscopy was employed to chemically identify unknown polymers. Thus far, preliminary results have shown plastic particles in precipitation. By the end of this project, we expect to be among the first to officially document microplastics in precipitation. The findings of this research project will further inform the prevalence of microplastics and their role in environmental contamination. As society moves further towards sustainability and environmental responsibility, it is imperative that we actively work to understand and resolve the implications of our plastics use.

Acknowledgements: Undergraduate Scholars Program (USP)

Stefan Andersson, Connor Edling: Electrical & Computer Engineering
Mentor: Brock LaMeres – Electrical & Computer Engineering
Pseudo Random Number Generation for Use in Encryption

The generation of random and pseudo random numbers is vital to the security of modern encryption methods. This research project will examine how pseudo random numbers are generated at the hardware, software, and operating system levels, along with the strength versus resource usage trade-off of each solution. The conventional pseudo random number generation techniques studied include methods such as linear feedback shift registers, linear congruential pseudorandom number generators, the Yarrow Algorithm, and methods involving entropy from the computer or application. Innovative and unconventional techniques with the goal of producing truly random numbers will also be considered, including with biological processes, radioactive decay, and quantum properties. The research methods consist of the analysis of peer reviewed articles, the analysis of software documentation, the analysis of open source software, and the implementation of a modified linear feedback shift register along with a linear congruential pseudorandom number generator.

Acknowledgements: Undergraduate Scholars Program (USP)

Nickolas Avila: Chemical & Biological Engineering
Mentor: Robin Gerlach – Chemical & Biological Engineering
A model to quantify the enhanced mass transfer of CO2 into high alkalinity algae culture medium

Microalgae can autotrophically utilize bicarbonate ions ($HCO3^-$) in solution as a carbon source. At a high pH (>10) and high alkalinity, algae cultures can take advantage of an enhanced mass transfer of $CO2$ from the atmosphere as well as provide a reservoir of bicarbonate for fixation; culturing under these conditions has been shown to increase biomass productivity and reach levels achieved otherwise only with high concentration $CO2$ supplies. We have developed a mathematical model that describes this enhancement of $CO2$ mass transfer by using the hydroxyl ion concentration, diffusion coefficients, total alkalinity, equilibrium constants of the carbonate/bicarbonate equilibrium equations, and the volumetric mass transfer coefficient (kLa), while also accounting for the effects of ionic strength and variable temperature of the media. Most of these parameters are well known from the literature and their changes at varying ionic strengths and temperatures have been previously described. Changes in hydroxyl ion concentrations are easily measured as pH. Our approach allows us to estimate the volumetric mass transfer coefficient by fitting data relating pH and time to an ordinary differential equation that describes this unsteady-state mass transfer. We determined the volumetric mass transfer coefficient for the transport of atmospheric $CO2$ into paddlewheel-mixed open alkaline ponds by fitting pH vs. time data to the model using an algorithm developed in the programming language Python. Temperature vs. time data and ionic strength data determined the time-dependent change in the model parameters. The algorithm results in good fits to seven experimental data sets over a range of total alkalinities (17.0 and 135 mEq),

temperatures and pH values. These generally good fits provide a strong basis for optimizing the operation of high-alkalinity cultivation processes of microalgae in the presence of only atmospheric CO2 to increase algal biomass productivity.

Acknowledgements: Undergraduate Scholars Program (USP)

Zoe Benedict, Madisen McCleary: Mechanical & Industrial Engineering
Mentor: Roberta Amendola – Mechanical & Industrial Engineering
The Effect of Aluminum Titanate (Al2TiO5) Doping by Infiltration Method on the Mechanical Properties of Solid Oxide Fuel Cell Anodes

Solid oxide fuel cells (SOFCs) are a competitive sustainable energy option composed of an anode, cathode, and electrolyte that electrochemically generate power when individual cells are clamped into stacks. Components are typically ceramic, and the most common materials for anodes are nickel oxide (NiO) and yttrium-stabilized-zirconium (YSZ). However, under the high clamping pressures of SOFC stacks, the brittle ceramic material can crack instantaneously and result in the reduced longevity of the SOFC, so anodes can be doped with a secondary material like aluminum titanate (Al2TiO5, ALT) to slow degradation rates and increase mechanical strength. Previous research has studied the effects of ALT doping by mechanically mixing NiO, YSZ, and ALT as powder precursors so that ALT is homogeneously dispersed. Other research has found that doping by an infiltration method instead results in higher electrochemical output and slower degradation rates than mechanical mixing. For this study, samples will be tape cast from powdered NiO and 8 mol% and doped with ALT by infiltration method to compare with the previously tested mechanical mixing method. Doping levels will be checked using a microbalance to determine the wt.% ALT of samples before being reduced then fractured by three-point bending. Phase formation and fractography will be analyzed using field emission scanning electron microscopy (FE-SEM) for correlation with ALT doping levels and their strength data under the supervision of Dr. Amendola's graduate student, Madisen McCleary. This study will help to elucidate the mechanisms for strengthening and failure for the ALT doped NiO-YSZ.

Acknowledgements: Undergraduate Scholars Program (USP)

Brandon Bess: Mechanical & Industrial Engineering
Mentor: Randal Larimer, Walter Knighton – Electrical & Computer Engineering, Chemistry & Biochemistry
Zero pressure balloon design and construction

The basis on my research as an intern at the Montana Space Grant Consortium was to develop a way to enable the space grand to design and build there vary own high altitude, zero pressure balloons. This would allow for the creation of low cost balloons that could be custom built to achieve specific float altitudes with desired payload weights. My research included, first, doing research into the design process of zero pressure balloons such as material properties, flight profiles, basic fundamentals, and lessons learned by industry. The next steps were to develop a design and build plan for these balloons and finally build a couple and test how they preformed at altitude. In total, Three balloons were built over the summer of 2018, each balloon averaged around 150 m^3 in volume and achieved altitudes around 67,000 feet MSL with a scientific payload of approximately 6 pounds. These flights yielded large amounts of flight data and an interesting insight into the flight characteristics of natural, and cylindrical shaped zero pressure balloons as well as provided the MSGC with a viable means of developing and building there very own , custom built balloons.

Acknowledgements: Montana Space Grant Consortium (MSGC)

Mitchell Black, Amelia Gerry, Kyle Melton: Computer Science
Mentor: Clemente Izurieta, Kayte Kaminski – Computer Science, Education
The Compassion Project

The Compassion Project is a public, collaborative art installation sourced from approximately 10,000 artists around Bozeman. Each participating artist painted an 8”x8” wooden block with their own interpretation of compassion. To accompany their art, each artist wrote an artist statement defining compassion or explaining how their block relates to compassion. We created a mobile app as a companion to the installation. The primary usage of this app is to allow visitors to lookup the artist statement on their phone from the unique ID number assigned to each block. Additional app functionality includes favoriting pictures, personal user viewing history, and usage statistics. We also performed a comparative analysis of image descriptors for the blocks. The purpose of this is two-fold. We were interested in the idea using these image descriptors to group visually similar blocks together as well as analysing the effectiveness of using one image to search for another. We have images of each block to be used as a thumbnail when users look up a block. To evaluate which image descriptors are most effective at grouping the blocks, we took secondary photos of a subset of the blocks and tested whether the descriptors can pair the thumbnail of a block to our photo of a block.

Acknowledgements: The Software Factory

Mary Burr: Civil Engineering
Mentor: Ellen Lauchnor – Civil Engineering
Characterizing Unique Methanotrophs from the Deep Subsurface

Methane contributes to over 15% of our planet’s warming and is one of the most potent greenhouse gases in our atmosphere. Microbial methane oxidation is an important process that limits the release of methane by converting it into other byproducts. However, much is still unknown about microbial methane oxidation processes. Investigating microbial methane cycling in extreme environments and characterizing microbes that convert methane into valued products is of significant interest. In this work, samples of methane utilizing bacterial communities from the deep subsurface found at the Sanford Underground Research Facility (SURF), a former gold mine in South Dakota, are investigated. Methanotrophs are isolated from environmental samples and their growth and methane oxidation kinetics are characterized. We believe that one of our isolates is closely related to Methylomonas koyomae, but given that not much is known about this Methylomonas strain and the isolated microcosm that the isolate originates from, there is great significance in the novelty and in exploring the capabilities of this organism. Growth curves are created monitoring methane consumption, pH, and cell dry weight. These growth studies provide the basis for characterizing the growth and methane oxidation kinetics of unique strains from the SURF mine. Characterizing these unique methanotrophs has implications in the production of valued products– such as alcohols, organic acids, and bio-polymers– and in bio-remediation. The characterization of the growth and methane oxidation of these organisms must be understood in order to prepare for greater applications.

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Caitlin Carmody: Mechanical & Industrial Engineering
Mentor: Jim Wilking, Scott McCalla – Chemical & Biological Engineering, Mathematical Sciences
Chickensplash! Exploring the Health Concerns of Washing Raw Chicken

The Food and Drug Administration (FDA) recommends against washing raw chicken due to the risk of transferring dangerous pathogens through splashed drops of water. Many cooks continue to wash raw chicken despite this warning, however, and there is a lack of scientific evidence outlining the danger of microbe transfer through splashing. Here we use large agar plates to confirm that bacteria can be transferred from the surface of raw chicken through splashed water drops. We also show that faucet height, surface angle, and flow type affect splash height and distance. Using high speed imaging and MATLAB particle tracking to analyze splash trajectories, we found that increasing faucet height increases splash height and that angling the splash surface decreases the splash height in the direction the platform is angled. We are currently working to identify the bacteria transferred

using 16s sequencing. We anticipate that the information found in these experiments can be used to recommend safe household practices for washing raw chicken.

Acknowledgements: Benjamin Grodner (MSU Undergraduate Student) – Chemical & Biological Engineering, IDeA Network of Biomedical Research Excellence (INBRE)

Isaac Copeland: Mechanical & Industrial Engineering
Mentor: Cecily Ryan – Mechanical & Industrial Engineering
Plasticization of Bio-Degradable Polymers

The use of organic and vegetable oil-based plasticizers to plasticize the biodegradable polymer poly(3-hydroxybutyrate-co-3-hydroxyvalerate) (PHBV) are investigated with the end goal of producing viable 3D printing filament. PHBV is a thermoplastic biopolymer synthesized from bacterial fermentation and is of interest because of its biodegradability and renewable production. The effects of camelina and hemp oils, both vegetable oils, and tributyl citrate, an organic plasticizer, are studied. The effect of the plasticizers on processing and on material moduli are measured. The results show that the vegetable oils have a small plasticizing effect on the storage and loss moduli but were immiscible in the polymer matrix. Tributyl citrate has a larger effect on the moduli and is miscible in the polymer matrix, however doesn't provide enough processing advantages, or reduce brittleness enough to make viable 3D printing filament.

Acknowledgements: Undergraduate Scholars Program (USP)

Alex Cuevas: Chemical & Biological Engineering
Mentor: Bernadette McCrory – Mechanical & Industrial Engineering
Single-Site Laparoscopic Surgical Tool Optimization

Single-site surgery is a minimally invasive surgical technique where a single, small incision is made usually in the abdomen's umbilicus. All surgical instrumentation is inserted through this single-entry point to perform a variety of procedures. This technique has gained acceptance due to its comparable safety and patient outcomes with traditional multi-incision laparoscopic surgery among expert minimally invasive surgeons in various surgical specialties (general surgery, gynecology, urology, etc). Common procedures performed utilizing the single-site technique include appendectomy, cholecystectomy and partial nephrectomy. Many studies have demonstrated that single-site surgery is feasible for more complex procedure types (e.g., Nissen Fundoplication), but the technical challenges and learning curve posed for these procedures makes traditional multi-incision laparoscopy still the preferred technique. This study's purpose was to understand the restricted mobility and positional requirements of single-site surgery to generate innovative instrument designs to overcome these restrictions for more complex procedures. A two-phase study was conducted. First, a lightly-embalmed (fresh tissue) cadaver model was utilized to estimate in vivo mobility restriction and positional requirements of existing instruments. After extrapolation of these data, these results were combined with previous work quantifying instrument force requirements to develop novel, non-trivial design/redesign solutions for minimally invasive instrumentation specific to single-site surgery. It was discovered that for more complex procedures certain anatomical structures positioned further from the umbilicus require adaptive instrument designs (intracorporeal and/or extracorporeal) to better enable surgeon performance.

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Martina Du: Chemical & Biological Engineering
Mentor: Ross Carlson – Chemical & Biological Engineering
Applying Synthetic Biology Techniques to Engineer Microbial Ecology Systems

Most microorganisms live as interacting consortia. From medical chronic wounds to environmental nitrogen cycling in soils, microbial cross feeding is essential for ensuring the stability, resilience, and productivity of

communities. Most natural communities are complex, so replicating these critical multispecies interactions with defined, engineered cocultures can help to gain a better understanding of the exchange of nutrients such as amino acids and organic acids that help bacteria thrive. This synthetic ecology project examined the cellular economics of amino acid and organic acid exchange between obligate cross feeding *Escherichia coli* mutants by utilizing synthetic biology techniques such as gene knockouts. The studied coculture model was 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. The constraints of each strain forced an obligatory symbiotic relationship for survival. Three different lactose-positive, arginine auxotroph strains with varying degrees of acetate secretion were generated to test trade efficiency and consumption in the system. Data from planktonic coculture growth curves in M9 minimal media supplemented with lactose suggested exchange efficiency because cocultures with higher levels of acetate production yielded higher biomass productivity. It was hypothesized that this was a result of the removal of excess acetate by the arginine secreting strain, as excess acetate can inhibit growth. The data also indicated that unknown metabolites were being exchanged. Monoculture growth curves were performed with media conditions that complemented individual strain growth to identify these additional metabolites through techniques such as Nuclear Magnetic Resonance and High Performance Liquid Chromatography. Future work will include designing a bioreactor to quantify strain ratio in steady state and constant environments.

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Brian Foley, Chad Johnerson, Brandon Klise: Computer Science
Mentor: Clemente Izurieta – Computer Science
SmartParkU

Montana State University sells more parking passes than parking spots available each semester, which poses the following question for university commuters: Will I be able to find a parking spot in lot X today? SmartParkU will shorten commute time by providing users with parking spot availability in a specified lot. Image sets are utilized for each parking lot (taken from likely camera locations) to ensure total coverage of a lot. These images are processed using You Only Look Once (YOLO) by Darknet. We use the YOLO real-time object detection capability to identify and count the total number of vehicles in a lot and subtract that number from the total number of spots to return the number of available parking spaces. SmartParkU aims to reduce the time students and faculty spend commuting to campus, and results in a more timely arrival of the university's commuters.

Uciel Garcia: Electrical & Computer Engineering
Mentor: Randal Larimer, Walter Knighton – Electrical & Computer Engineering, Chemistry & Biochemistry
Sun Photometer for High Altitude Aerosol Profiling

As we rely on the use of products that release aerosol particles into the air, it is important to understand where these aerosol particles go and their concentration in certain areas. Nowadays, there are devices that can measure the aerosol levels in the air at low altitudes, however, this technology is static, expensive and requires high maintenance. As a solution, my research focus on looking for an alternative low-cost and low maintenance device that can be mounted into a high-altitude balloon or drone to help measure the aerosol particles at high altitude and create a profile for the area

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Evan Gilbert: Mechanical & Industrial Engineering
Mentor: Walter Knighton, Randal Larimer – Chemistry & Biochemistry, Electrical & Computer Engineering
Imaging of Water Droplets and Particulates at High Altitude

This project sought to investigate the size of water droplets and particulates at high altitude with updated technology. In order to image water droplets, past experiments made use of photography film and a flash bulb to leave a shadow of the droplet or particulate on film. However, this method requires a high degree of precision in manufacturing and operating the device. The new mechanism designed for this project made use of a Raspberry Pi miniature computer, the accompanying camera, and an LED light ring. The majority of components used in this project were custom designed and 3D printed from polylactic acid thermoplastic. An enclosure was designed to hold the device. The device consists of an assembly to move a plastic film carrying water droplets under a digital camera, a digital camera with an accompanying LED light ring and lens, and a Raspberry Pi to coordinate movement of the film and pictures taken by the camera. The enclosure was designed to fit in a standard BOREALIS payload container to be flown on a high altitude balloon. This project has not yet flown on one of the BOREALIS Balloons due to unfavorable weather conditions on launch days.

Acknowledgements: Montana Space Grant Consortium (MSGC)

Joseph Golichnik: Civil Engineering
Mentor: Jean Dixon – Earth Sciences
Quantifying sediment transport in mountainous catchments of W. Montana

Sediment transport and soil erosion are highly variable processes and require multiple tools to accurately quantify across both space and time. In this paper we explore one such tool, fallout radionuclides (FRNs), which have been widely applied to agricultural systems as erosion tracers but are underused in natural systems. We employ gamma spectrometry of FRNs in soil samples collected from small catchments in western Montana to quantify their sediment transport processes. We also use existing LiDAR data from the catchments to derive erosion estimates from Python's LANDLAB toolkit, which includes multiple modern landscape evolution models (LEMs). This paper compares the outputs of both methods and highlights the discrepancies between FRN analysis and computer-based LEMs when employed in small mountainous catchments.

Acknowledgements: Kailey Adams (MSU Graduate Student) – Earth Sciences, LeaAnne Harbour (MSU Undergraduate Student) – Earth Sciences, Undergraduate Scholars Program (USP)

Megan Guinn: Civil Engineering
Mentor: Joel Cahoon – Civil Engineering
Development and Hydraulics Testing of a Modified Denil Fishway

Optimizing fish passage around man-made stream barriers, for example dams or small irrigation diversions, is a priority of the Ecohydraulics group in the MSU Department of Civil Engineering. One focus is on smaller streams where water flows are low and make traditional fishways (sometimes called fish ladders) ineffective. The goal of this research project was to design, fabricate, and test a new fishway. The prototype is a modification of the traditional Denil fish ladder. The new fishway is smaller, lighter, and fabricated from commonly available materials. A small fishway is desirable in small streams where the total stream flow may not be enough to support the fishway flow in addition to the barrier function. A lighter fishway would be easier to install and maintain. Using common material to construct the fishway will reduce the cost. The new fishway was designed in CAD (Solidworks and Fushion 360). A prototype was built using the dimensions from the CAD model. As of this writing the prototype is undergoing hydraulic testing to assess water velocities and water surface profiles. The hydraulic observations will be contrasted against published values for traditional fishways and current knowledge of fish swimming capability to see if this is a promising approach and should be further developed and tested in a wider experimental design. If successful, the end product could enhance fish mobility and habitat access in basins where the traditional Denil fishway is ineffective.

Acknowledgements: Undergraduate Scholars Program (USP)

Embla Hagensen: Civil Engineering
Mentor: Katey Plymesser – Civil Engineering
Velocity Profiles in a Denil Fishway and the Implications for Fish Passage

In Montana, instream water diversions are necessary for agricultural purposes but are causing passage issues for Arctic Grayling and other Montana fish. MSU's Department of Civil Engineering researches how to optimize the Denil fishway in an effort to improve the conservation status of the Arctic Grayling. The purpose of this research was to find the preferred water inlet depth that maximizes the fishway success rate while minimizing the amount of water used. The research involved collecting centerline surface water elevations at 2-inch intervals for four inlet heights, as well as finding the velocities on a 2-inch grid at three cross sections for seven inlet heights. The research found that at inlet heights 1.18 ft and 1.34 ft a more negative velocity was located over the baffle notch. This negative velocity is assumed to be preferred by fish as it would help them swim upstream. The inlet depths between 0.85 ft to 1.01ft and 1.5 ft to 1.82 ft showed positive velocities which fish are likely not to prefer. The change in velocities reveals that there is an interval of inlet heights that support the fish moving upstream. This research was intended to help future engineers and scientist decide on what inlet height is best for the Denil fishway to optimize the passage of the Arctic Grayling while minimizing water use.

Acknowledgements: Haley Tupen (MSU Graduate Student) – Civil Engineering, Undergraduate Scholars Program (USP)

Ryan Hansen: Computer Science
Mentor: Brittany Fasy – Computer Science
Assessing Model Fitness Using Sheaves

Metabolism is commonly known as the biological process that sustains and develops an organism. The consensus model for metabolism is a system of stoichiometric equations, each with associated rates and metabolites. Data interpretation of such large systems is often subject to high variation and models are subsequently hard to verify. Our research focuses on reliable techniques to consolidate models and data, in particular when applied to metabolism. We find metabolism has a natural representation as a *sheaf* of sensor data. This representation grants us three useful analytic tools. First, we can quantify how well the model corresponds to measured data. The method is implemented with code written in MATLAB. Second, using an iterative process called a *consistency radius filtration*, we show how to determine which components, reactions or metabolites, of the model are responsible for the highest variation. We note these components may not be an accurate representation of the process being modeled. Third, we develop a method to construct a new model minimizing local error for the input data. The new model is identified by finding the nearest global section while constraining measurement assignments. We propose this new model is better for the given data than the previous model.

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Keaton Harmon: Mechanical & Industrial Engineering
Mentor: Randy Larimer, Berk Knighton – Electrical & Computer Engineering, Chemistry & Biochemistry
Ballast Drop and Vent Construction

Controlled flight of a weather balloon is a key aspect of directional flying. Being able to control the flight pattern of a balloon is advantageous for many reasons. One of these reasons is controlled descent. The ability to drop ballast and vent helium is critical for controlled descent. Dropping ballast will cause your balloon to raise in altitude and venting helium will cause the balloon to drop in altitude. Using these methods, we are able to control what wind layer the balloon will use to move about the atmosphere. Building a device that can perform these actions can help to perform certain experiments at certain altitudes or take pictures of something when you find a stationary wind layer. This also allows us to descend in a safe place away from hazards so that our payloads and equipment can stay safe. There are many possibilities that open when this device works properly.

Acknowledgements: Montana Space Grant Consortium (MSGC)

Kendra Hergett: Chemical & Biological Engineering
Mentor: Anja Kunze – Electrical & Computer Engineering
Optimizing surface coating on poly(dimethyl-siloxane) for neuronal cell shape studies

Neurons form a complex network in the brain through extending their cell bodies over several micro- to centimeter, building axonal and dendritic cell compartments, which form branches and synaptic connections. Electrical impulses, from one neuron to another neuron, are used to carry information through these networks throughout the brain. However, a variety of brain diseases may affect these impulses such as dementia, Alzheimer's Disease, or schizophrenia. The Kunze Lab focuses on finding treatments to these diseases using magnetic nanoparticles. To better understand how cells interact with magnetic nanoparticles, it is important to learn how the metabolic state of cells infers with nanoparticle uptake. Using microfabricated devices we found a way to force cells into a defined cell shape and aspect ratio, which has been shown to impact the uptake of nanoparticles. Our cell-shaping microdevices are fabricated in poly(dimethyl-siloxane) (PDMS) through photoresist-based master molding. The final cell-shaping microdevices have small microwells, in which E18 cortical rat neurons should get trapped in to take up adjust their cell body to the well. To promote high-throughput of spatial neuronal cell trapping surface coatings including poly-L-Lysine (PLL), pluronic solution, poly-ethylene-imine, and plasma treatment have been used in various combinations and been compared to PDMS stamping methods. Current results show highest amount of single cell trapping for coating of PLL in the wells and pluronic solution on the surface.

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Benjamin Holmgren: Computer Science
Mentor: David Millman, Brittany Fasy – Computer Science
Updating the R Package TDA

In the field of topological data analysis (TDA), one useful way to analyze data is by utilizing a technique known as persistent homology, which allows for the simultaneous study of homology in a topological space at multiple scales. Persistent homology can lead to the detection of features in a data set with differing persistence, assumed to indicate varying levels of statistical significance. As a result, persistent homology is useful in order to understand the topological structure of data, showing the overall trends and meaning of data in a relatively efficient, holistic manner. In order to apply these methods to actual data, major techniques in topological data analysis have been implemented in the R package 'TDA'. The R package has become a vital tool within the international TDA community, though it faces shortcomings in documentation. Throughout the academic year, I have been working to improve the documentation of the R package, both by creating self generating roxygen documentation in its internal R functions, as well as by creating markdown tutorials for important algorithms in TDA. My work in generating documentation for the R package has spanned the fundamental techniques in TDA including the distance function, k nearest neighbor density estimation, and kernel density estimation, as well as homology specific topics including Rips filtration, alpha complex filtration, and alpha shape filtration. In doing so, I have been fortunate to make important contributions for the long term feasibility of the R package, while simultaneously gaining familiarity with important concepts in TDA.

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Keola Jamieson: Civil Engineering
Mentor: Michael Berry – Civil Engineering
Feasibility of Non Proprietary Ultra-High Performance Concrete

Ultra High Performance Concrete (UHPC) is a classification of concrete with mechanical properties far superior to regular concrete. A standard concrete mix might have a compressive strength of 4,000 pounds per square inch (psi), while a UHPC mix could have a compressive strength of over 20,000 psi. Because of the high cost of commercial UHPC, it hasn't been widely used. However, over the past several years, MSU researchers have developed a more cost effective nonproprietary mix using materials available in Montana. The goal of the ongoing feasibility study is to determine if the nonproprietary mix can be adapted for use by the Montana Department of Transportation (MDT) for applications including joints in precast bridge decks. Many large and small scale UHPC mixes were prepared under varying conditions in the MSU Structural Engineering Labs. Variable material sources were used in order to replicate the many conditions in which the UHPC might be mixed in field applications. From these mixes, test specimens were cast and tested at 7, 28, and 365 day intervals. The dataset from these mixes will help MDT prescribe adequate mix designs and specifications for use in the field.

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Ethan John: Chemical & Biological Engineering
Mentor: James Wilking – Chemical & Biological Engineering
Coalescence of Human Gastric Organoids

Human gastric organoids (HGOs) are microscale, spherical tissues that mimic fully-developed stomachs. In the last several years, they have attracted attention for their utility in the study of organ development, the gut microbiome, as well as the potential for use in the development of transplantable tissue. HGOs are cultured from fragments of gastric epithelial tissue to form a tissue shell that contains many of the various cell types found in fully-developed organs and encloses fluid in an inner lumen. HGOs observed with time-lapse confocal microscopy are dynamic and undergo a variety of unexpected behaviors including rotation, periodic rupturing, and coalescence1. Here we focus on HGO coalescence events, which are rare, occurring for only 1% of all organoids observed. HGO coalescence could have significant applications in tissue engineering, but little is known about the mechanisms driving HGO coalescence. We begin by conducting analysis of time-lapse microscopy videos. Coalescence appears to occur in four general steps: contact, attachment, hole formation, and merging into a larger sphere. While initial attachment is likely governed by biological factors, the flow of fluid and changes in shape can be explained by physical phenomena. Thus, we focus on the last two steps. We measure transfer of luminal contents following hole formation and find that the volumetric flow rate from one HGO to another decays exponentially, with a characteristic time on the order of hours. This suggests that the flow is likely governed by the viscoelastic properties of the HGOs and the surrounding Matrigel. We expect that these observations will guide future experiments in which HGOs are placed in specific locations to increase the frequency of coalescence and increase the maximum size of gastric organoids. Knowledge gained from these studies may also contribute to a better understanding of the biological factors governing organoid coalescence.

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Khristian Jones, Erik Gilbertson, Abigail Stroh: Electrical & Computer Engineering
Mentor: Bradley Whitaker – Electrical & Computer Engineering
The Application of Machine Learning in Disease Detection and Diagnosis

Sepsis is an often overlooked illness despite killing 250,000 people in the U.S. each year. Sepsis is caused when a person's immune system develops an extreme response to an infection. This causes it to fight not only the infection but also the person's organs. If untreated, they can go into septic shock with an approximate mortality rate of 50%. This makes early detection vital to a patient's survival. Since January 1, 2019, there have been 34,305,620 people admitted to hospitals in the U.S. alone. Doctors see many patients each day, so the faster they can diagnose them the better. In 2018, a neural network demonstrated the effectiveness of 85% for diagnosing

and detecting Atrial Fibrillation, and it took only a few seconds to run. While it's still not accurate enough to release clinically, it shows that neural networks can be an effective method for patient diagnosis in hospitals. For our research project, we wanted to develop a similar neural network that would be used to diagnose Sepsis. Our neural network is split into three parts: a feature extractor, a feature learner, and a classifier. Using this architecture for our neural network and training it with a public database of hour by hour biometric data taken from an ICU, we plan to beat hospital detection times of sepsis by 6 hours with minimal false positives. By using an hour by hour database, we hope to increase our programs portability to other disease detection applications. If all is successful, we will have a program that could help in reducing detection times of Sepsis by simple biometric data input.

Acknowledgements: IDeA Network of Biomedical Research Excellence (INBRE)

Derek Judge: Electrical & Computer Engineering
Mentor: Anja Kunze – Electrical & Computer Engineering
Neural Network Communication Alteration from Neurite Growth Guidance

The breakdown or alteration of a neural network due to neurodegenerative diseases or nerve severances can be halted or even reversed with the assistance of physical growth stimuli. By designing a magnetic gradient to apply a magnetic force to an entire cell culture simultaneously, the effects of guiding the growth of neurites as well as the impact upon the network communication can be observed. A holder for an array of permanent NdFeB magnets was 3D printed and used to create the magnetic gradient, which acts upon chitosan-coated nanoparticles which are taken into the cell. After an incubation period, the neurites lengths and directions were observed and measured using a combination of a Leica microscope and the Simple Neurite Tracer plugin in FIJI. The neurites have shown preferential growth towards the direction of the magnetic force, with a slight decrease in neurite growth rates. The connectivity of a culture can be determined by monitoring the electrical impulses picked up by a microelectrode array (MEA) and looking for correlations between the action potential firings of individual neurons. The connectivity of a neural network is closely associated with the communication, and the network should show preferential firing towards and from the direction of the magnetic force, which can be quantified in Matlab.

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Hammad Khan: Electrical & Computer Engineering
Mentor: Anja Kunze – Electrical & Computer Engineering
Fine-tuning Agarose Concentrations for Soft-gel Neuro-microfluidics

Biological hydrogels made from collagen, agarose, and other polymers are commonly used to establish in vitro cell to cell systems. In particular, agarose-based micro-patterning techniques offer enhanced stability for cell growth and provide flexibility in fabricating microchannels for directed neurite growth. To test an agarose micro-patterning technique for localized neuronal cell growth, we developed a method to fine-tune the optimal agarose concentration for highly reproducible pattern fabrication and guided neuron growth. Various agarose concentrations, injected with fluorescent microparticles for visibility, were prepared ranging from 0.5% to 3% (w/v). The agarose was then dropped onto a Petri dish coated with polyethyleneimine (PEI) to ensure surface adhesion between the polystyrene and agarose gel. Embryonic cortical rat neurons were seeded adjacent to the agarose drops and cultured for two weeks. Using inverting microscopy we quantified a growth repellent effect of agarose. Calcium florescent imaging was performed to observe cell to agarose interactions. We found that increasing agarose concentration incrementally reduced neurite growth into the agarose supporting a growth repellent effect that can be further implemented for neurite growth guidance. This approach refines the optimal agarose concentration for prevention of neurite growth and will be a powerful tool for implementation of neurological functional cell assay studies, cell patterning and axon guidance.

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Whitney Kieffer: Chemical & Biological Engineering
Mentor: Ellen Lauchnor – Civil Engineering
Bacterially influenced leaching of metals from mine tailings

Mine tailings, a waste product from mining processes, consist of finely pulverized rock which can leach heavy metals into surface and ground waters. Use of microbially induced calcite precipitation (MICP) as a remediation strategy for tailings was previously investigated at the Center for Biofilm Engineering; a significant amount of copper leached from the tailings when MICP was used. The objective of this study was to investigate the mechanism of copper leaching from mine tailings in the presence of bacteria and to identify conditions which optimize and impede copper leaching. Batch tests were run to compare the effects of native ureolytic bacteria native and Bacillus subtilus on the leaching of copper. These trials were run with uninoculated controls and various solution chemistries. The supernatant was tested for dissolved copper concentration using inductively coupled plasma mass spectrometry. Copper leaching was observed in every trial, including controls that were not inoculated with any bacteria, indicating that it is not solely a biologically driven process. However, the presence of bacteria could act as a catalyst in the dissolution of copper. In addition, it was determined that the presence of ammonia in the feed solution increased the amount of copper leaching in every trial.

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Andy Kirby: Electrical & Computer Engineering
Mentor: Anja Kunze – Electrical & Computer Engineering
Verification of Synchronous Microelectrode Array Recording and Calcium Imaging of Neuronal Activity

Electrophysiological and chemical processes are used by neurons for signal propagation, creating an intricate environment for network development and communication. Understanding the full complexity of the brain relies on the observation of this neuronal communication. The widely studied action potential–an electrical impulse sent along axons–has been found to trigger voltage gated calcium channels, influencing calcium dynamics. Methods exist to measure both of these processes separately, including patch clamping, multielectrode arrays (MEAs), fluorescent probes, and live cell microscopy, but each have their respective spatial or temporal limitations. Synchronous MEA recording and calcium imaging is a relatively novel tool that captures both activities and allows for more complex analysis. We have developed a protocol along with automated software to extract spike trains from synchronously recorded MEA waveforms and calcium imaging data, perform analytics on the correlation between MEA and calcium spike events, and quantify the correlation between the signals. This automated software, in combination with synchronous MEA recording and calcium imaging, is a faster, more powerful tool to study neuronal signal communication under a diversity of chemical and mechanical stimulations.

Acknowledgements: IDeA Network of Biomedical Research Excellence (INBRE)

Dylan Ladd: Chemical & Biological Engineering
Mentor: Nick Stadie – Chemistry & Biochemistry
Decaborane as a Precursor in Boron-doped Graphitic Carbon Synthesis

This work investigates heteroatom doping of graphitic carbon from a specific boron precursor, decaborane, with the overall goal of producing a material, BC_3, of high crystallinity and high boron incorporation in the carbon lattice. First, benzene-decaborane solutions were pyrolyzed at various temperatures in evacuated ampules. The series of temperature-varied samples was characterized using Raman spectroscopy, X-ray diffraction, and scanning electron microscopy. The results were used to deduce the optimal pyrolysis temperature for the synthesis of highly ordered BC_3. Second, Lewis bases (e.g., pyridine) were introduced to decaborane solutions to assist in cracking of the decaborane molecular structure. These solutions were pyrolyzed and characterized as above. The inclusion of nitrogen in pyridine-BC_3 samples is also assessed. Future experimentation based on these findings is discussed.

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Brett Layman: Computer Science
Mentor: Clemente Izurieta – Computer Science
Artificial Life Agents

Artificial Life Agents is an ecologically inspired system for training neural network-based agents to adapt to limited resource environments. The agents are able to move through a two dimensional space, where they can detect and consume resources in order to survive. They evolve via reproduction and natural selection, where the weights of their neural networks are treated as their genetic material. The neural networks guide agent behavior by receiving inputs from the environment, other agents, and the agent's internal state, and producing outputs that correspond to actions such as movement, reproduction, and resource consumption. One goal of the system is to observe improvements in agent behavior as the networks evolve. Eventually, the system will be capable of producing cooperative and competitive behaviors between agents. The project is being developed with the Unity game engine and the C# programming language. The program runs separate threads for the simulation and the front-end display. The user is able to set parameters, and run the simulation with a specific time interval between each rendering of the system. Upon each rendering, the user is able to see the positions of the agents on the 2D grid, as well as resource levels.

Christian Lewis: Chemical & Biological Engineering
Mentor: Brent Peyton – Chemical & Biological Engineering
Nutrient-Induced Accelerated Growth of Microalgae

Microalgae are microscopic algae that can be found in freshwater and marine systems. Laboratory experiments have shown that algal biofilms can be used as a way to photosynthetically produce biomass and associated algal byproducts. The alga proposed for this research is Haematococcus pluvialis, due to the high concentration of intracellular astaxanthin. H. pluvialis grows in two phases; the green phase in which cell growth occurs and the red phase in which astaxanthin is produced and rapidly accumulated in cells that are in environmentally unfavorable conditions. Previous research found that the addition of sodium bicarbonate along with nitrogen starvation increased lipid production in microalgae. The research proposed aims to examine different concentrations of sodium bicarbonate at the beginning of the green phase to increase cell growth and a sodium bicarbonate amendment at the start of the red phase to increase astaxanthin accumulation. Here it is shown that using such methods, the final concentration of astaxanthin was increased by a factor of three. The control with 2.24 ï,± 0.23 mg/L and the initial 2.5mM bicarbonate solution with 6.70 ï,± 0.89 mg/L. It was found that the trials initially with sodium bicarbonate contributed to higher cell growth rates and higher cell concentrations going into the red phase. These higher concentrations allowed for more astaxanthin to be produced. There is some uncertainty as to the reason this occurred because the addition of sodium bicarbonate increased pH. Current research on this project aims to control pH to eliminate uncertainty.

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Collin Lindeman: Electrical & Computer Engineering
Mentor: Randal Larimer, Berk Knighton – Electrical & Computer Engineering, Chemistry & Biochemistry
Improvement of Ground station Tracking

This presentation reports on research done on the ground station tracking system used by Montana Space Grant Consortium over the summer of 2018. The tracking system uses GPS coordinates including altitude and bearing to point two antennas towards the launched payloads as they travel in the lower atmosphere and collect data. The tracking system in question had an ability to by both manually and automatically updated by the personnel handling the ground station, but it would not hold the manually entered offsets once the automated tracking was reinitiated. This was a limiting factor to the design, so modifications were deemed necessary. I came forward to work on the design of the code that controlled how the system kept track of the offsets used by the manual inputs

and then applied those to the initialization of the automated tracking. This resulted in a tracking system that could be manually calibrated within a small degree of error in a controlled environment before launch which then led to better data being received by the ground station for longer. This allowed for more projects to be possible that require longer stretches of time to be considered credible data and opened up the possibilities to upgrade the code design in more ways. While the modifications done to the code were helpful, I do believe that there is plenty of room for further enhancement in both what was modified and the original design.

Acknowledgements: Montana Space Grant Consortium (MSGC)

Francis Loviska: Mechanical & Industrial Engineering
Mentor: Joseph Seymour, Sarah Codd – Chemical & Biological Engineering, Mechanical & Industrial Engineering
NMR Investigation of the Microphysical and Structural Properties of Ice

This project investigates how colloids, small particles evenly dispersed throughout a media, affect the structure of ice molecules during freezing. Freezing colloids in Martian soil (known as regolith) are extremely important when forming models of Martian climate since the effects of these stable ice mixtures are relatively unknown. Using nuclear magnetic resonance, this research has found that for samples frozen between -2Â°C and -25Â°C, pore size will decrease, and pore density will increase at high current speeds. This research has also discovered the NMR signatures for surface to volume ratio, unfrozen water content, and tortuosity of unfrozen water veins. These signatures have been recorded using PMMA beads to simulate the Martian soil. Three different sizes of PMMA beads (0.4 Âµm, 39 Âµm, and 102.2 Âµm) were used to detect variations in NMR readings. Future research will investigate the effects of ice-binding proteins on the formation of ice. Ice-binding proteins are present in all living organisms and affect the formation of ice by rounding ice molecules to slow ice growth. Once the effects of ice-binding proteins on NMR signatures are known, future nuclear magnetic resonance instruments on extra-terrestrial icy bodies, such as Europa or nearby comets, can determine if one of the building blocks of life is present.

Acknowledgements: Peng Lei (MSU Graduate Student) – Chemical & Biological Engineering, Undergraduate Scholars Program (USP)

Katie MacLeod: Civil Engineering
Mentor: Kevin Hammonds – Civil Engineering
A comparison of snow density measurement techniques for hydrological research and remote sensing applications

Density is a fundamental property of snow that is influenced by the snow microstructure, can change as a function of time, and has implications in a variety of scientific fields. Snow density is used as a parameter to understand and apply the physical properties of snow, and its accurate measurement is of critical importance to avalanche forecasting, snow remote sensing, and hydrology modelling. Snow density has traditionally been measured in the field using gravimetric methods; these techniques are time-consuming, prone to variability, and extrapolate small samples of data to represent large spatial areas. The objective of this work was to compare density measurements from a recently developed near-infrared (NIR) probe to established methods of snow density measurement. The Lyte Probe, currently in development by Realtime Adventure Data, proposes a new method of determining snow parameters, including density, using near-infrared reflectance in the place of traditional snow profile methods. Field data from manual snow profiles at multiple sites in south west Montana was compared to stratigraphy profiles produced by the Lyte Probe. In the Subzero Research Laboratory on the MSU campus, near-infrared probe density measurements were directly compared to other methods currently employed in snow research, including the Snow Micro Penetrometer and x-ray computed microtomography. This study provided an opportunity to quantitatively analyze current near-infrared technology for snowpack analysis, and to assess the utility and potential of such instruments to improve the accuracy of observation technology for researchers in numerous fields related to snow and climate science.

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Anna Martinson: Chemical & Biological Engineering
Mentor: Adrienne Phillips, Arda Akyel – Civil Engineering, Chemical & Biological Engineering
pH Controlled UICP

Leaking CO_2 sequestration sites and orphaned natural gas and oil wells inhibit society's attempts to reduce global warming. One method to seal subsurface leakage pathways is urease induced calcium carbonate precipitation (UICP), a method of biocement production. The biocement formed through UICP has been shown to decrease permeability of subsurface leaks in concrete, however, the current method allows calcium carbonate to form while traveling to the fracture. UICP in undesired locations could clog the pathway rather than the fracture. The generation of biocement decreases at low pH conditions with a significant decrease in precipitation at pH conditions lower than 6. Meanwhile, the process of urea hydrolysis increases the pH of its surroundings. Using this information, UICP can be controlled by designing a method to control the pH. UICP solutions at a pH too low for significant amounts of calcium carbonate precipitate could be transferred into deep subsurface fractures. The pH of the UICP solution would increase at a predetermined rate. When the UICP solution reaches the fracture, the pH should be high enough for significant precipitation to begin. While traveling, the buffer solution and pH must be high enough not to denature the urease enzyme, but low enough to significantly slow down the biocement production rate. From this research, ureolytic activity was shown to stop at pH conditions lower than 4.1 from a plant source and at 4.8 for *S. pasteurii* source. With an engineered buffer and a flow rate, UICP would be able to occur only at desired locations.

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Benjamin McHugh: Mechanical & Industrial Engineering
Mentor: Roberta Amendola – Mechanical & Industrial Engineering
Influence of Redox Cycling on the Mechanical Properties of Solid Oxide Fuel Cell Anodes

Clean energy has quickly become a focus in today's society as the world strives for an increasing energy demand. Solid oxide fuel cells (SOFCs) are a source of clean energy that produce power through an electrochemical reaction with heat and water as by-products and minimal carbon dioxide emissions. What makes a SOFC promising is opportunity for fuel flexibility meaning traditional oil based (e.g. methane) or even advanced renewable fuels like hydrogen. The SOFC is based on the common battery principle consisting of two poles (the cathode and anode) and a connecting electrolyte which are all ceramic materials. One major cause of SOFC failure that is keeping them from commercialization is their inherent brittleness. In the working conditions, SOFCs experience reduction and oxidation cycles that may be responsible for chemical changes within the material which then could decrease the system lifetime and eventually cause catastrophic failure. This research aims to increase the lifetime and improve the strength of common SOFC materials used to fabricate anodes. Such goals are achieved through the addition of small amounts (1-10wt. %) of a selected compound (Aluminum titanate) to the standard anode composition without altering the state-of-the-art manufacturing process. Mechanisms responsible for the development of secondary compounds responsible for the overall improvement of the material's behavior will be presented and discussed.

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Carter McIver: Mechanical & Industrial Engineering
Mentor: Cecily Ryan – Mechanical & Industrial Engineering
Sustainable Natural Fiber Composites for 3D Printing

Increasing concern for the environment is driving the development of sustainable polymers and composites as alternatives to non-renewable materials. Incorporation of naturally occurring fibers into natural fiber composites (NFC) can improve the mechanical properties of plastics while also providing environmental and economic

benefits. These fibers are embedded in reprocessed petrochemical plastic matrices such as polypropylene or in fully bio-based matrices, such as bio-derived polyethylene, to form green-composites. There are several choices for fibers used in NFC, with wood as a particularly cost-effective byproduct widely used in wood-polymer composites (WPC). WPC are commonly used in applications such as decking and cladding, and also used in automotive, packaging, and construction industries. Today there are few NFC and WPC products that can be used in 3D printing applications, although this manufacturing process is projected to grow rapidly over the next several years. Technological improvements have enhanced the mechanical properties of NFC, although durability remains a concern. Natural fibers are susceptible to absorbing moisture which can be exacerbated by freeze-thaw cycles in certain environments. This absorption can cause deterioration leading to degradation of the material properties. This work explores the mechanical properties of NFCs of interest for processing via additive manufacturing in applications requiring environmental durability.

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Paysen McKeehan: Chemical & Biological Engineering
Mentor: David Hodge – Chemical & Biological Engineering
How Crystallinity Impacts the Kinetics of Acid Hydrolysis of Cellulose

Cellulose comprises the largest fraction of plant cell walls and is the most abundant natural polymer in the biosphere. As such, cellulose represents an enormous resource of renewable carbon. As abundant as cellulose is, creating new ways to utilize cellulose can be beneficial. Although, currently, selectivity is low, commodity chemicals such as levulinic acid and formic acid can be produced by subjecting cellulose to a strong acid via the chemical process of acid hydrolysis. As with enzymatic hydrolysis of cellulose, the kinetics can be changed by manipulating the crystallinity of cellulose. Cellulose is comprised of crystalline regions that are highly resilient to biological and chemical conversion. To decrease the crystallinity of cellulose, Avicel PH-101 was subjected to concentrated phosphoric acid to create a regenerated amorphous cellulose called phosphoric acid swollen cellulose (PASC). Both forms of cellulose were then put under the same reaction conditions, in which the products were analyzed using high-performance liquid chromatography (HPLC), in order to determine which form of cellulose boasts a quicker reaction rate. However, if run at certain conditions, the desired products will react further to create an unusable polymer called humins. To determine the optimal conditions to maximize the yield of acid hydrolysis of cellulose, PASC was subjected to multiple sets of reactions in which one condition was changed, such as acidity, temperature, and time.

Kelsey Moorhouse: Mechanical & Industrial Engineering
Mentor: Sarah Codd, Joseph Seymour – Mechanical & Industrial Engineering, Chemical & Biological Engineering
Ripening of Ice crystals in Ice-Brine Systems

In ice-brine systems such as the arctic ocean water molecules freeze to form ice crystals, saturating the surrounding fluid with salt. This creates brine channels between the crystals that promote convection and may host micro-organisms. Over time, the crystals change size and shape, a process called Ostwald Ripening. This change in ice crystal structure was studied with microscopic photography and MATLAB quantitative analysis. Micro-particles were also introduced into the system in order to observe whether the crystal ripening is affected by small particles. The effect of micro-particles on ice-brine systems was observed with microscopic photography in tandem with nuclear magnetic resonance (NMR) studies done independently of this project.

Acknowledgements: Undergraduate Scholars Program (USP)

Alexis Ostwalt: Chemical & Biological Engineering
Mentor: Joseph Menicucci, Stephanie McCalla – Chemical & Biological Engineering
Exploring the Effects of Point Defects in Self-Assembled Monolayer Systems

Due to their flexible chemical functionality and simple formulation, self-assembled monolayers (SAM) on nanoparticles are ideal for a variety of applications, such as drug delivery. An issue in the preparation of SAMs is naturally occurring defects, which molecular dynamics simulations don't take into account; therefore, there are discrepancies between simulation and experiment. Alkanethiols of different chain lengths were explored because they display different levels of order. Molecular dynamics simulations were used to randomly implement point defects into ideal planar SAM systems where the ligand order and hydrophobicity were measured. Understanding the effects of hydrophobicity on SAM surfaces can help predict their behavior in biological systems. The fraction of trans dihedrals was used to quantify ligand order of the SAM surface and ligands surrounding the defect. Butanethiol is an initially disordered system, and dodecanethiol is ordered. Octanethiol is in an order-disorder transition where the ligand order drastically increases between 5 and 6 methylene groups in the SAM. The goal was to add defects into the SAM systems to minimize the ligand order gap between simulation and experimental. Initially disordered systems showed minimal changes in overall ligand order as defects were added, and there was no correlation between ligand order and distance from the defects. Initially ordered systems displayed a steady decrease in overall ligand order and a consistent decrease in order for surrounding ligands as defects were added. The hydrophobicity was calculated using chemical potential; it was found that the defect locations and surrounding areas were likely to be more hydrophilic, whereas the rest of the SAM surface was more hydrophobic.

Acknowledgements: Brad Dallin (Non-MSU/Other) – Chemical & Biological Engineering, National Science Foundation

Simone Paul: Chemical & Biological Engineering
Mentor: Wan-Yuan Kuo – Health & Human Development
Improving the Textural Stability of Gluten-Free Granola: A Collaborative work with the MSU Farm to Campus Initiative

The purpose of this project is to improve the textural stability of the gluten-free granola made by a local vendor, Gluten-Free Prairie (Manhattan, MT). This project has partnered the MSU Food Product Development Lab, the MSU Farm to Campus Initiative, and Gluten-Free Prairie. At the beginning of this project the texture of the gluten-free granola was not stable due to two major reasons. First, the oats crumbled to powders. Second, the coconut flakes were too small to mix well with the granola clusters. The crumbled oat powders and coconut flakes, therefore, settled in the bottom of the dining hall dispensers. A modified recipe has been developed that has an agave, honey, and brown sugar mixture to provide better binding effect of the granola clusters and to avoid oat crumbling. In addition, the small desiccated coconut flake has been replaced with a larger coconut flake that doesn't sink to the bottom as easily and thus binds to the granola clusters more thoroughly. The recipe modifications have been analyzed using a texture analyzer. The crunchiness, expressed by the jagged-smooth ratio from the texture data, was significantly higher in the modified granola sample. This suggests greater textural stability in the modified granola compared to the original. On April 4th a sensory study will be held to evaluate the consumer acceptance of the modified product. 120 participants will sample 7 different granola variations and give feedback on a 9-point scale. This data along with texture analysis data will be combined to present a new product to Gluten-Free Prairie and the Farm to Campus coordinators by May. The goal is to have this new product served in the dining halls across campus.

Acknowledgements: Undergraduate Scholars Program (USP)

Jazzlyn Pulley: Computer Science
Mentor: Clem Izurieta – Computer Science
VibeTribe

VibeTribe was founded on the idea that everyone should have the ability to share their feelings through music anytime anywhere and with whomever they want. This idea lit a fire that propelled the creators of the company to invent a new way that individuals could send their favorite portions of songs corresponding with anything going on in their lives to whomever they want. VibeTribe is a new form of social media that is based on music. An article

focusing on the potential for music-based social media platforms says “In the age of mixtapes, music lovers want to know what their best friends were listening to. Today, they want to connect with their favorite influencers and brands in the same way.” [1] Users with a Spotify Premium account are able to search any song from the Spotify Application Program Interface (API), and share a 5-20 second clip of a song with friends and family. The main objective through music sharing and discovery is to bring people closer together, as well as creating a new level of global messaging. Currently we have the ability to share photos with Instagram or even our current thoughts via Twitter, but there is no media to share one of the biggest aspects of our everyday lives: music. The web application is currently implemented with a MERN Stack and has the ability to search for any song available on the Spotify API and then play any portion of the song.

Acknowledgements: Undergraduate Scholars Program (USP)

Jacob Rotert: Chemical & Biological Engineering
Mentor: James Wilking, Phil Stewart – Chemical & Biological Engineering
Fabrication of Custom Microfluidics for Biofilm Investigation in Crevices

The goal of this project is to investigate if bacterial biofilms are protected from disinfectants or antibiotics when they form in recesses or crevices that are sheltered from the main fluid flow path above the biofilm. This research could provide new insight into strategies on how to remove detrimental biofilm from pipe systems or equipment. To investigate this problem, custom microfluidic devices were fabricated that include deadlegs perpendicular to the main flow channel. The short and inexpensive fabrication process involves sketching a design in a CAD software, transferring the design to a computer-controlled laser cutter, and cutting three pieces from acrylic sheets. These pieces are then solvent bonded together using a mild solvent along with pressure and heat. Pin connectors for tubing are sealed into ports in the device and microfluidic tubing is attached to allow flow in and out of the device. Flow tests have been performed to visualize the fluid path and exchange of different fluids in the device. In the future, Staphylococcus aureus bacteria will be inoculated into the device, allowed to grow for a period, and then treated with bleach or an antibiotic to observe local antimicrobial action and biofilm persistence.

Acknowledgements: Tom LeFevre (MSU Graduate Student) – Chemical & Biological Engineering, Undergraduate Scholars Program (USP)

Tristan Running Crane, Uciel Garcia, Brandon Bess: Electrical & Computer Engineering, Mechanical & Industrial Engineering
Mentor: Randal Larimer, Berk Knighton – Electrical & Computer Engineering, Chemistry & Biochemistry
Sun Photometer for High Altitude Aerosol Profiling

As we rely on the use of products that release aerosol particles into the air, it is important to understand where these aerosol particles go and their concentration in certain areas. Nowadays there are devices that can measure the aerosol levels in the air at low altitudes, however, this technology is static, expensive and requires high maintenance. As a solution, my research focus on looking for an alternative low-cost and low maintenance device that can be mounted into a high-altitude balloon or drone to help measure the aerosol particles at high altitude and create a profile for the area

Acknowledgements: Montana Space Grant Consortium (MSGC)

Petria Russell: Chemical & Biological Engineering
Mentor: Connie Chang – Chemical & Biological Engineering
Encapsulation of Single Bacterial Cells in Alginate Hydrogels

Biofilms, or assemblages of bacteria held together with an extracellular polymer matrix, exhibit properties that can be useful or detrimental to human activities. Biofilms can also be exploited to generate bioproducts or perform functions such as wastewater treatment, while medical biofilm infections can exhibit much higher levels of

antibiotic tolerance than free-floating cells. Some of the unique properties of biofilms arise from the complex intercellular interactions that occur in assembled communities of microbes. The ability to precisely engineer biofilm models by arranging single bacterial cells within a matrix may be a powerful tool for better understanding these interactions within a biofilm. Hydrogels, or water-soluble polymer chains that can be crosslinked to form a gel, can mimic the structural features of the biofilm matrix. This project selects and refines a method for the immobilization of Escherichia coli cells in alginate hydrogel microspheres while maintaining high cell viability. A microfluidic device is used to manipulate small volumes of an E. coli cell suspension containing alginate and an oil phase to produce monodisperse alginate spheres containing E. coli. It was found that the properties of ion chelating molecules can be exploited to crosslink alginate polymers into a gel after drop formation. Because the process occurs at constant pH and temperature, high cell viability is maintained. Additionally, cell and polymer imaging challenges are addressed with synthesis of fluorescently labeled alginates. Encapsulating and imaging single bacterial cells hydrogel microspheres is an important first step for controlling the spatial arrangement of single cells in engineered biofilms.

Acknowledgements: Shawna Pratt (MSU Graduate Student) – Chemical & Biological Engineering, IDeA Network of Biomedical Research Excellence (INBRE)

Anthony Savoy: Chemical & Biological Engineering
Mentor: David Hodge – Chemical & Biological Engineering
The Effect of Varying Alkaline Pretreatment Reaction Coordinates on Woody Biomass

The purpose of this project was to analyze how varying reaction coordinates effected alkaline pretreatment yields and lignin properties. The goal of this work was to generate reaction coordinates that optimize both the severity of the reaction as well as producing higher yields. All reactions took place in Teflon tube reactors a silicon oil bath. The biomass consisted of three strands of wood: two hybrid poplars and one willow. The reactions coordinates tested varying alkaline loadings of 0.1 g/g biomass, 0.15 g/g, and 0.2 g/g, a temperature range of 90-150 0C, a reaction time range of 15min-5hours, and solid liquid ratios of 10 wt%, 15 wt%, and 20 wt%. An optimal set of reaction coordinates consisting of an alkaline loading of 0.1 g/g biomass, 10 wt%, 1 hour, and 110 0C were obtained and were then scaled up to maximize extraction yields. The extracted precipitates (containing mostly lignin and some xylan) from these bulk reactions then underwent GPC and NMR analysis to characterize the average molecular weight of the extracted lignins, β-O-4 content, and other functional groups of interest. This information helped illustrate the extent of lignin depolymerization that can be achieved for each strand of biomass. Further work will consist of researching the extent of depolymerization of industrially produced lignin in an ethanol-water mixture by characterizing the extracted lignin's properties using GPC and NMR analysis. In addition, the extracted lignin's solubility in propylene carbonate, methanol, DMSO, THF, acetone, ethyl acetate, and water will also be investigated.

Acknowledgements: Sandip Kumar (MSU Postdoc/Research Scientist) – Chemical & Biological Engineering, Undergraduate Scholars Program (USP)

Derek Snyder: Civil Engineering
Mentor: Otto Stein – Civil Engineering
Cold Temperature Nitrification in Constructed Wetlands

Research at Montana State University and other locations has demonstrated that treatment wetlands (TW), engineered wetlands specifically designed for domestic wastewater treatment, are a viable option for secondary wastewater treatment. Secondary treatment involves the biological removal of dissolved organic matter and nutrients using microbial communities. One of the most important removal processes is nitrification, which transforms ionized ammonia to nitrate. We know that treatment wetlands can efficiently perform nitrification at temperatures down to about 4ºC from studies using the pilot-scale TW at the Bridger Bowl Ski Area. While the general efficacy of TW in cold temperatures has been demonstrated by this system at Bridger Bowl, the Montana DEQ has expressed interest in a study of nitrification rates in constructed wetlands at near freezing

temperatures. The goal of this project is to test nitrification rates in TW at temperatures below 1ºC to see if, or at what temperature, there is a decline in nitrogen removal efficiency. Nitrification rates will be examined in preexisting TW "columns" housed in the Sub-zero Laboratory. The potential implications of this project are widespread. If it can be shown that treatment wetlands effectively perform nitrification at extremely cold temperatures, one of the final regulatory barriers to more widespread application of TW technology in Montana will be removed, improving wastewater treatment in rural cold weather regions in Montana and beyond.

Acknowledgements: Undergraduate Scholars Program (USP)

Tara Sundsted: Chemical & Biological Engineering
Mentor: Stephanie Wettstein: Chemical & Biological Engineering
Heterogeneous catalysts for lignocellulosic biomass upgrading

New initiatives for reducing adverse environmental impacts in chemical and fuel manufacturing propagate for the development of novel refining strategies using renewable feedstocks. Most research on lignocellulosic biomass focuses on upgrading the sugars and platform chemicals produced after pretreatment; however, a major opportunity exists in improving the pretreatment step and potentially combining pretreatment with upgrading. Currently, the most common processing methods are aqueous-based, which lead to low yields and low concentrations due to the formation of unwanted by-products. Since biomass feedstock costs make up 60-70% of the production costs, efficient pretreatment of the lignocellulosic biomass is necessary to compete with traditional petroleum and chemical production processes. Recently, interest has risen in using organic solvents for renewable chemical production. For example, it was found that using gamma-valerolactone (GVL), water, and small amounts of acid led to solubilization of all parts of the lignocellulose, leaving trace amounts of filterable solids. Additionally, solubilizing the biomass allowed the aqueous acid commonly used for hydrolysis to be replaced with solid acid catalysts, such as SAPO-34, a zeolite. Small pore powdered zeolites with their tunable acidity and chemical and thermal stability have achieved furfural yields as high as 63% from xylose. Hybrid, composite materials, such as SAPO-34/5A zeolite beads, offer an industrially relevant option. The rational design of these composite catalysts could lead to increased furfural yields from biomass and model sugars. This presentation will show how different heterogeneous catalysts can be used in biomass upgrading resulting in high yields and easily recoverable and recycled catalysts.

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Eli Sutherland, Luke Middelstadt, Brendan Gleason: Mechanical & Industrial Engineering
Mentor: Brock LaMeres – Electrical & Computer Engineering
Radiation and Material Interaction Research for use in Housing for Space Based FPGA Random Number Generators

This research discusses various types of radiation found in space and the atmosphere outside the ozone layer, approximately 30.5 [km] and higher. How these types of radiation interact with various materials is analysed and evaluated. The purpose of this paper is to identify suitable materials for use as housing to protect electronics during high altitude experiments involving radiation. Applicable materials protect sensitive experiments at high altitude conditions while allowing radiation to pass through to the experiments. The authors performed a literary review, gathering information involving radiation and different material interaction in order to inform decision making of researchers undergoing similar atmospheric radiation experiments.

Acknowledgements: Undergraduate Scholars Program (USP)

Matthew Trzinski: Mechanical & Industrial Engineering
Mentor: Bernadette McCrory, Alice Running – Mechanical & Industrial Engineering, Nursing
Comparative Assessment of the NASA-TLX and SURG-TLX

This study discovered and assessed key differences in subjective workload measurement between the Surgery Task Load Index (SURG-TLX) and the NASA Task Load Index (NASA-TLX). The isolation of these differences provides further understanding of what specific aspects of workload each instrument measures. The NASA-TLX uses a weighted average of six rating scales to measure the following categories: Mental Demands, Physical Demands, Temporal Demands, Performance, Effort, and Frustration. The SURG-TLX is another workload assessment tool created to analyze the specific demands of surgery-related tasks. However, the SURG-TLX replaced Performance, Effort, and Frustration with Task Complexity, Situational Stress, and Distractions. In practice, conflicting scoring has been observed when both the NASA-TLX and SURG-TLX were conducted simultaneously resulting in the need to discover and define relationships that exist within and across the scales and instruments. Two separate open card sorting experiments were conducted. Participants (n=11) were asked to sort 12 cards (each scale heading from both indices) into groupings of their choosing, name the grouping, and provide a short explanation. Participants then repeated the procedure with the scale descriptors. The number of categories and category names were analyzed for both card sorts to create a similarity matrix. Participants uniformly grouped the scale titles into three similar categories of the "Mind," "Body," and "Outcome" while diverging with scale descriptions. Situational Stress was strongly related to Distractions (91%) and Frustration (91%) and moderately related to Task Complexity (55%). Distractions was strongly related to Frustration (82%). Lastly, Physical Demand was moderately related to Effort (73%).

Acknowledgements: IDeA Network of Biomedical Research Excellence (INBRE)

Joseph Tschida, Hayden Frederick: Mechanical & Industrial Engineering, Business
Mentor: Maggie Thorsen, Andreas Thorsen – Sociology and Anthropology, Business
An Investigation of Service Characteristics and Chronic Disease Management at Community Health Centers in Montana

Community health centers (CHCs) are an important part of the safety-net health system in the US. These centers provide comprehensive health services to underserved and uninsured populations. The specific services that these centers offer vary in type and volume due to differing patient populations, regional contexts, and availability of providers. Prior research has attempted to classify this variation at the national level and finds that these differences matter. Importantly, these centers are a critical source of primary care for medically underserved individuals, and these populations depend on them for many services including assistance in the management of chronic diseases. In this research, we use results from prior literature on CHC classifications using national data in order to better understand variation in patient composition for the 17 centers within Montana. Data come from the Uniform Data System collected through the Health Resource Administration (HRSA). Next, we examine staffing patterns and outcomes related to the management of chronic diseases in Montana both in general and across the classifications. We also compare the performance and characteristics of CHCs in Montana to those in the Mountain West, as well as the nation. Initial results suggest that large differences exist in staffing patterns in Montana. We also find that, compared to CHCs across the nation, health centers in Montana are doing well in terms of the management of diabetes and hypertension among their patients.

Acknowledgements: Center for American Indian and Rural Health Equity

Janae Vasatka: Mechanical & Industrial Engineering
Mentor: Cecily Ryan, Flynn Murray – Mechanical & Industrial Engineering, Graduate Departments and Degrees
Material Properties of Biopolymers and Bio-composites used in Fused Deposition Modeling

To minimize humanity's carbon footprint, it is necessary that society move away from using petroleum plastics. However, replacing petroleum plastic requires that we find materials that are not only bio-friendly, but can be utilized for the same purposes. Biopolymers and bio-composites are currently being researched to see if they could one day replace petroleum plastics. The goal of this research is to understand the behavior of 3D printed parts

made from materials including acrylonitrile butadiene styrene, polylactic acid, and hemp polylactic acid composites. Samples are created using a SolidWorks model and then printed in six build orientations, and subject to uniaxial tension while using a Digital Image Correlation system to collect the strain and force data. From the collected data, directional strengths, elastic moduli, Poisson's ratio, and shear moduli of each material can be determined. These properties are then used to create the material's constitutive model allowing for finite element models of various loading conditions. Through this process we can better understand how 3D printed biopolymer parts will behave and ultimately fail, as well as begin to identify applications where biopolymers can replace petroleum plastics.

Acknowledgements: Undergraduate Scholars Program (USP)

Logan Vining, Ethan Malo, Derek Wallace: Computer Science
Mentor: Clemente Izurieta – Computer Science
NuMo - A Better Diet A Better Life

As health and nutritional monitoring becomes more popular in today's mobile society, the demand for accurate and efficient food tracking technologies is rapidly increasing. While many solutions exist that are capable of recording daily consumption and displaying basic nutrient information, most apps lack detailed views of macronutrients and fatty acids essential to maintain a healthy body and a healthy mind. To solve these issues, with the help of experts in consumer economics and biochemistry, we are developing NuMo, the Nutritional Monitoring app that seeks to provide scientifically based information about macronutrients and essential fatty acids. These macronutrients, including the Omega-3 to Omega-6 fatty acid ratio, are integral for optimal brain function. Being developed for both the iOS and Android platform, NuMo provides users with the ability to analyze their daily eating habits and determine imbalances in their diets by looking at user-specific nutritional guidelines gathered from the USDA SR28 database. In addition, NuMo displays detailed and intuitive graphics visualizing their daily nutrient consumption and hydration. Finally, NuMo provides users with the freedom to create their own recipes to see how they contribute to the user's dietary goals. With these features, NuMo offers an informative, effective, and user-friendly platform for users to achieve a better diet for a better life.

Jaclyn Wing: Mechanical & Industrial Engineering
Mentor: Scott Monfort – Mechanical & Industrial Engineering
Effects of Cognitive Dual-Task and Number of Short Bouts on Reliability of Local Dynamic Stability Estimates

Dynamical system measures have been proposed to provide unique insight to gait stability, but the reliability of the measures, particularly for analyzing dual-task walking is not as well identified. Everyday tasks require cognition that can influence basic locomotion. For this reason, cognitive tasks are used to simulate realistic cognitive-motor dual-task situations. However, different cognitive tasks may elicit varying responses in gait characteristics, which motivates the need to establish reliability across different cognitive tasks. Additionally, it is unknown how a simple cognitive dual-task that may 'standardize' cognitive load while walking may influence reliability relative to single-task, normal walking. The purpose of this project was to evaluate the reliability of gait stability for overground walking with varying levels of simultaneous cognitive challenge. This study investigated the reliability of characterizing walking under different cognitive loads using gait stability measures. Within- and between-day reliability of stability measures was assessed using inertial measurement units (IMUs) in a generally healthy population during short walking bouts of 20 meters for normal walking and two cognitive dual-task conditions. As a result, marginal improvements in reliability were observed including more than 15-20 bouts of walking 20 meters. Short bouts can yield reliable within-day estimates of short-term maximum Lyapunov exponents across conditions with and without cognitive dual tasks, as long as a sufficient number of bouts are used. Variability in estimates between bouts remained lower but stabilized with at least 10 bouts. The methods of short bouts of gait and affordable IMUs create opportunities for future use in clinical settings.

Acknowledgements: Undergraduate Scholars Program (USP)

Mikayla Wood: Chemical & Biological Engineering
Mentor: Stephanie McCalla – Chemical & Biological Engineering
Investigation of Heat Transfer in Microfluidic Devices for PCR Reactions

Microfluidic devices can be used in low-resource areas to quantify specific DNA and RNA molecules via digital PCR. Current methods of PCR require advanced, expensive equipment and highly trained personnel to acquire quality results. A key aspect of the PCR reaction is effectively transferring heat during different heating cycles. This research investigated the heat transfer in a microfluidic device in a thermocycler. COMSOL was used to model heat transfer in the microfluidic device and an equation was derived to determine the temperature at the surface of the device when given a specific PDMS layer thickness, room temperature, and device-heating element interface temperature. Temperatures were recorded within the microfluidic device while at steady state in the thermocycler. The heat transfer coefficients were determined using the experimental data. Heat transfer coefficients in the thermocycler were found to be 33.98 W/m2K, 26.45 W/m2K, and 15.56 W/m2K for a 0.5 mm, 1 mm, and 2 mm layer of PDMS, respectively. COMSOL can be used to determine what thickness of PDMS is optimal in the thermocycler setup to achieve appropriate heat transfer in the necessary timeframe. Work is still being done to determine heat transfer coefficients in a setup with a heating element on a microscope that allows for monitoring in the microfluidic wells while the PCR reaction runs. A customized 3D-printed holder is currently being designed for this microscope heating setup in order to improve results.

Acknowledgements: Undergraduate Scholars Program (USP), VPRED

Xingzi Xu: Electrical & Computer Engineering
Mentor: Anja Kunze, Dominique Zosso – Electrical & Computer Engineering, Mathematical Sciences
Simulation-Based Study of Vesicle Motion

Every biological cell must drink and must eat, even in the brain. To transport the ingested material throughout a fully-grown neuronal network, neurons use nanoscaled lipid vesicles. These vesicles are lled with cytosolic liquid, proteins, DNAs or RNAs and therefore play an important role in healthy neuronal cell function. How vesicles in neurons, however, truly move around is still poorly understood. Speci cally, predicting when does a vesicle decide to transport or to secret proteins is essential in nding e ective cell-speci c treatments. To better understand motion patterns of vesicles, we developed a computational model allowing us to study and predict vesicle motion depending on transport speed and caged motion patterns. Using characteristic features like average caging diameter and total traveled lengths, we distinguished between \primed" or \caged" motion patterns and quanti ed how long a vesicle stayed in a speci c motion pattern and compared our computational results with experimental observation obtained from previous work by Dr. Anja Kunze et al.[1]. Furthermore, we added a force component to our mathematical model to predict how motion patterns will change based on force direction and amplitudes. In summary, our computational model was successful in predicting the impact of magnetic forces on magnetic nanoparticle-guided vesicle motion in our experimental data, which will allow future experimentalist to design force-based cell assays with high spatial and temporal precision.

COLLEGE OF LETTERS & SCIENCE

Cammy Agrimson: Mathematical Sciences
Mentor: Lisa Davis, Tomas Gedeon – Mathematical Sciences
Distribution of Spacing Patterns in Elongating RNAPs for high through-put genes.

Two stochastic models describing DNA transcription by RNA polymerases (RNAPs) for the case of high through-put genes. While both models have their foundations in TASEP, Totally Asymmetric Simple Exclusion Process, one of the models also includes torque effects where elongating RNAPs exert forces on the DNA strand that influence the elongation rates of neighboring RNAPs. The influence of transcriptional pauses is also considered for each model. A simulation study is conducted where RNAP spacing patterns are measured by imposing checkpoints along the DNA strand where time differences between successive RNAP arrivals are recorded. Simulation data also includes the number of RNAPs that complete elongation for each simulation, as well as percent of DNA strand covered by RNAPs at any one time, for each simulation. Average transcription times per RNAP are also reported. Histograms, QQ-plots and distribution tests are used to evaluate the simulation data. Results indicate that the spacing pattern of neighboring RNAPs is significantly impacted by torque effects and transcriptional pauses experienced by the RNAPs. Although both models initiate elongation according to a Poisson process, the research shows that the distribution of the data changes as the RNAPs advance down the length of the DNA strand. The degree to which that data changes depends on the relative influences of both torque and pauses.

Acknowledgements: IDeA Network of Biomedical Research Excellence (INBRE)

Keith Andrews: Cell Biology & Neuroscience
Mentor: Susy Kohout, Vamsee Rayaprolu – Cell Biology & Neuroscience
The Translocation of Hs-VSP to the Cellular Membrane

Voltage-sensing phosphatase (VSPs) are transmembrane proteins that are composed of voltage sensing domains (VSDs) attached to a cytoplasmic phosphatase domain (PD). When a cell's membrane potential is changed, the VSD participates in a conformation change which allows the PD to dephosphorylate phosphatidylinositol phosphates (PIPs) at specific locations. This VSP mechanism is incredibly important; VSP dephosphorylation of PIPs regulates diverse cellular processes including proliferation, migration, cytoskeletal dynamics, membrane trafficking, and control of ion channels. There are two separate VSP homologs in humans, TPTE and TPTE2 (Hs-VSP1 and Hs-VSP2 respectively). They are expressed in the testis, brain and stomach. Recent studies support the possibility of Hs-VSPs being expressed in the human kidney because kidney expression was found in both mice and frogs. VSP-mediated signaling in mammals has remained largely unknown, in part because they do not express well on the plasma membrane of heterologous expression systems. My research focused on introducing signaling sequences to increase the expression of both Hs-VSP1 and Hs-VSP2 to allow for more testing of these proteins. My efforts included using PCR to introduce the signal sequence to ultimately test for expression and catalytic activity using *Xenopus laevis* oocytes. This ability to study mammalian VSP in exogenous systems will allow us to better understand how VSPs impact human health.

Acknowledgements: IDeA Network of Biomedical Research Excellence (INBRE)

Emily Askey: Sociology and Anthropology
Mentor: Mike Neeley – Sociology and Anthropology
Analysis of Chipped Stone at the Baxter Creek Site (24GA1551): A Multicomponent Hunter- Gatherer Site in Southwest Montana

Located on the western edge of Bozeman, the Baxter Creek site (24GA1551) contains the remains of prehistoric artifacts spanning the past 12,000 years of Montana's history. Archaeologists at MSU first became aware of this site as agricultural activities began unearthing evidence of prehistoric activities in the form of stone tools. This resulted in three short class excavations in the Fall of 2001, 2002, and 2003 and yielded a collection of chipped

stone artifacts and animal bones. The focus of this project is on the chipped stone and what it can tell us about past human behavior. This analysis of stone tools focuses on: (1) the diversity of raw material types; (2) the sourcing of raw materials to known locations; (3) the differential use of raw materials based on selected analytical attributes; and (4) the age of the site as represented by different, time-sensitive projectile point types. This project is significant as it provides insight into the movement of both raw materials (via trade) and peoples across the landscape in the past. This project has placed the occupants of the Baxter Creek site within the greater context of hunter-gatherers in the Great Plains.

Acknowledgements: Undergraduate Scholars Program (USP)

Sarah Barr: Sociology and Anthropology
Mentor: Jennifer Woodcock-Medicine Horse – Native American Studies
The Influence of the United States on Centeral American Indigenous Peoples

This paper examines the influence of the United States government and large American empires on the citizens of Guatemala, El Salvador, and Belize. Because of the recent rise in migrants from Central America, multiple solutions have been proposed, I would like to deconstruct the issue further and look at the root causes of mass migration. Weak governments are puppeteered by strong ones and the opportunity to make money is often placed at a higher priority than the well-being of citizens. Safety, money, and opportunity drive the people who are left with nothing. Many can no longer afford their own crop, they are forced to buy cheap manufactured food from American companies. Others fear for their lives because of political instability originally caused by the meddling of the United States government, that has only increased due to those who use crime to rule. America claims it is the land of opportunity, and many can no longer resist their chance.

Faith Beard: Sociology and Anthropology
Mentor: Jennifer Woodcock-Medicine Horse – American Studies
A Comparison of Contemporary U.S. and Historic Mayan Forms of Body Modification

Contemporary body modification has become increasingly popular among young people in the last decade. Modern body modification includes: elective plastic surgery, gauged ears, piercings, tattoos, and hair and skin color alterations. Many people in the contemporary world that aren't educated in the body modification culture find the practices to be deviant and taboo. However, body modification has extensive historical roots. For example, the Mayan culture practiced body modification from the time of birth in the form of head binding as well as teeth filing, tattoos, and piercings. The purpose of this research is to fulfill a course requirement and to compare contemporary body modification with ancient Mayan practices of body modification. The comparison may help individuals to better understand current body modification practices by putting them within a historical context. To make this comparison I will review literature on Mayan culture and create a visual representation of my findings that will later serve as an outline for a more in-depth paper.

Donata Bercier: Native American Studies
Mentor: Jennifer Woodcock-Medicine Horse – Native American Studies
First Nation People of British Columbia/ Pacific Northwest Precontact

What is the cultural significance of the carvings of totem poles, big house, and house posts of the First Nation peoples of British Columbia/ Pacific Northwest. Why is this significance still relevant and essential today? Indigenous cultures consist of rich history and meaning. This project focuses on the cultures of coastal tribes precontact of settlers and colonization and how they are still relevant today. The research is gathered primarily from the Don's Map website that consists of a variety of information from different cultures and the IndigenousFoundationsArts.ubc.ca. Many photos have been gathered of these carvings both before and after they were restored. Totem poles were passed down within families depicting a variety of animals, humans, and spiritual deities often carved from red cedar. The totem poles represent family crests and clans of which the families are in

relation to. These carvings represented prestige. These unique structures are still being created to this day similar to the plains Indians, they were forbidden to practice their cultures after the arrival of European settlers. This is due to the claim that these structures represented a paganistic religion and assimilation of the Indigenous people was the goal of settlers, however, the peak of totem poles was post contact. Despite the laws against Indigenous peoples preserving and practicing their cultures, they still held onto their way of life.

Margaret Branine: Microbiology & Immunology
Mentor: Sara Branco – Microbiology & Immunology
Investigating ecological trade-offs in endophytic insect pathogenic fungi

Endophytic insect pathogenic fungi are plant mutualists and insect antagonists and can therefore protect their plant hosts from detrimental insect pests. This study examined trade-offs between being a plant mutualist and an insect pathogenic fungus. We assessed the endophytic and pathogenic capacities of 8 isolates of Beauveria and Metarhizium (B. pseudobassiana, B. bassiana, M. anisopliae, and M. pemphigi) to determine if single isolates are better at one strategy than the other. We performed two assays in order to test for the presence of trade-offs. In the insect pathogenicity assay, surface-sterilized wheat stem sawfly larvae were exposed to standardized spore solutions from the Beauveria and Metarhizium isolates. Infection and mortality of the larvae was tracked over a 7-day period. In the endophyte assay, wheat plants were cultivated from seed in a greenhouse and exposed to standardized conidial solutions of each fungal isolate and grown for four weeks. For each plant we measured chlorophyll content, height, and number of shoots, leaves, and inflorescence before and after the treatment. Our preliminary results show all isolates have high efficiency establishing as insect pathogens as we observed rapid and high mortality rates within larvae across all isolates. Wheat plants exposed to distinct isolates within the endophyte assay showed differential growth and physiological characteristics that may be due to endophyte establishment, suggesting a potential trade-off in endophytic pathogenic ability for some isolates. Our next steps include sequencing the fungal ITS region from plant tissue to ascertain endophyte presence and determine differential endophyte establishment and mutualistic ability.

Acknowledgements: Megan Hager (MSU Graduate Student) – Plant Sciences & Plant Pathology, Sonya Erlandson (Non-MSU/Other) – Microbiology & Immunology, Undergraduate Scholars Program (USP)

Brianna Bull Shows: Microbiology & Immunology
Mentor: Suzanne Held – Health & Human Development
Evaluation of culturally consonant incentives used in a community-based chronic illness self-management program

Messengers for Heath is a nonprofit organization based on the Apsáalooke (Crow) reservation. Messengers uses a community based participatory research approach to address health issues on the reservation. In 2013, project partners designed a culturally consonant intervention for community members that provided information on CI self-management. Proper management of CI can lead to lower mortality rates and a higher quality of life. Overall, 50-80% of patients do not adhere to medication and lifestyle change recommendations. The capacity for effective self-care is key to improving CI management, as people living with CIs spend significantly more time managing their care in the community compared to time spent at the hospital or in ambulatory care settings. As a part of a community-based and community-led CI self-management program developed for Apsáalooke (Crow) community members, we developed incentives related to the different topic areas of the program. At the post-intervention session, participants completed an evaluation of the different incentives. Participants indicated how often they used the incentive (ranging from not at all to all the time) and add comments about the incentive gift. Some of the incentives were used more than others and participants offered helpful comments about the use and helpfulness of the different incentives, and how they shared the incentives with family members. A limitation of this evaluation was that not all participants completed the evaluation of incentives and some of the participants did not receive all of the incentives. Conducting an evaluation of the usefulness of these incentives can help to improve our program in the future. All the incentives and incentive surveys will be provided.

Acknowledgements: Alma Knows His Gun-McCormick (Non-MSU/Other) – None, Undergraduate Scholars Program (USP), McNair Scholars Program

Brock Butcher: Mathematical Sciences
Mentor: Andrew Hoegh – Mathematical Sciences
Statistical Modeling of Cattle Feet Quality

Using visual characteristics to evaluate the expected life of production in beef cattle has been a tool ranchers have used for generations. When certain components of the body in cattle deteriorate, they are no longer suited for production which leads to a loss in revenue. This study analyzes the effects of different bulls and measures the probability of increasing preferred visual characteristic expression. Visual scores were recorded on 600 mother cows and assigned a score of 1 to 5 based on the characteristic they expressed visually. Five was the most desirable expression and one was the least desirable. Then offspring were also assigned a score. Using ordinal logistic regression to predict improvement in offspring we saw that there were some Sire groups that increased the probability of observing a higher frequency of improvement when compared to others.

Andrew Calderhead: Liberal Studies Degree
Mentor: Jennifer Woodcock-Medicine Horse – Native American Studies
Pacific Northwest Native American Salmon Fishing

Salmon Fishing in the Pacific Northwest has been a large part of Native Tribe's lives for as long as they have lived there. Tribes rely on the Salmon for food as well as income. While the Native's rights to have access to the streams they historically fished is guaranteed by the Stevens Treaties of 1854, they have recently been having a dispute in court in the state of Washington over their rights. The Stevens Treaties of 1854 arranged the exchange of the land the Native Tribes were occupying to the hands of the State, relocating them to reservations. In return, the State of Washington gave Native Tribes the right to fish all of the streams they usually would, as they always have. Unfortunately, urbanization and development of land as of recently has been making such a large negative impact on the hydrology and health of rivers and streams that Salmon run in that the Tribes are unable to fish as they used to. This issue is very controversial and been going on for years, as it is hard to decide whether the State actually violated the Stevens Treaties by building so much.

James Callahan: Earth Sciences
Mentor: Jennifer Woodcock-Medicine Horse – Native American Studies
Contemporary Mexico: Religious Practices

My research dives into the depths of modern-day religious practices in Mexico and the aspects of mythology. I will discuss Aztec mythology and how it relates to modern practices of Aztec religion. Current Mayan and Olmec traditional practices and mythology will also be presented. How these religious rituals affect daily lives and how it's changed over time will be a part of the presentation. I'm interested in discussing these topics because they contain a complex background. I will also discuss specific practices that are conducted today and religious festivities that are currently celebrated. My presentation will go in-depth with the feathered serpent God Quetzalcoatl and the contemporary beliefs of the overall mythology. My conclusion will consist of how Aztec beliefs are still thriving today and how it affects contemporary culture.

Acknowledgements: Undergraduate Scholars Program (USP)

Saré Campbell: Earth Sciences
Mentor: Devon Orme – Earth Sciences
The Provenance of the Kibbey, Amsden, and Quadrant Formations, Located in the Bridger Range, Montana

This project focuses on determining the provenance of sedimentary strata exposed in the Bridger Range, Montana through the use of Uranium (U)-Lead (Pb) detrital zircon Laser Ablation Inductively Coupled Plasma Mass Spectrometry (LA ICP-MS). Exposed east of Sacagawea Peak, the Kibbey, Quadrant, and Amsden Formations were deposited during the Paleozoic Era in a shallow marine environment. When rocks are deep within the Earth, they reach a certain temperature and pressure where the rock will crystallize, solidifying and trapping elements such as U and Pb. The original location where sediments of the Rocky Mountains crystallized is generally known to be the eastern margin of North America based on the U-Pb ages of mountains in Appalachia. However, details of the exact location and when these sediments were transported to western North America remain mostly unknown. Based on the age domains calculated through U-Pb detrital zircon LA ICP-MS, I will determine where the rocks that make up the Bridger Range were originally crystallized and uplifted. This is important in understanding the geologic history of Montana, and to learn what processes had to occur to create the mountains we see today. After the sample collection, our sediments were processed at the GeoSep Lab in Moscow, Idaho and are currently travelling to the University of Arizona to be processed at the Geochronology Center. Once the crystallization dates of the zircons are calculated, I will determine potential source regions of these sediments. I hypothesize that the Kibbey, Quadrant, and Amsden formations will contain zircons with U-Pb age populations of 300-500 Ma, 1000-1200 Ma, 1600-1800 Ma, and >2000 Ma, which originally resided in the Appalachian orogeny and Wyoming Craton on the eastern and central parts of North America, respectively.

Acknowledgements: Sophie Black (MSU Undergraduate Student) – Earth Sciences, John Cook (MSU Undergraduate Student) – Earth Sciences, Chance Ronemus (MSU Undergraduate Student) – Earth Sciences

Joseph Carey, Ellie Smith, Carter Gall: Cell Biology & Neuroscience
Mentor: Renee Reijo-Pera, Ninuo Xia – Cell Biology & Neuroscience
Neural Stem Cells; A Quicker Way To Make Neurons

Parkinson's disease (PD) is one of the most common neurological disorders, with a projected prevalence of over one million Americans in 2020. PD is largely associated with people over age 50, and as this population grows so will the prevalence of PD. The symptoms of PD – tremors, speech difficulty, and trouble with posture among others – are highly related to the death of dopaminergic (DA) neurons deep in the brain. A common method to study these processes is to use in vitro modeling of DA neurons. In this context in vitro means adding stem cells to a culture dish and using small molecules or RNA to prompt the cells to become DA neurons. By growing "neurons in a dish" we have relatively easy and inexpensive access to DA neurons to be used in drug screens, genetic studies, and immunofluorescence assays. A large body of differentiation methods use small molecules to turn embryonic stem cells (ESCs) into DA neurons, a process that takes at least 30 days to generate mature neurons. Our project is to convert one of these protocols (written in 2014) into one that starts with neural stem cells (NSCs). NSCs are a semi-specialized cell type that is developmentally between ESCs and neurons or glia. By using NSCs as a starting point we hope to reduce the time of differentiation by at least a third. We chose the 2014 protocol because it generates robust and homogenous cultures of DA neurons, but it has many opportunities for modernization at its earliest steps.

Jason Carr: Physics
Mentor: Charles Thiel, Rufus Cone – Physics
Rare-Earth Doped Material Synthesis for Optical Cooling

Optical cooling is the process in which the sequential absorption of two or more photons leads to the emission of light at shorter wavelength than the excitation wavelength. This produces a net loss of heat energy in the material. This process allows solid-state refrigeration in a robust and predictable package, without the need for moving parts or refrigerant products - revolutionizing many areas of science such as micro-processing or space-equipment design, where size and vibration is an issue. However, the materials that promote this effect and their respective growth procedures are not well defined. It is known that trivalent ytterbium, Yb3+, successfully fluoresces when doped into crystalline substances. Rigorous synthesis methods are sought after to allow for consistent

reproduction of Yb3+ doped materials. This research defines growth techniques (hydrothermal, co-precipitation, solution) for Yb:YAG, Yb:YLiF, and certain morphologies of CaCO3. The composition and structure of the materials is tested using x-ray diffraction and scanning-electron microscopy. The ratio of Yb3 fluorescence for two different transitions, pumping at the 1030nm cooling transition and utilizing 10nm bandpass filters centered at 940nm and 970nm, is measured. The response of Yb:YAG to up-conversion processes is characterized as linear at high temperatures (293K to 443K) for 20% Yb3+ -dopant, revealing the capacity to readily measure temperature variations of a few degrees with a simple setup.

Acknowledgements: Philip Woodburn (MSU Graduate Student) – Physics, Undergraduate Scholars Program (USP)

Dakota Chapman: Physics
Mentor: Brian D'Urso – Physics
Processing of SiC Micro-Crystals

The D'Urso group has recently proposed the idea of using a Silicon Carbide (SiC) micro-crystal instead of a silicon sphere to improve the precision of the measurement. The idea stems from the fact that the magnetic field sensitivity of the spins associated with defects, specifically the Si vacancy VSi(V2) in 4H-SiC, in the SiC provides a mechanism to measure the trapping magnetic field experienced by the particle as it oscillates. This could lead to a measurement of G that is orders of magnitude more precise than any previous measurements and develop a system that may provide experimental data about the quantum nature of gravity, potentially bridging the gap between gravity and quantum mechanics! The original plan was to process these particles in a magnetogravitational trap one at a time. However, that has proven to be more challenging and time consuming than originally thought. We have now moved over to a bulk processing technique that will allow us to create more particles in the same time frame.

Acknowledgements: Undergraduate Scholars Program (USP)

Sage Chase: Microbiology & Immunology
Mentor: Douglas Kominsky – Microbiology & Immunology
Defining the Mechanism of Salmonella Virulence Modulation by CD73 in the Intestinal Epithelium

The intestinal tract is a tissue lined with columnar epithelium that is only a single cell layer. Important for nutrient uptake, the immune system, and providing a critical barrier between luminal contents and the underlying mucosa, damage to the epithelium can lead to intestinal inflammation. The Kominsky Lab focuses on intestinal inflammation in inflammatory bowel diseases. Salmonella typhimurium is a model inflammatory pathogen that initiates infection by invading host intestinal epithelial cells (IECs), stimulating the release of large amounts of extracellular ATP, leading to amplified inflammatory responses. Extracellular ATP is released into the intestinal lumen by S. typhimurium, infiltrating leukocytes upon detection. S. typhimurium-infected epithelial cells then undergo pyroptotic cell death. During typical infection conditions, extracellular ATP is quickly metabolized to adenosine by enzymes on the apical surface of IECs in order to dampen the inflammatory response. This conversion is partly dependent on CD73. The only known function of CD73 is hydrolyzing extracellular AMP to adenosine during an inflammatory response. CD73- generated adenosine contributes to host-microbe interactions by modulating pathogen replication and virulence. My previous research demonstrated that in CD73 knockdown epithelial cells there is altered intracellular replication and translocation of S. typhimurium. This relationship between CD73, Salmonella, and the intestinal epithelium further indicates that CD73 is a necessary molecule for both the resolution of inflammation and the successful infection and trafficking of Salmonella. Because of these results, it is believed that the absence of CD73 leads to alterations in extracellular adenosine generation, transport, and/or signaling during S. typhimurium infection.

Acknowledgements: Undergraduate Scholars Program (USP), IDeA Network of Biomedical Research Excellence (INBRE)

Hanbyul Cho: Microbiology & Immunology
Mentor: Seth Walk – Microbiology & Immunology
Progressive Adaptation of Resident Escherichia Coli in Human Gut Microbiome

The human gastrointestinal tract harbors a diverse and complex microbial community that plays a fundamental role in human health. However, the factors that influence temporal microbiome dynamics of gut microbiome are largely unknown. The Walk Lab undertook a two-year study to examine the population dynamics of Escherichia coli in a group of eight volunteers. All participants were colonized by multiple resident strains that persisted for months to years. The goal of the project was to understand how resident E. coli populations evolve in the human gut. By comparing the genome sequences of resident E. coli clones isolated at different points, we identified multiple Single Nucleotide Polymorphisms (SNPs) and insertion deletion events (indels). We hypothesized that genetic changes in resident strains of E. coli are adaptive in the human gut. Mutations will be considered adaptive if we find evidence of non-synonymous changes and amino acid changes at a higher rate than we would predict at random. If all the SNPs that are found do not result in a change in amino acid, then the hypothesis will not be supported. In this ongoing project, SNPs were identified and we are using sanger sequencing for confirmation, after which we will quantify the ratio of non-synonymous substitution and synonymous substitution. Understanding how beneficial microorganisms colonize and persist in the human gut may lead to new treatments and clinical interventions.

Acknowledgements: Jonathan Martinson (MSU Graduate Student) – Microbiology & Immunology, Nicholas Pinkham (MSU Graduate Student) – Microbiology & Immunology, IDeA Network of Biomedical Research Excellence (INBRE)

Brenna Christopherson: American Studies
Mentor: Jennifer Woodcock-Medicine Horse – Native American Studies
Central American Religion

This presentation is about how ancient Native American religions in central America have mixed with Christianity. Looking at how religion has influenced central American culture through holidays such as the Day of the Dead. Asking how long it took for these religions to intertwine and become a permanent fixture of society. Looking at how and when they started to come together and how it affected the people at the time. Examining the points at which the two religions relate to one another and how they differ from each other.

Stewart Cook: Earth Sciences
Mentor: David Varricchio, Colin Shaw – Earth Sciences
A Lost World: A New Amber Bearing Lignite Deposit in the Hell Creek Formation of Southeastern Montana

Plants have developed an array of defenses against herbivorous insects: for some tree species, resin is an important defense both chemically and physically. Resin is preserved as amber in the geologic record and has the ability to preserve soft-bodied organisms with high resolution. Amber can be found globally, but some of the youngest Mesozoic deposits, from the Late Cretaceous Hell Creek Formation have recently attracted paleontological research. This deposit has shown much promise for study: it has yielded large volumes of amber, large specimen sizes, and contain abundant organic inclusions. This project will provide a preliminary description of this new amber deposit and the first insect inclusion found at the site. Methods of conservation, preparation, and study of Hell Creek amber will be explored; the implication of the study of Hell Creek amber will be discussed as well. Preparation of the amber involved embedding specimens in epoxy resin and the use of thin sectioning equipment. A multitude of optical and imaging techniques were performed, including stereoscope light microscopy and High-Resolution X-Ray Computed tomography. Future analyses will be explored with Confocal Laser Scanning Microscopy. The preservation bias of the Hell Creek Formation excludes the existence of many organisms in the formation's record. However, amber has provided an avenue for these specters of time to be studied and is a pivotal piece to understanding the environment, ecology, and biodiversity of Montana's Latest Cretaceous.

Acknowledgements: Nathan Carroll (Non-MSU/Other) – Earth Sciences, Carter County Museum

Haley Cox, Lillian Ball: Cell Biology & Neuroscience
Mentor: Christa Merzdorf, Jennifer Forecki – Cell Biology & Neuroscience
Xfeb, A Direct Target of Zic1, is Involved in Neural Crest Development

The peripheral nervous system, melanocytes and craniofacial cartilage and bone arise from neural crest cells that develop during early embryonic neural development. Transcription and signaling factors form a network to regulate this development. For example, it has been shown that Zic1 and Pax3 in conjunction are able to induce full neural crest cell development (Monsoro-Burq et al., 2005). Xfeb and Gbx2 also play roles during neural crest cell development as they are present in the same regions and developmental stages as the neural crest (Plouhinec et al., 2014; Li et al., 2009). A microarray identified Xfeb as a direct, downstream target of Zic1 (Li et al., 2006). An additional lab also identified Xfeb as a neural crest gene induced by Zic1 (Plouhinec et al., 2014). We hypothesize that Pax3, Xfeb, Gbx2 and Zic1 are all part of the same gene regulatory network controlling neural crest development. To investigate the relationship between the Xfeb, Pax3, Gbx2, and Zic1 genes, we first upregulated Xfeb gene expression with sense RNA and down regulated Xfeb gene expression with morpholino oligonucleotides (MO). We used in situ hybridization to visualize neural crest induction by staining for Slug RNA expression, a known neural crest marker. Our results showed that embryos injected with Xfeb sense RNA expanded Slug expression while those injected with Xfeb MO diminished Slug expression. We have also demonstrated that knocking out Xfeb reduces neural crest tissue development, and the next step will be to determine if upregulation of Pax3, Gbx2 or Zic1 will rescue neural crest development in the absence of Xfeb. This research will contribute to our understanding of gene regulatory networks, gene families, and how these contribute to early neural development.

Acknowledgements: Undergraduate Scholars Program (USP), Montana Academy of Sciences

Morgan Craig, Jacey Anderson, Rachel Dunlap, Emma Folkerts, Elanor Nolan: History & Philosophy, Liberal Studies Degree, Interdisciplinary Studies, Modern Lanuages & Literatures
Mentor: Molly Todd – History & Philosophy
Object Lessons: Making History at MSU

Objects can be powerful tools in creating civic discourse and helping communities interpret and respond to challenges. This presentation focuses on the work of MSU's Public History Lab and, more specifically, the process of creating exhibits and workshops aligned with the goals of Project Solidarity: a transnational collaborative research project. Designed to parallel "Project Solidarity: Constructing Narratives from the Past to Inform the Future," this presentation will illustrate how each of our lab-based projects involves careful thought and curation. In collaboration with project partners, the team establishes themes and goals for each exhibit and workshop, and subsequently selects relevant historic photographs and objects from the Project Solidarity archive of the 1980s Salvadoran civil war. We tailor each event for transnational audiences, using mobile displays, voting systems, and other activities to engage exhibit viewers. Following each event, the team reflects on the results and applies feedback from participants and partners to produce reports and posters, improve our contributions to other events, and inform the future direction of the Public History Lab. Our process is dual-purposed. We offer opportunities, through historic photographs and objects, for participants to claim their personal histories and find common ground. At the same time, our group of student collaborators gains valuable insights into and experience with the field of public history.

Acknowledgements: The Whiting Foundation for the Humanities, the US-El Salvador Sister Cities network, CRIPDES-El Salvador, the Department of History & Philosophy

Lauren Crose: Microbiology & Immunology
Mentor: Micheal Franklin – Microbiology & Immunology
Characterizing Dormancy Factors in Pseudomonas aeruginosa

Bacterial antibiotic resistance is an important public health issue, and threatens our ability to treat infectious diseases. One mechanism of antibiotic resistance is associated with bacterial biofilms, which contain cells that are persistent even during antibiotic treatments. Persister cells, or dormant cells, are not targeted by antibiotics that inhibit active metabolism. This allows the dormant cells to resist antibiotics and to cause recurring infections. Pseudomonas aeruginosa, is an antibiotic resistant bacterium and opportunistic pathogen. We are using random mutagenesis to identify genes required for P. aeruginosa survival during dormancy. P. aeruginosa cells are mutated with a mariner transposon containing the gentamicin resistance gene. If the transposon inserts into and inactivates an important gene related to dormancy, then it will display a delayed lag time following recovery from dormancy . In these experiments, the mutated cells are starved for four days, allowed to resuscitate, then analyzed for regrowth kinetics. If a mutated cell displays an increased lag time the DNA where the transposon inserted is sequenced to identify the dormancy factors. Directed mutations are being used to construct gene deletions of dormancy genes identified previously. I am in the process of constructing mutations of the shaC and tyrZ genes. The information gained from this study will ultimately be used to help prevent dormant biofilms cells from recovering from dormancy following antibiotic treatment, which will be useful in treating recurring bacterial infections.

Acknowledgements: IDeA Network of Biomedical Research Excellence (INBRE)

Cesar Cruz: Psychology
Mentor: Neha John-Henderson – Psychology
Technology and Well-being in College Students

First-generation College Students (FGCS) face significant hurdles like navigating through economic, social, and cultural barriers once in college, all while also encountering guilt, low self-esteem, and more depressive symptoms than their non-FGCS peers. This study aims to examine the intersectionality of technology usage, specifically smartphone usage, with the student's overall well-being; ranging from their anxiety levels, depressive symptoms, sleep quality, to their belongingness to the university. Participants took part in a three-day long survey process where they would submit their phone usage, sleep quality, and overall well-being. As the data presented, FGCS significantly spent more time on average on their phones than their non-FGCS peers; as well, they also reported worse health and lower belongingness to MSU.

Acknowledgements: McNair Scholars Program

Joshua Davisson: Chemistry & Biochemistry
Mentor: Susy Kohout, Vamseedhar Rayaprolu – Cell Biology & Neuroscience
Dimerization of the Voltage Sensing Phosphatase from Xenopus laevis

The voltage sensing phosphatase (VSP) is the only known protein with a direct link between voltage and phosphatase activity. Composed of a voltage sensing domain (VSD) and a phosphatase domain (PD), this protein is conserved in many species, including humans, sea quirt, and frogs, such as Xenopus laevis. While the physiological function of the Xenopus laevis VSPs (Xl-VSP) is unknown, XlVSPs can dephosphorylate phosphatidylinositol phosphates (PIP) in both the 3 and 5 positions on the inositol ring. This is significant because PIPs are secondary messengers involved in vital cellular functions such as synaptic regulation, ion channel modulation, development, proliferation, and migration. Characterizing XlVSP is an important step in determining its physiological role and understanding how membrane potential influences PIP signaling pathways within cells. Protein dimerization is observed through coimmunoprecipitation and Western blot. This first involves the synthesis of epitope tags, then expression in a Xenopus laevis oocyte, before lysing the oocytes and coimmunoprecipitating dimers with cobalt beads and anti-FLAG antibody beads. A subsequent SDS-PAGE gel and Western blot can reveal the presence of protein dimers. The same methodology applies to detecting homo and hetero dimers of XlVSP's two homologs. Demonstrating that XlVSPs dimerize raises further questions about the physiological functions of VSPs and could help eventually determine the overall role VSPs play in organisms. This characterization of VSPs through

dimerization may help in determining the role of human VSP as both human and Xenopus laevis VSPs have two homologues, suggesting they might interact in a similar way.

Acknowledgements: IDeA Network of Biomedical Research Excellence (INBRE)

Keegan Diehl: Psychology
Mentor: Brandon Scott – Psychology
Investigating the Behavioral Health-Emotion Connection in College Students: Are Physiological Indices of Emotion Regulation Associated with Both Anxiety and Aggression?

The ability to regulate emotions is an important skill we learn as youth and deficits in emotion regulation may lead to negative outcomes across adulthood. This study investigated the specific and non-specific relations between two physiological indices of emotion regulation (i.e., resting heart rate variability [HRV] and change in HRV to stress) and both problematic anxiety and aggression among college students. The current study also examined if individuals who have difficulty regulating their emotions in general (lower resting HRV), and particularly during times of stress (no change or augmented in HRV), were at greater risk for experiencing emotional and behavioral problems. A sample of 121 undergraduate students at Montana State University completed a physiological assessment and questionnaires assessing aggression and anxiety symptoms. Based on previous research findings, we predict that 1) lower resting HRV will be associated with greater levels of both anxiety and aggression, and 2) augmented or no change in HRV from a resting baseline to a cognitive stressor will be associated with greater anxiety and aggression. The findings will make an incremental contribution to the extant literature by determining the specific and non-specific biological correlates of anxious "flight" and aggressive "fight" expressions of college students and is a critical step towards the dimensional classification of mental health disorders.

Acknowledgements: Undergraduate Scholars Program (USP)

Alec Dinerstein: Physics
Mentor: Randy Babbitt – Physics
Automated particle detection in optical tweezers

Optical tweezers are useful experimental tools for research in a wide range of topics from fundamental tests of quantum physics to studies of biological phenomena. As the name suggests, they allow for the precise manipulation of particles through laser light. A common limitation of optical tweezers is the long observation period involved in loading particles into them. The purpose of this project is the design and implementation of an apparatus that allows for the automated detection of loaded microbeads that are 4+ micron in diameter. Digital image data from the tweezer is analyzed using MATLAB image processing software to look for side scattered light as an indication of particle presence. The intensity of side scatter, a function of particle size and shape is used as a rough characterization of the loaded particle. We are also working on incorporating additional protocols to extend system automation to particle loading and unloading, and particle dynamics measurements.

Acknowledgements: Undergraduate Scholars Program (USP)

Alisa Drenner: Physics
Mentor: John Neumeier – Physics
Physical Properties and Superconductivity of $SrTa_2S_5$ and $BaTa_2S_5$

$SrTa_2S_5$ and $BaTa_2S_5$ are revealed to be BCS superconductors with bulk superconducting transition temperatures Tc = 2.27(3) K and 2.87(3) K, respectively, as determined from specific heat. The superconducting transition from electrical resistivity ρ measurements is 2.40(16) K for $SrTa_2S_5$ and 3.14(26) K for $BaTa_2S_5$; the slightly higher values are associated with filamentary superconductivity. Intergranular conductivity dominates ρ in $SrTa_2S_5$, as surmised from its large magnitude (ρ(3 K) = 454 μΩ cm). The electrical resistivity ρ is metallic in $BaTa_2S_5$ with ρ(3 K) = 69.6 μΩ cm. The magnetic susceptibility is paramagnetic and temperature independent for both samples with a large Van

Vleck contribution in $SrTa_2S_5$ and a Curie Weiss contribution in $BaTa_2S_5$; below T_c the Meissner effect is observed in both. Hall effect measurements show that the majority charge carriers are holes for both materials with charge-carrier concentrations n(5 K) = 2.75(15)×10^{20} cm^{-3} for $SrTa_2S_5$ and n(6.25 K) = 1.55(7) ×10^{20} cm^{-3} for $BaTa_2S_5$. The electronic specific heat coefficients are observed to be γ = 7.62(14) mJ/mol K^2 and γ = 7.61(44) mJ/mol K^2. The energy gaps associated with the superconducting state are found to be Eg = 0.575(15) meV and Eg = 0.872(9) meV. $SrTa_2S_5$ and $BaTa_2S_5$ are classified as Type II BCS superconductors.

Acknowledgements: Shermane Benjamin (MSU Postdoc/Research Scientist) – Physics, Michael Smith (Non-MSU/Other) – Chemistry & Biochemistry

Devan Driscoll-Roach: Earth Sciences
Mentor: David Varricchio – Earth Sciences

Wood Bore Traces of the Late Cretaceous, Two Medicine Formation of Montana: Ichnotaxomic Description and Interpretation

The Two Medicine formation represents a seasonal, semi-arid environment during the Campanian age of the Late Cretaceous. Historically, this formation has been a hotspot for vertebrate paleontologists, containing many influential dinosaur sites. Silicified wood specimens collected from a petrified forest within the formation contain curious remnants of biologically manufactured borings. These borings display a variety of structures from cavity-like structures to small scale tunnels; pellets are tightly compacted into these cavities. This is also the first occurrence of wood boring traces found in the Two Medicine Formation. Many groups of insects such as beetles, wasps, and termites have developed unique behaviors to utilize plants in their life cycles. Some insect groups even take this strategy to an extreme and construct elaborate nests within wood. The structure of these traces can directly reflect behavior, indicating whether this organism was feeding or nesting within the wood as. Further investigation into the trace maker identity can provide details into the ecology of the Two Medicine, as well as evolutionary relationships between plants and floral parasites. The goal of this project is to define and interpret these traces. Using ichnotaxobases (characters used for trace fossil classification) a description and designation of an ichnotaxon will be accomplished. The trace maker identity will be inferred as well by examining extant wood borings. Study of these traces will provide a greater understanding of the Two Medicine's environment and ecology by examining the formation's lesser preserved residents.

Acknowledgements: Stewart Cook (MSU Undergraduate Student) – Earth Sciences

Solange Dubreuil: Ecology
Mentor: Amy Apprill – Chemistry & Biochemistry

DNA-based sequencing approach to identify microbial community diversity from Cuban Coral Tissue

Normal environmental variation and major stress events contribute to changes in the interactions between corals and their microbiome. Water samples at Canarreos and Gardens of the Queen Reef systems, in Cuba, showed a correlation between reef's health and the microbial community composition of these water samples. Corals microbiome might be inherited and also might originate from surrounding seawater. Additionally, when coral microbiome's shift from a symbiotic stable state to a dysbiotic state could result in the disruption of essential biological functions for the host animal. The goal of this research is to identify species of bacteria and archaea present in these three corals species and also distinguish microbial composition variations originated from environmentally distinct reef systems Genomics of tissue-associated bacteria and archaea could help better understand host-microbiome interactions, specifically how marine animals adapt to normal environmental variations and frequently occurring stress events impacting the ocean environment.

Acknowledgements: McNair Scholars Program

Rachel Dunlap, Morgan Craig, Jacey Anderson, Emma Folkerts, Elanor Nolan: Liberal Studies Degree, History & Philosophy, Interdisciplinary Studies, Modern Language & Literatures
Mentor: Molly Todd – History & Philosophy
Project Solidarity: Constructing Narratives from the Past to Inform the Future

This poster presentation draws from a series of transnational historical memory workshops. It demonstrates how collaborative story-telling can bridge social gaps, enabling people to interpret and respond to present day challenges in creative ways. Between 2018 and 2019, the MSU Public History Lab team collaborated with former refugees, human rights activists, and photographers in El Salvador and the United States to create a database of documents, objects, and photographs from the Salvadoran Civil War, create interactive exhibits, and facilitate story-sharing workshops. Each of these activities and events, as well as their planning and organizing processes, relied on participatory methodologies. Participants at some workshops drew pictures and selected photos related to themes of resilience, perseverance and, organizing. At other events, participants commented on photos with sticky notes, interviewed each other with recorders, and voted for the photos they found most striking or inspiring. Among the outcomes for each event was a collectively-curated poster featuring photos that best represented participants' shared understanding of the past. In each instance, reflection on the past led to conversations on present-day challenges, particularly climate change, immigration, and the difficulty of passing history on to the next generation. The Public History Lab team documented "data" collected from these workshops and is currently working on sharing this information to workshop participants in creative ways.

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Will Early, Mark Sargent: Physics
Mentor: John Sample – Physics
Observing Terrestrial Gamma Ray Flashes using a Light and Fast Detector

In recent decades research of Terrestrial Gamma Ray Flashes (TGFs) has grown substantially due to the lack of observations of this phenomenon. TGFs are found in the column of air located above a thunderstorm. The number of TGFs observed since their discovery has been small compared to the estimated number of events which occur worldwide each day. In order to construct a lightweight, versatile, and deployable supplement to detect these TGFs, a Light and Fast TGF Recorder (LAFTR) was designed. LAFTR aims to determine the frequency of TGFs as well as distinguish between the two leading theories of TGF formation: relativistic feedback discharge and the lightning leader tip models. To determine which theory is correct, the count rate and time resolution of the recorded events are key, so LAFTR sacrifices some energy resolution in order to detect events with a pulse width of approximately 40 nanoseconds and time resolution of approximately 20 nanoseconds. LAFTR can either ride on an off-the-shelf weather balloon above a thunderstorm at approximately 26 km above sea level or sit as a ground unit above a valley or coastline where thunderstorms and lightning strikes originate. With this versatility, LAFTR has been a valuable tool in identifying TGFs across the world.

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Faith Ellis: Psychology
Mentor: J. Mitchell Vaterlaus – Health & Human Development
Relationship Expectations in High School Dating Relationships

High school dating is a common aspect of high school life and serves as a way for adolescents to explore romantic relationships. Utilizing the theoretical framework of Ecological Systems, the current qualitative study explores the

expectations of these relationships based on the thoughts of high school students (n= 80), college students (n= 106), and parents (n= 199). A conventional qualitative content analysis resulted in three major themes derived from all three samples. First, participants explored the ephemerality of these relationships as a function of immaturity and lack of experience. The second theme encompasses participants' reports of interpersonal expectations of emotion and action between the two partners. Finally, participants also discussed how these relationships affect social influences and opportunities.

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Anders Enevoldsen: Microbiology & Immunology
Mentor: Alice Running, Bernadette McCrory – Nursing, Mechanical & Industrial Engineering
Dust Mitigation System for Use in Sterile Human Foot Medical Care

The United States' population is aging, and chronic conditions are more prevalent. Foot care and lower extremity wound interventions are more complex and are now routinely provided by skilled clinicians such as nurses and physical therapists. These highly trained clinicians employ a cordless, rotary tool for electric sanding/filing of toenails (dystrophic, mycotic, ingrown nails) and other skin areas (tough/rough, callused, small corns). These rotary tools reduce or eliminate the need to manually sand/file, have several attachments, and allow variable speeds to provide comprehensive patient care. To perform foot care using the rotary tool a clinician must assess the potential treatment area, choose an appropriate attachment (often a flat sanding disk or thin diamond burr), select a slow speed between 5,000-8,000RPM, and apply steady 45-degree forward pressure. Common issues encountered with the rotary tool are heat, noise and dust generation during treatment. Heat and noise are mitigated through appropriate speed selection, patient inquiry and incremental work. Dust generation is physically excluded using personal protective equipment such as a surgical mask, scrubs, headcover and full-face shield. The extremely fine dust particles consist of a suspension of fine solid particles and are not easily contained at the point source of treatment currently. This study observed routine foot and wound care to identify patient and clinician needs and determine constraints. Commercially available products within and outside of healthcare were also studied to develop possible solutions. Combining currently available solutions with the identified needs and constraints led to two alternative design solutions.

Acknowledgements: Undergraduate Scholars Program (USP), IDeA Network of Biomedical Research Excellence (INBRE)

Arden Engel: Ecology
Mentor: Ryan Thum – Plant Sciences & Plant Pathology
Microsatellites distinguish morphologically similar native and invasive water primroses (Ludwigia hexapetala and L. grandiflora)

Ludwigia is a diverse genus of aquatic plants in the Onagraceae family. Morphological similarities between two aquatic plants that occur in Florida, *Ludwigia grandiflora* (native) and *Ludwigia hexapetala* (invasive), have led to debate as to whether they should be considered distinct taxa. While morphometric analysis suggests separation, no genetic analysis has been performed to date. Here, we tested whether *L. grandiflora* and *L. hexapetala* were genetically distinct at 10 microsatellite markers. Separate clustering of native *L. grandiflora* and invasive *L. hexapetala* marker data in principal coordinates analysis demonstrated that the two represent genetically distinct groups, which supports their recognition as distinct taxa. These results were corroborated by STRUCTURE analysis, which divided individuals into two populations that were consistent with their separation in the PCoA and matched their morphology-based species identities. Managers should therefore distinguish the two when making management decisions and evaluating efficacy of control tactics. Given the difficulty in distinguishing them using morphological characters, genetic analysis provides a useful tool to distinguish them.

Acknowledgements: Undergraduate Scholars Program (USP)

Emily Entz: Chemistry & Biochemistry
Mentor: Sharon Neufeldt – Chemistry & Biochemistry
Nickel-Catalyzed Stille Cross-Coupling of Phenolic Electrophiles

The purpose of this research was to examine the scope and mechanism of Ni-catalyzed Stille cross-coupling of phenolic electrophiles with organotins. The Stille reaction, traditionally involving Pd-catalyzed cross-coupling of an organic electrophile and a nucleophilic organotin reagent, has proven to be a powerful method to form carbon-carbon bonds. This research investigated the use of nickel, rather than palladium, because it is cheaper and can better activate less reactive electrophiles. The anticipated significance of this research includes the development of the first efficient Ni-catalyzed Stille cross-coupling of phenolic electrophiles and a better understanding of the mechanistic differences between nickel and palladium. This research was conducted by optimizing the conditions for Ni-catalyzed Stille cross-coupling by changing several variables; temperature, ligand, and solvent were all screened to successfully optimize the reaction. Further, this research evaluated the scope of phenolic electrophiles and organotins that can be used under the optimized conditions, and mechanistic studies that would help discover and understand the reaction pathway. This research ultimately provided a platform to help broaden the scope of Ni-catalyzed cross-coupling and help explain why prior efforts to achieve Ni-catalyzed Stille coupling of phenol derivatives were unsuccessful.

Acknowledgements: John Russell (MSU Graduate Student) – Chemistry & Biochemistry, Undergraduate Scholars Program (USP)

Athena Erickson: Agricultural Economics & Economics
Mentor: Vincent Smith – Agricultural Economics & Economics
Charter School Enrollment & Authorization Exploration

Charter schools are publicly funded privately owned choice schools. The very first charter school first opened its doors in St. Paul Minnesota in 1992, and since then charter schools have been established all over the country as states have written and implemented their own charter school legislation. As of 2018, there are five states in the US that have neither a charter school, nor charter school legislation: Nebraska, North Dakota, South Dakota, Vermont, and West Virginia. Among the five US territories only Guam has charter school legislation and operational charter schools. In this exploration legal authorizers and charter school enrollment from Fall 2010 and Fall 2015 were compared across states and US territories. A comparison of percentage of students enrolled in charter schools in both 2010 and 2015 shows an overall all increase for children in primary and secondary school. Charter school authorizers were identified per each state and territory. Of the twelve different authorizers identified, local school boards are found to be the most common, while a mayor or LLC having authorizing power are the least common.

Madeline Field: Political Science
Mentor: Jennifer Woodcock – Native American Studies
Intersectionality between white and native cultures as seen through the game of Lacrosse

Through this research I intend to answer questions regarding the origins of the popular and well-known game of lacrosse. While lacrosse has become a staple sport of rich white prep school boys across the east coast its roots are slowly being forgotten. Exploring the origins in which lacrosse developed through out Native American nations of the East, like the Iroquois and the Cherokee Nations, would immensely help our understanding of the intersectional ideals that white and native cultures have. While not exactly the same, sports are something that has the ability to bring cultures together and start to create positive communication and progression between white and native cultures.

Marisa Flores: Mathematical Sciences
Mentor: Katharine Banner, Dominique Zosso – Mathematical Sciences
An Investigation of Penalized Logistic Regression with Imaging Data

The deadliest form of skin cancer is melanoma, causing over 9,000 deaths in the United States annually. Automated classification models are necessary due to shortages in practicing pathologists and poor documented accuracy for classifying skin cancer. The goal of this study is to investigate the three-step process of disease classification for images containing malignant or benign skin lesions. A total of 7,818 images were extracted from the International Skin Imaging Collaboration archive of 23,906 total images. Images were separated into three distinct groups: training (5,800), validation (500), and test (1518). The first two steps are image segmentation and feature extraction. The images were segmented using Otsu's thresholding technique within a depth-probing method, an alternative method was considered using imager's built-in segmentation process. The features were calculated from the successful segmented images and put into a data matrix to be used in model building and classifying. The training set were used to build many Penalized Logistic Regression models for comparison. Future research entails an in-depth inspection in the black box of the cv.glmnet function in R. The importance of this task extends to doctors and patients around the world to understand the disease classification process.

Acknowledgements: Undergraduate Scholars Program (USP), IDeA Network of Biomedical Research Excellence (INBRE)

Anna French: Ecology
Mentor: Ryan Thum – Plant Sciences & Plant Pathology

Identification of hybridization between native and invasive aquatic floating hearts (Nymphoides aquatica and N. cristata)

Invasive species are a major ecological and economic concern. Hybridization has been associated with increased invasiveness in many plants. In this study, we used DNA sequencing from the Internal Transcribed Spacer (ITS) and Amplified Fragment Length Polymorphisms (AFLP) to test whether native Nymphoides aquatica hybridizes with invasive N. cristata in the United States, as suspected by some aquatic plant managers. Suspected hybrids contained ITS sequences containing biparental polymorphisms at sites where pure N. aquatica and N. cristata differed. Similarly, AFLP data identified putative hybrids as genetically intermediate between pure N. aquatica and N. cristata. These results demonstrate strong evidence for hybridization between N. aquatica and N. cristata. Future studies should determine whether they exhibit different spread risk, growth patterns, and response to established treatment methods.

Acknowledgements: Undergraduate Scholars Program (USP)

Makenzie Fry: Cell Biology & Neuroscience
Mentor: Kalli Decker – Health & Human Development

Parents' and Therapists' Reports of Early Intervention: Comparing Ideal Services with Reality

This project investigated the experiences of parents with children who have disabilities or delays and are enrolled in early intervention services in Montana. We compared parents' and therapists' perceptions of their early intervention experiences to what their ideal version of what services would be like. Surveys were sent to parents and therapists who were part of a larger INBRE project. As part of the survey, parents (N = 27) were asked to indicate what their ideal version of services for their child looks like and what reality is regarding how services are provided. Participating therapists (N = 20) were asked to indicate how parents are actually involved in services and how they ideally would like parents to be involved. Data was also collected via therapist interviews (N = 14). We were interested in discovering a) if parents are satisfied with their services, b) if the reality parents indicated matches the reality therapists indicated, and c) if parents and therapists indicated that their ideal services include a family-centered approach. We found clear similarities between what parents and therapists want to occur during visits. They both prefer to check in with discussion of progress and time for questions/concerns happens most often. They also agreed that parents should leave the room during sessions least often. We also found parents perceive that they: 1) interact with their child while the therapist observes and 2) interact with the therapist and their child together, more often than the therapist reports that this occurs.

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Britney Gibbs: Cell Biology & Neuroscience
Mentor: David Millman, Brendan Mumey – Computer Science
Automation of Biofilm Research Workflows Linking Various Bioinformatics Tools

Biofilms are communities of potentially diverse microorganisms that work together, making them better able to withstand adverse conditions. Biofilm research results in diverse formats of high-volume data making biofilms difficult to study. The Biofilm Resource and Information Database (BRaID) will help further biofilm research by combining biofilm-related data in a centralized location and offering specialized analysis. Researchers often query databases for gene-related information. Microbesonline is one example of a database that can be queried. Some researchers manually access this database through a web interface, but compiling data for many genes of interest is tedious and time-consuming. An automated pipeline can be used to speed up the data-gathering process, giving the research more time to focus on other tasks. In this project, we helped one researcher automate her retrieval of gene information while expanding BRaID's toolkit. We are developing a Python toolkit that can be used within BRaID or as a standalone tool. It is able to query biological databases and present the results in a user-friendly format. Currently, our tool communicates with the microbesonline database using SQL and queries by gene name to retrieve a subset of information (organism, GeneInfo Identifier (GI), etc), which can be further filtered by the user. Using the GI number, we enrich the data with the proteins' conserved domain (CDD) information by querying the NCBI CDD database. The researcher's specific pipeline also provides links to view some of the websites' query results. All of the data is sorted by gene and then compiled into a CSV file. Future directions include adding more databases to the toolkit, as well as incorporating the toolkit into BRaID and expanding its user base.

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Kevin Goodan: Native American Studies
Mentor: Jennifer Woodcock-Medicine Horse – Native American Studies
Indigenous Nations of Central American: Contemporary Art Movement

The main purpose of this research project in Native Cultures of North America is to focus on the Indigenous Nations of Central America, dealing specifically with the contemporary art movement and the artists meanings, interpretations, and influence at the time. Contemporary art is the art of today, formed in the second half of the twentieth century or in the twenty first century. The art is a part of the cultural dialogue of place, which deals with large important issues such as personal and cultural identity, family, community, and nationality. Contemporary art usually refers to paintings, sculptures, photography, installation, performance, videos, and graphic art (drawing and print making). Guatemala, Belize, El Salvador, Honduras, Nicaragua, Costa Rica, and Panama will be the main countries for research study. Central America has a powerful place in the history of painting and has contributed considerably to the art world. Each individual artist has their own style of portraying life in Central America consisting of a primitive, impressionist, landscapes, modern versions of Mayan art, portraiture, attitudes towards the colonial past, as well as the impact of politics and surrealism for example. I hope to utilize the artists style, and their type of contemporary art to interpret an in-depth understanding of the issues at the time. This understanding will be helpful to demonstrate how past events and issues influence the formulation of current contemporary artistic expression, and what may come of this impact in the future.

Keegan Grady: History & Philosophy
Mentor: Susan Cohen – History & Philosophy
Once and Future Kings: Searching for King Arthur and Jesus in England

This project set out to investigate some of the many modern manifestations of the legend of King Arthur. Arthur was a fundamental myth of the Middle Ages and has continued to be a vital figure in Western culture to this day, spawning reimaginings ranging from film to literature to pop culture. His legend was deeply tied to notions of propriety, chivalry, and right behavior—and thus, Arthur's domain gradually mixed with the domain of religious figures like Jesus of Nazareth. Though comparatively little-known today, the stories surrounding Arthur have been vastly influential to Western society as a whole. This project aimed to investigate Arthurian influences, especially as they related to religion in the southern British Isles, via literary history and personal exploration. The influences of Arthur were revealed by the trip to be ingrained in the landscape and culture of the British Isles; but paradoxically, those selfsame influences are not consciously noted by the inhabitants of the landscape, nor (in most cases) are the stories investigated as separate and wide-ranging texts, but rather as an amalgamated whole composed of many stories melded into a cohesive legend. The project culminated in a long essay-form travelogue called "Once and Future Kings."

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Nolan Grunska: History & Philosophy
Mentor: Prasanta Bandyopadhyay – History & Philosophy
Are Scientific Models of Life Testable? A Lesson from Simpson's Paradox

The difference between scientific theories and theories about religious beliefs (ignoring some wrinkles about string theory) is often drawn in terms of testability - only the former are testable. We discuss two competing theories about the emergence of life on earth: Metabolism First Theory (MFT) and RNA World Theory (RWT). MFT postulates energy utilizing chemical reactions to have generated primordial organic life. In contrast, RWT holds that self-replicating RNA forms the basis of life by storing both genetic information and catalyzing the chemical reactions in primitive cells. One central debate between them consists in objecting to one another that chemical reactions invoked by the other is inefficient. We call this the "inefficiency objection" to the emergence of life theories, which, if true, precludes the emergence of life. Given that life did indeed emerge, the inefficiency objection needs to be explained away. Borrowing an insight from Simpson's paradox (SP) we argue that even though bio-chemical reactions for producing life could be locally inefficient in each cell, they could be globally efficient - a reversal characteristic of SP. This shows that the inefficiency objection need not pose a problem for emergence of life theories.

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Laina Hall, Pushya Krishna: Microbiology & Immunology
Mentor: Blake Wiedenheft, Paul Van Erp – Microbiology & Immunology
Activation of the CRISPR system in Escherichia coli under Acid Stress

Clustered Regularly Interspersed Short Palindromic Repeats (CRISPR)-Cas (CRISPR-associated) systems defend bacteria and archaea genomes from infection by viral and plasmid infection. In Escherichia coli K-12, expression of the CRISPR-Cas system is repressed by the H-NS (histone like nucleoid structuring protein), which acts as a global regulator of gene expression in many prokaryotes. Genetic ablation of H-NS, activates the E. coli immune response but natural conditions under which this immune system becomes active have yet to be discovered. However, in Salmonella enterica, a close relative of E. coli, H-NS was displaced from DNA during acid stress. This led to the prediction that culturing E. coli under acid stress would result in the removal of the H-NS binding of DNA, and expression of the CRISPR-Cas system. To test this, we grew Wild Type and H-NS deletion mutants of E. coli in different acid environments and monitored the evolution of CRISPR loci over time.

Acknowledgements: Undergraduate Scholars Program (USP)

Elizabeth Hamilton: Native American Studies
Mentor: Jennifer Woodcock-Medicine Horse – Native American Studies
Washoe Native American Survival Precontact

The Washoe Indian tribe of western Nevada and eastern California in the Lake Tahoe area had to move, hunt, and gather food with the seasons. The spring season brought the end of their food supply. In early spring gathering of bulb plants then the migration to Lake Tahoe for plant harvesting and fishing. In summer months "Gadu" or summer houses were constructed in the Lake Tahoe area until the snow melted then families would disperse into the mountain country to fish in smaller lakes and hunt quail at this time. In the fall the Washoe began to focus on plant harvesting that would last through the winter months. It was also the best time for hunting because animals were also preparing for winter. During the winter months the Washoe ate mostly what they had stored from the year. They also lived in "Galais dungal" or winter houses. Both summer and winter houses were constructed differently. I have used the internet and museum information to research how the Washoe people lived with the many different seasons of the Northern California Sierra Nevada mountains. I grew up in Grass Valley, CA just two hours from the Lake Tahoe area and had zero knowledge of the Washoe people. I thought it would be interesting to learn about their movements and how they could survive the ever-changing climate of that area.

Colin Hammock: Cell Biology & Neuroscience
Mentor: Neha John-Henderson – Psychology
Childhood Family Environments, Social Network Size and Immune System Inflammation in College Students.

Early life family environments associate with health in adulthood. Specifically, greater adversity or risk associates with worse health outcomes. Immune system inflammation is one pathway that may contribute to this relationship. Less is known about the social factors or experiences that may mediate associations between early family environments and later health. The current study examines early family environments and social network size as factors that may affect health risk in a sample of 92 college student participants. Risk in early family environments was measured with the Risky Family questionnaire and we measured immune system inflammation through collection of dried blood spots. Specifically, we measured levels of C-reactive protein (CRP), which associates with risk for cardiovascular disease. We also measured the number of people in students' social networks. Risk in early family environments associated with higher levels of CRP. This relationship was in part accounted for by social network size (i.e. greater risk in early family environments associated with smaller social network sizes). Documented relationships between early experiences and later health may in part be attributed to differences in the size of social networks. The results suggest that one potential focus for interventions may be to increase social networks for students who come from early family environments characterized by risk.

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Trevor Hawks: Psychology
Mentor: Keith Hutchison – Psychology
Transcranial Direct Current Stimulation Effects on Attentional Control.

The field of neurostimulation has undergone sweeping changes in the last decade. One of the major new technologies on the scene is a noninvasive way of modulating brain activity known as Transcranial Direct Current Stimulation (TDCS). TDCS is a noninvasive procedure in which an extremely small current (I<2mA) is applied via electrodes to two locations on the scalp. Stimulation is hypothesized to simultaneously stimulate and inhibit parts of the cerebral cortex by depolarizing and hyperpolarizing neurons respectively. Claims about TDCS's benefits range from improved task performance and enhanced learning to treatment for depression and other psychiatric disorders; however, relatively few of these claims have been substantiated. The present experiment aimed to investigate the effect of (TDCS) on attentional control. Attentional control is necessary for task performance

because it suppresses distracting stimuli while enhancing task relevant information. Demonstrating an impact on attentional control due to TDCS would have implications for the field of cognitive research. A between-subjects design using TDCS was employed in conjunction with a validated assessment of attentional control to determine if TDCS is an effective tool for improving attentional control (n=30). A secondary aim of this study was assessing whether people lower in working memory capacity would be differentially impacted by TDCS treatment. Surprisingly, TDCS was found to degrade subjects' attentional control as measured by an antisaccade task regardless of subjects working memory capacity. These results bring into question the claims about TDCS and call for further research to investigate the effects of TDCS on task performance.

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Madison Hebner: Microbiology & Immunology
Mentor: Eric Boyd, Eric Dunham – Microbiology & Immunology
Traditional Approaches for Life Detection When Modern Approaches Fail

Iceland is a barren island nation that is defined by its dramatic topography of volcanoes, hot springs, and glaciers. Of these, one glacier of particular scientific importance, Dragajökull, lies in an isolated and northernmost part of Iceland. The bedrock of this glacier is composed of iron-rich weathered basalt, estimated to be 3.1 million years old, making it the oldest extant rock base on the island. Previous sediment samples taken from Kaldalón, an outlet of this glacier, were not indicative of any life; molecular methods of multiple displacement amplification and PCR did not yield any detectable DNA. Although it appeared as though no microbial life existed in this isolated environment, I have been able to observe four morphologically different phenotypes by traditional microbial culture methods. With this knowledge of an existent microbial ecosystem as part of the Dragajökull glacier, further physiological information regarding the isolated microorganisms extracted can be obtained, specifically the metabolic processes that are distinct to these organisms, in order to determine how they are adapted to this extreme habitat. This research is specifically relevant to exobiology. For example, it is known that icy planets and moons exist in our solar system, and research focused on analogous systems on Earth, such as glaciers, can provide a deeper understanding of the processes that sustain life in these environments and the particular techniques that are well suited to detect evidence of this life.

Katelyn Henningsen: Cell Biology & Neuroscience
Mentor: Frances Lefcort – Cell Biology & Neuroscience
The Role of the ELP1 Gene in the Development of the Enteric Nervous System of the Stomach

The relationships between the intrinsic and extrinsic innervation of the gastrointestinal tract, the microbiome, and epithelial morphology is still very unknown. A Wnt/Cre embryonic mouse model with a conditional knockout of the ELP 1 gene (previously known as IKAP) within the neural crest and its lineage is being used to explore these relationships, specifically in regards to the development of the enteric nervous system. This conditional knockout mouse model represents the neurodegenerative disease of Familial Dysautonomia (FD), a genetic disorder that affects neuronal development and survival, specifically in neurons that control digestion, breathing, regulation of blood pressure, motor skills, and more. It is hypothesized that innervation differences between mutant and control embryonic mice will be present and therefore potential morphological and physiological differences as well. Analysis of stomach innervation and the differentiation of neurons was conducted using parallel sectioning of dissected embryonic mouse stomachs and immunohistochemistry. This allowed for a detailed analysis of the development of innervation, morphology, and how physiological actions of the stomach are affected when IKAP protein is deleted from neural crest lineage cells and therefore the intrinsic nervous system of the gastrointestinal tract.

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Katherine Hernandez: History & Philosophy
Mentor: Maggie Greene – History & Philosophy
The Imperialist Mindset: Race in British Victorian Fairy Tales

British Victorian fairy tale writers wrote both to children and adults about social issues that the writers wanted to reform. The illustrations that went with these tales shared a similar exigence on race. Race issues were not that strongly addressed, yet both the stories and illustrations depicts the white hero conquering the supposed 'inferior' other race. The importance of the representation was crucial to continue to shape British imperialism. Leaders, like Winston Churchill, were heavily influenced by these tales in their politics. Understanding the influence of Victorian children's stories, shows the lasting impact the stories have on children and adults alike.

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Breanne Hodgson: Physics
Mentor: Recep Avci – Physics
The Effects of Graphene Coatings in Protection Against Biocorrosion in Suboxic Environments

The total annual cost of corrosion in the US is ~ 1 trillion dollars, larger than the annual cost of US defense spending. The main objective of this study is to test the preventative role of coating metal surfaces with graphene to prevent corrosion and biodegradation. In this experiment two different types of metal samples were used to test this concept; nickel and copper. For the nickel samples a foil coated in multiple layers (~ 1 micron thick) of graphene was purchased and tested, as well as a control sample without any graphene coating. For the copper samples, two different types of foils were tested, one with a single layer of graphene and another with 6-8 layers of graphene coatings as well as a control that was uncoated. These foils were placed in a suboxic sulfidogenic environment that was created using two different strains of highly corrosive bacteria grown in San Diego Bay seawater. The first bacteria were aerobic and used to reduce the dissolved oxygen levels in the seawater so that the second anaerobic sulfate reducing bacteria (an anaerobe) could live in this oxygen depleted environment. After some weeks the foils were analyzed with high resolution electron microscopes to observe surfaces of these foils. It was found in the nickel samples that bacteria formed a very little biofilm on the graphene coated samples whereas a thick layer of a bacteria biofilm formed on the uncoated samples. In the copper samples it was observed that large amounts of corrosion deposits formed on the surfaces of the foils as well as at the bottom of the containers. Furthermore, large number of bacterial death was observed within a week of inoculation. The source of Cu oxide deposits at the bottom and on the surface of foils are originated from the dissolution (corrosion) of the edges of Cu foils. In addition, there was also some copper sulfide deposition that were present on the surface of the copper foils. In comparison, a more recent series of reactors were made using the same copper foil but now have the edges sealed off using epoxy, it was recorded that no bacterial death occurred and the blue deposits that made up the copper oxide were not seen. We expect that graphene offers a great potential as anticorrosion coating preventing biodegradation of the material surfaces.

Acknowledgements: ICAL

Myndi Holbrook: Microbiology & Immunology
Mentor: Blake Wiedenheft – Microbiology & Immunology
Determining the role of the AP-complex in C. trachomatis pathogenesis

Chlamydia trachomatis is an obligate intracellular bacterium that is the most commonly reported sexually transmitted infection worldwide with an estimated 89 million new cases annually [1]. Despite the impact of this parasite on human health, there is a critical gap in our understanding of specific host factors and molecular pathways C. trachomatis uses during infection. To address this knowledge gap we performed a genome wide knockout screen using CRISPR-Cas9. The screen identified genes associated with the adaptor protein complex (AP-complex) as being important for completion of the Chlamydia trachomatis lifecycle. The AP-complex plays an

important role in intracellular membrane trafficking and the genes identified in the screen included: AP1B1, AP3S2, and AP1G2. To validate results from the screen we created clonal cell lines containing knockouts of each gene. These clones are currently being challenged with Chlamydia trachomatis to quantify the impact of these genes on Chlamydia replication. Completion of this project will provide fundamental new insight into the C. trachomatis life cycle in human cells, and will be an important milestone towards unraveling the complex relationship between this bacteria and its host.

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David Holzer: Psychology
Mentor: Neha John-Henderson, Cara Palmer – Psychology
Sleep Quality in College Students

Low childhood socioeconomic status (SES) associates with poor sleep quality in adulthood. Recent work from our lab indicates that a nurturing childhood family environment offsets the association between childhood socioeconomic status and self-reported sleep quality. Here, we sought to replicate and extend these findings using actigraphy-derived measures of sleep. We used linear regressions adjusting for age and sex to examine relationships between childhood SES, risk in childhood family environments, self-reported global sleep quality and an actigraphy derived measures of wake after sleep onset (WASO). Replicating earlier research, childhood SES and early family environments interacted to predict self-reported global sleep quality. Similarly, these factors interacted to predict WASO. Specifically, individuals who came from low SES backgrounds in childhood who also reported more risk in their early family environments had significantly greater WASO compared to individuals who came from low SES backgrounds who reported a more positive family environment. Findings highlight the importance of considering socioeconomic and family environments in childhood as informants of sleep quality across the lifespan. Future work should focus on designing interventions that may improve sleep quality for college students who are at the greatest risk.

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Kennan Hooker: Cell Biology & Neuroscience
Mentor: Anja Kunze – Electrical & Computer Engineering
Optimization of Genetically Encoded Tau Indicator in E18 Cortical Rat Neurons

One of the challenges faced by the field of neurodegenerative disease study is the lack of visualization methods for implicated cellular components in vitro. The use of biologically compatible fluorescent dyes has allowed for high-contrast resolution imaging of cellular features but many reagents face the disadvantage of being cytotoxic, thereby limiting the longitude of a neuron culture. The development of genetically expressed fluorescent sequences coupled to a protein of interest circumvents this issue. By altering the protein product for continued fluorescent expression, this technique allows for live-cell imaging throughout the maturation of a neuronal network without adverse effects on cell viability. We have developed an optimized protocol for expression of a genetically encoded tau indicator (GETI) in E18 rat cortical neurons. A fluorescent light microscope is used to image living tau+ neurons. In addition, we used the GETI in conjunction with fluorescent chitosan-coated magnetic nanoparticles (mNPs) to quantify the amount of endocytosed nanoparticles.

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Leidy Hooker: Chemistry & Biochemistry
Mentor: Sharon Neufeldt – Chemistry & Biochemistry
Chemodivergent Nickel-Catalyzed Suzuki Cross-Coupling

Suzuki cross-couplings reactions allow the creation of carbon-carbon bonds, usually between two aryl groups, using a metal catalyst. Although palladium is the most common catalyst, this work utilizes nickel as the catalyst.

Nickel's nucleophilic nature increases its reactivity with a broad array of electrophiles, especially phenol-derived electrophiles. With numerous functional groups to work with, the goal of this project is to use ligands on nickel to control selectivity for different electrophilic functional groups in Suzuki cross-coupling reactions. In particular, we have found that nickel can be induced to react selectively with a halide functional group or, alternatively, with a phenol-derived functional group simply by switching the ligand in the reaction. This poster describes our discovery of ligand-switchable selectivity between aryl halides and phenol-derived functional groups and our efforts to optimize the reaction. We have screened a number of boron nucleophiles as well as synthesized and screened alternative pre-catalysts. Although further work is needed to improve yields, we anticipate that these results will have significant implications for organic synthesis. The ability to switch catalyst selectivity in cross coupling reactions could facilitate synthesis of compounds ranging from polymers (e.g., plastics) to pharmaceuticals (e.g., drugs to treat leukemia).

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Benjamin Hulme: Sociology and Anthropology
Mentor: Jennifer Woodcock-Medicine Horse – Native American Studies
Causal Factors of Intimate Partner Violence of the Plains Indians

Today, over 1 in 3 women experience some form of intimate partner violence or abuse. Native Americans, specifically women and children, experience the highest rates of violent victimization of any race in the United States. Although there is prior evidence to support this prominent issue, there is little evidence explaining how intimate partner violence is correlated with physical and sexual abuse, substance abuse, depression, and most commonly, suicide attempts. This study will examine causal factors as to how domestic violence victims are more like to engage in illegal activities or self-harm. Intimate partner violence has a significant impact on victims, greatly increasing their chances of engaging in illegal activities. However, further research is needed in order to get a better understanding of what aspects of violence cause victims to engage in these activities/habits.

Rudolph Hummel, Travis Ball, Calvin Eden, Fiona Lewis: Earth Sciences, Chemistry & Biochemistry, Ecology
Mentor: Dave Varricchio – Earth Sciences
Digestive Taphonomy: Equifinality in Corroded Bones

Taphonomy is the study of post-mortem processes and their effects on the remains of organisms. Within taphonomy, the term equifinality describes the observation that multiple taphonomic processes can produce similar taphonomic effects. In the past, researchers have used acid corrosion on fossil bone to infer its digestion; however, other naturally occurring acidic solutions (such as bogwater) can also be corrosive. We hypothesize that the taphonomic effects of acid corrosion alone cannot be used to differentiate digestion and corrosion from bogwater in fossil material. We will submerge bone in simulated gastric juice and bogwater solutions to determine whether gastric juices produce a unique, identifiable suite of taphonomic effects compared to bogwater. Sets of three chicken tibiae will be submerged in one of the four solutions (gastric juices, two different bogwater solutions, and distilled water as a control group) for predetermined time intervals. Mass loss of each bone will be recorded and high-resolution photographs will be taken. Qualitative observations of taphonomic effects (presence of polishing, pitting, etc.) will be made by two researchers, who will know the identification number of each bone but not its acid bath or time interval. If the gastric juice solution produces a suite of taphonomic effects which is not unique compared to those of bogwater, the results will support our hypothesis. If the suite appears unique to the gastric acid solution, we will reject our hypothesis and describe the suite so future authors can differentiate between digestion- and bogwater- induced corrosion in fossil bone.

Acknowledgements: Rocky Mountain Section of Geological Society of America

Rudolph Hummel: Earth Sciences
Mentor: Chris Organ – Earth Sciences
Origin and Dispersal of Gorgonopsia: A Phylogenetic Approach to Permian Therapsid Biogeography

Gorgonopsia is a group of extinct, Permian-age, carnivorous therapsids (mammal ancestors) largely from Russia and Africa. The origin and dispersal of Gorgonopsia and related therapsids is poorly understood; specifically, how gorgonopsian species originated in both northern and southern Pangaea (including modern day Russia and Africa) despite Permian climatic data supporting an expansive desert dividing the two regions. This study aims to determine the origin and dispersal of Gorgonopsia using phylogenetic (evolutionary tree) methods and test whether the desert in central Pangaea was a significant ecological barrier. Previous phylogenetic analyses of Gorgonopsia were hampered by a poor understanding of the group's taxonomy. This problem is largely the result of a lack of interest and poorly preserved holotypes. At present, there is no phylogeny combining sufficient specimens of Gorgonopsia from both regions. In fact, there is no quantitatively-inferred phylogeny for the Russian species at all. The creation of a specimen-level phylogeny (as opposed to the previously attempted species-level phylogenies) using data from specimen descriptions will bypass these taxonomic issues. The relationships of Russian and African specimens provided by this phylogeny will then be used to quantitatively predict the group's likely geographic origin and subsequent path(s) of dispersal. Finally, the results of this biogeographical study will be used to test whether the desert covering central Pangaea was impassable, as some authors have assumed, or possessed 'corridors' that allowed faunal interchange, as others have recently suggested.

Acknowledgements: Jacob Gardner (MSU Graduate Student) – Earth Sciences, Undergraduate Scholars Program (USP)

Micah Johnson: Physics
Mentor: Charles Kankelborg – Physics
Confocal microscopy for high-precision non-contact optical measurements

The EUV Snapshot Imaging Spectrograph (ESIS) is a slitless, tomographic imaging spectrograph for observing the solar transition region in extreme ultraviolet (EUV) at 63 nm wavelength. An array of concave diffraction gratings re-image from the telescope prime focus to our CCD detectors. The instrument is aligned and focused in visible light, using substitute diffraction gratings ruled for the red HeNe laser line. To transfer precise alignment and focus of the visible gratings to the EUV gratings, we have developed a miniaturized, three point, non-contact measurement system, TEA (Transfer ESIS Alignment). TEA locates the grating surface using confocal microscopy, with three independent channels scanned together on a single stage, to specify the position and orientation of the spherical surface. Challenges for this measurement include the small size of the ESIS gratings (~16 x 20 mm), their curved surfaces, diffraction effects, the alignment of tiny optics within TEA, and the mechanics used to repeatability mount the gratings. Our testing shows that the intrinsic repeatability of our measurement apparatus is approximately 2 microns. In practice, however, our error is dominated by the process of mounting the grating subsystem in TEA, which introduces 12 micron differences between subsequent runs. This level of repeatability meets our requirements for ESIS.

Acknowledgements: Rubin Meuchel (MSU Research Engineer) – Physics, Roy Smart (MSU Graduate Student) – Physics

Herlin Kadriu: Microbiology & Immunology
Mentor: Carl Yeoman – Animal & Range Sciences
Does Spontaneous Oxidation of Biogenic Amines Alter Their Inhibition of Bacterial Growth?

Bacterial vaginosis (BV) is the most common vaginal disorder among reproductive age women. Clinical signs of BV include amine or "fishy" odor, a creamy gray discharge, an elevated pH and/or the presence of superficial squamous cells with peripheral clumps of bacteria (clue cells). The odor of BV is associated with an increase in Biogenic Amines (BA) that have been identified as important biomarkers of the disorder. However, BAs may also play a mechanistic role in the etiology of BV, including altering the growth of both healthy and BV-associated

vaginal taxa. While testing how the growth rates of anaerobic bacteria are affected by BAs, it was observed that their effect varies if these BAs are added to media and allowed to pre-warm to 37°C too far in advance of growth assays. Through further investigation we have observed and quantified by spectrophotometer colorimetric changes in BAs incubated in media over a 1 and 7 day period. Due to these observations, we have hypothesized that BAs form products with other media constituents and/or spontaneously oxidize. These reactions seem to be temperature dependent. This research determines specific ingredients in media that alter the integrity of specific BAs through colorimetric changes measured at a large range of optical densities.

Acknowledgements: IDeA Network of Biomedical Research Excellence (INBRE)

John Katzenberger: Economics
Mentor: Jennifer Woodcock Medicine Horse – Native American Studies
The Pre-Contact Lifestyles and Diets of Southwestern Indigenous Tribes

This research paper will examine the lifestyles and diets of the Southwest Native American peoples prior to the sixteenth century. The major tribes of the southwest include the Pueblo, Hopi, Yuam, Zuni, Navajo and Apache. The rocky, dry land in what would become Arizona, New Mexico and southern Colorado allowed for the cultivation of few crops and required the fields to be systematically irrigated. Crops grown in this area consisted of mainly corn (maize), beans, squash, and sunflowers. Most of these tribes lived in villages and farmed as their main occupation. The native people of the southwest were very spiritual people and are well-known for their beautifully handcrafted pottery that often depicted ancient ceremonies and important events. Tribal housing of this geographic region consisted of Adobe houses, Hogans and shelters made of brush. Before contact with European explorers, the indigenous tribes of the southwest lived a relatively undisturbed and self-sustaining lifestyle. With the rapid spread of Catholicism and colonialization throughout the 16th and 17th centuries, the indigenous tribes of the southwest would undergo massive lifestyle changes that would inevitably lead to the ethnocide of the indigenous peoples

Deanta Kelly: Physics
Mentor: Amy Reines, David Nidever – Physics
Color Selection of Quasars in a SMASH Data Field

This project is a search for quasars, a type of active galactic nucleus, in a field from the SMASH (Survey of the MAgellanic Stellar History) catalog of the Large and Small Magellanic Clouds using color selection in order to take advantage of the survey's deep data to potentially see dimmer quasars than would otherwise be possible. The selection box was checked using data from the Magellanic Quasars Survey by Kozlowski, et al. While the preliminary quasar candidate list retrieved some of the already known quasars in that area of the sky, a significant percentage of known quasars were not retrieved. More work is necessary in order to refine the $z < 2$ quasar selection box in order to retrieve a larger portion of the known quasars at those distances.

Isbah Khan: Cell Biology & Neuroscience
Mentor: Jason Cook – Plant Sciences & Plant Pathology
Validation of QSnh.mst-4A for Seed Number per Spike in Biparental Spring Wheat Mapping Population

Wheat is one of the most consumed grains globally and research for further improvement for yield potential is needed to meet demands of consumption. The research objective was to validate a seed number per head quantitative trait locus- *QSnh.mst-4A* in a second recombinant inbred line (RIL) mapping population derived from a cross between spring wheat lines, Vida and MTHW0202, to determine if *QSnh.mst-4A* will be useful for increasing yield in spring wheat. Secondly, we aimed to examine spring and winter wheat diversity panels to measure the frequency of high seed number per head for the *QSnh.mst-4A* allele in different breeding programs located across North America. Experimental methods consisted of obtaining genetic material through DNA

extractions of young wheat tissue for Kompetitive Allele Specific PCR (KASP) assays- providing analysis of genotyping wheat lines and finding an association between phenotypes- and genetic linkage mapping via QTL analysis. The results of this experimentation displayed that the parent MTHW0202 wheat lines were statistically significant for the marker that increased seed number per head compared to Vida wheat lines. Therefore, it is validated that the *QSnh.mst-4A* allele is correlated with increasing wheat yield via seed number per head in RIL mapping populations.

Acknowledgements: Undergraduate Scholars Program (USP)

Scott Killian: Cell Biology & Neuroscience
Mentor: Susy Kohout, Will Ratzan – Cell Biology & Neuroscience
Localizing endogenous VSP in the brains of African clawed frogs and mice.

Voltage sensing phosphatases (VSPs) are proteins composed of a transmembrane voltage sensing domain (VSD) coupled to a cytoplasmic phosphatase domain (PD). In response to changes in membrane potential, the VSD undergoes a conformational change allowing the PD to dephosphorylate membrane phosphatidylinositol phosphates (PIPs). These modified PIPs are involved in a variety of cellular processes including cell proliferation, migration, ion channel modification, and cytoskeleton remodeling. Considering their ubiquity, it's crucial to find out VSP's specific role as a mediator between membrane potential and PIP signaling pathways. A first step in finding this role is to determine in which tissues and cell types VSPs are expressed. Using Western blots, my lab showed that VSP is found in the kidneys and brains of Xenopus laevis (African clawed frog), Xenopus tropicalis (western clawed frog), and Mus musculus (house mouse). Following this lead, I used immunohistochemistry to show VSP expression on the luminal surface of X. laevis embryonic kidney (pronephros) and within the functional unit (nephron) of the adult kidney. This fall, I began searching for VSP in brain tissue while also improving my immunohistochemistry and tissue sectioning protocol. While I have not been able to get a conclusive subcellular localization of VSP in the brain, I will continue to optimize my methods to find this interesting and important protein.

Acknowledgements: IDeA Network of Biomedical Research Excellence (INBRE)

Erin Kimbro: Physics
Mentor: Amy Reines – Physics
A Survey of AGNs in the NSC Using Optical Variability

I used the NOAO source catalog (NSC) to identify AGNs using three properties - variability, the star class identifier, and size. Variability describes how an object's energy output changes over time and variability is a common characteristic of AGNs. I used optical wavelengths to calculate variability. The star class identifier is a value within the NSC that describes the probability of an object being a star. The size of an object is also listed within the NSC. Due to problems with the catalog and the project, I was not able to conclusively find AGNs throughout the whole catalog, but I produced light curves for several objects that are characteristic of different types of objects in the sky, such as AGNs. This preliminary work can be used as a guide to find more AGN like objects in this catalog.

Acknowledgements: Undergraduate Scholars Program (USP)

Ashland Knowles: Physics
Mentor: Anton Vorontsov – Physics
Resolving Anomalies of Third Sound Modes in Thin Films of Superfluid Helium-3

In an experiment (Schechter, Simmonds, Packard, and Davis, 1998) which identifies third sound waves in thin films of superfluid Helium-3, there is an unresolved inconsistency between theoretical predictions and experimental data concerning the relation between resonant frequencies and film temperature, also known as mode behavior or third sound spectra (Schechter, Simmonds, Packard, and Davis, 1998). In the research performed by my

professor and I, the goal was to develop a valid theoretical model that accurately describes the third sound spectra observed in the experiment. Several different hypotheses were tested, from which the models were developed. One hypothesis attributes the inconsistency to a non-uniform film profile imposed by the driving electrode above the film. The first two models from that hypothesis are based on a piecewise surface wave solution in different regions of the film, and a linear perturbation solution over the entire film. Using a similar hypothesis, another model was developed involving supercurrents under the electrode and at the edges of the underlying substrate. Superfluid density variation within the film was also considered which formed another model. Out of all the models it appears that the most significant improvements come from the piecewise solution approach. Improvements occur only in low temperature regimes, and further research is in progress to obtain a valid model that also explains higher temperature regimes. In each model a standard hydrodynamic approach was taken but it now seems necessary to go beyond hydrodynamics and explore the underlying microscopic theory to understand the mode behavior.

Acknowledgements: Undergraduate Scholars Program (USP)

Chelsea Koessel: Cell Biology & Neuroscience
Mentor: Ada Giusti – Modern Languages & Literatures
Geriatric Care in Morocco

Geriatric care facilities have recently been implemented in Morocco. Historically, caring for elders has been the responsibility of female family members; however, recent changes in demographics have led to a need for nursing facilities. With an increase in life expectancy during the last 40 years, it has been projected that by 2050, the elderly population will exceed 23% of the total population (Fourrier, 2015; Xinhua, 2017). In addition, currently 30% of females have entered the work force, with the rate steadily increasing (Fourrier, 2015). Thus, it has become more challenging to provide geriatric care within the home. To learn about the care provided for seniors, a series of interviews was conducted with 16 random adults in Morocco. The interviews were completed in both rural and urban regions, and it was found that all individuals interviewed had the same conflicted feeling about the development of nursing facilities. Each interviewee identified a need for facilities because of the increase of homeless elderly people. However, due to the cultural expectation that elders should be cared for within the home, the facilities were considered shameful. Many expressed that there was unfortunately less care being provided in the home for various reasons, creating a need for nursing facilities. To gather further information, observations were made by shadowing employees in a geriatric facility located in Meknes. It was noted that the care provided was similar to care given in the United States, but the employees lacked education on basic hygiene and sanitation practices.

Acknowledgements: Undergraduate Scholars Program (USP)

Emilyn Kracher: Physics
Mentor: Brian D'Urso – Physics
Photoluminescence of Silicon Carbide with Silicon Defects

Silicon defects within silicon carbide can be very useful, especially in opto mechanics, quantum optics, and atomic physics. This is due to its properties when a silicon atom is missing, which gives it a magnetic moment and could allow for some exciting advancements to be made. Currently, it is being used in magnetic traps to measure big G to an greater accuracy and could be used for fundamental quantum physics tests such as trapping a micro particle or nano particle in superposition. To achieve this it is important to understand the material. One helpful way to do this is through its photo luminescence. By taking the silicon carbide's spectroscopy we can analyze which peaks are due to the defect and use this information to understand how the material changes through the processes of etching, resizing, and trapping the particle. This is done by exciting the material with a laser and directing the emission through a spectrometer where the light is spread by a diffraction grating and collected by a CCD. The energy peaks can be calibrated to asses its wavelength and ensure that the peak is from the defect. By directing the laser at specific portions of the material we can asses the how homogenous the defect is throughout the

sample and when the sample goes through the etching process the temperature at which the defects begin the migrate can be determined. This allows the material to be used smoothed and accurate when used in the experiment.

Acknowledgements: Undergraduate Scholars Program (USP), Montana Space Grant Consortium (MSGC)

Quinn Krause: Cell Biology & Neuroscience
Mentor: Bernadette McCrory – Mechanical & Industrial Engineering
Systematic Literature Review of Currently Available and Emerging Intracorporeal Imaging Technologies

Current intracorporal imaging technologies are not sufficient. Many research studies developed ways to integrate alternate technologies into existing procedures. For example, augmented reality in medicine has impacted in simpler operations. Even conventional ultrasounds can be improved by attaching a small projector to display the ultrasound's image directly onto the surface of the skin aiding in the clinician. To understand the use of these different intracorporeal imaging technologies a systematic literature review was performed. Using the keywords of "Ultrasound Vascular Access" a total of 6,402 articles were found. Based on an initial review of these 6,402 articles further keywords were used to refine the search results. These keywords were "Intravenous, cannulation, augmented reality, virtual reality, mixed reality, and peripherally inserted catheters." This narrowed the results to 200 articles. Two major themes were identified: advanced intracorporeal imaging used during surgical procedures and those used only to acquire vascular access during a variety of procedures (n=35). The 35 articles identified not used only for surgical procedures were then further reviewed. Based on these initial findings, integrated augmented reality system for ultrasound (mixed reality) appears to be the most promising technology that is effective, reduced cognitive workload and has adequate usability in clinical environments.

Acknowledgements: Undergraduate Scholars Program (USP)

Michael Laase: Earth Sciences
Mentor: Colin Shaw – Earth Sciences
Three-Dimensional Reconstruction of Carbonate Reservoir Rock Pore Networks Using Confocal Laser Scanning Microscopy

In 2003, the Big Sky Carbon Sequestration Partnership (BSCSP) launched the Kevin Dome Carbon Storage Project aimed at determining the feasibility of sequestering large volumes of CO2 into a carbonate liquid-gas reservoir in the Kevin Sunburst Dome (KSD). As part of this effort, the Shaw Research Group completed bench-scale experiments designed to replicate reservoir conditions in the KSD host strata during supercritical-CO2 injection with KSD core samples. In this study, these experimental core samples were analyzed with a methodology using Confocal Laser Scanning Microscopy (CLSM) and a sample "serial-sectioning" technique to study the physical changes in pore-networks arising during supercritical-CO2 injection. Specifically, this research aims to: 1) characterize how carbonate pore-network topologies and geometries change across reservoir facies during injection. 2) Quantify and visually capture the effects of injection on micro-porosity, macro-porosity, total-porosity, and pore-fracture connectivity. To achieve this comparison, sections of cores were collected before and after injection trials. These sections were impregnated with low-viscosity epoxy doped with fluorescent dye in order to register porous space in samples. Data processing with Imaris Microscopy Image Analysis Software allowed "image-stacks" produced by CLSM imaging to be rendered in three-dimensional space and compiled to reconstruct pore-networks with micrometer-scale resolution. The results of this analysis show that CO2 injection increases total-porosity amongst the host facies and changes pore-network structure with varying magnitude across these facies. Samples with pre-existing fracture networks show the greatest increases in pore-throat aperture locally; some experiencing an effect being referred to as rapid "wormholing" parallel to bedding planes.

Acknowledgements: Omotayo Omosebi (MSU Postdoc/Research Scientist) – Earth Sciences, Undergraduate Scholars Program (USP)

Thomas LaBarge: Earth Sciences
Mentor: Chris Organ – Earth Sciences
The Interrelationships of Phorusrhacidae and the Evolution of Gigantism

Phorusrhacids, commonly referred to as "Terror Birds", are an extinct group of large, flightless, predatory birds. As a result of South America's isolation following the Cretaceous-Paleogene Extinction (66 Ma), the derived members of this group represent a unique example of birds evolving to sizes and ecologies similar to their theropod dinosaur ancestors. However, the evolutionary means by which they achieved these enormous sizes remains largely unstudied. We hypothesize that midway through this group's evolution, these animals experienced a period of rapid diversification correlated with an overall increase in body size. To test our hypothesis, we created a revised evolutionary tree for the family Phorusrhacidae with analyses on body size evolution. Using past analyses as a framework, we formed a new composite matrix of diagnostic traits and constructed a Bayesian phylogeny, a tree calculated using Bayesian statistics. New data and characters were added to accommodate the addition of the species Llallawavis scagliai and Titanis walleri. We will use the tree to test for variability in the rate of body size evolution across the group and determine if these rates are associated with species divergence. The new evolutionary tree indicates that gigantism is constrained to one group with extreme examples occurring solely in Phorusrhacinae. This revised Phorusrhacid tree clarifiers how this group evolved. It may also have further implications regarding Phorusrhacid ecology and reveal evolutionary trends regarding gigantism.

Acknowledgements: Jacob Gardner (MSU Graduate Student) – Earth Sciences

Madalynne LaLanne: Physics
Mentor: John Sample – Physics
Debris Recycler for Low Earth Orbit

This project is the start of a future project of a Debris Recycler for Low Earth Orbit. This is a small scale induction furnace used to melt metals within a vacuum chamber to test and modify a future design for a satellite that will melt down metal debris within our low Earth orbit into chunks of material to be sent to the International Space Station or back to Earth to be repurposed. This project will give us a solution to the growing space debris problem that we are facing. If this problem is not addressed, we will have a harder and harder time getting into space without the potential for collisions with this debris.

Acknowledgements: Undergraduate Scholars Program (USP)

Maggie LaRue: Ecology
Mentor: Lindsey Albertson – Ecology
Impact of Beaver Dam Analog Structures on Secondary Production in the Centennial Valley of Montana.

Within the United States, the EPA reports more than one-third of its rivers are listed as impaired or polluted. Freshwater ecosystem impairment and pollution is not limited to the commonly known sources of agricultural runoff containing pesticides and fertilizer, or infrastructure additions, such as highways. Instead, removal of keystone species such as the beaver (Castor canadensis) can influence the trophic interactions and ecosystem function by altering stream structure and community composition. Specifically, a beaver's dam-building shifts the annual discharge, decreases relative velocity, creates a stair-step profile, floods a larger area of soils and increases the deposition of fine sediment to the streambed. The Centennial Valley in southwest Montana is home to one of the last adfluvial populations of grayling in the state. Due to historic cattle grazing and loss of beaver population, beaver dam analog structures (BDAs) were implemented as a method of stream restoration in 2016. This project quantified how previously analog (BDAs) structures impact secondary production in freshwater ecosystems favored by Grayling. The study did so by comparing macroinvertebrate densities from actual beaver dams to two different mimicry structures on Long Creek in the Centennial Valley. Surber samples using standardized methods were collected at ten different sites over a two-year period. After preliminary data analysis, natural beaver dam

structures were found to have significantly higher densities and biomass of macroinvertebrates than mimicry structures. This data provides further insight into the importance of follow up studies on stream restoration projects concerning ecologically important species, such as the Arctic Grayling.

Acknowledgements: Holden Reinert (MSU Graduate Student) – Ecology, Undergraduate Scholars Program (USP)

Verena Lawrence: Microbiology & Immunology
Mentor: Michelle Flenniken – Plant Sciences & Plant Pathology
Natural Infection of Hemocytes in Honey Bee Antiviral Defense

Honey bees (Apis mellifera) are the primary pollinators of many plants. Since 2006, several factors, including viruses, have caused annual honey bee colony losses averaging 33% (Lee et al, 2015). In an effort to better understand how the honey bee immune system and antiviral responses work, natural infection in honey bee larvae and isolated hemocytes (macrophage-like immune cells) is being investigated. Fruit fly (Drosophila melanogaster) hemocytes remained uninfected in virus-infected flies, since hemocytes help mediate antiviral responses (Tassetto et al., 2017). Hemocytes are used as a model for cellular level studies of antiviral responses in honey bees, so the goal of this research project is to determine if hemocytes may also remain free of viruses in otherwise infected honey bee larvae. RNA was isolated from each larval carcass, which include epithelial and other cells, or from primary hemocyte samples and reverse transcribed to generate cDNA. Virus-specific polymerase chain reactions (PCRs) were done to test for the presence of eight honey bee viruses in the hemocytes and carcasses. It was determined that the hemocytes of naturally infected larvae are generally uninfected. Of 39 larvae, 13 were infected with black queen cell virus, deformed wing virus, or sacbrood virus. Of these, one hemocyte sample was infected with the same virus that had infected the larva (black queen cell virus). Further experimentation will include testing a larger sample of hemocytes and carcasses. A larger sample size will increase the number of naturally infected larvae and thereby increase the number of potential hemocyte infections. Experiments will also be done using adult honey bees inoculated with flock house virus in laboratory-based experiments to establish whether hemocytes from adult honey bees and larvae are virus resistant. Should hemocytes remain uninfected in otherwise infected larvae or adult bees, this could indicate that they are able to mount a strong antiviral response and that they may be a useful model for studying infection and antiviral responses in honey bees at a cellular level.

Acknowledgements: Alex McMennamin (MSU Graduate Student) – Microbiology & Immunology, Undergraduate Scholars Program (USP)

Katherine Lee: Physics
Mentor: Charles Kankelborg, Berk Knighton Angela Des Jardins – Physics, Chemistry & Biochemistry, Physics
High-Altitude Solar Observations with Raspberry Pi

High-altitude balloons have a number of advantages in that they allow easy, inexpensive access to upper layers of the Earth's atmosphere for purposes of scientific study. This project uses a low-resolution camera mounted on a high-altitude balloon to test whether student-level methods can be used to demonstrate solar phenomena. The secondary goal of the project is the development of a method of analysis that can be adapted to higher-resolution, more rigorous methods of studying the sun. To test this analysis method, we use a phenomenon called limb darkening, in which the sun appears darker near the edge of the solar disk due to the variance of temperature with height in the solar atmosphere. We use two different low-resolution cameras to test limb darkening in both visible and near-infrared wavelengths, and also develop an algorithm to compare the data to existing models, so as to determine the agreement of such inexpensive methods with more rigorous testing. We are interested in eventually altering this procedure to study the outer layers of the sun's atmosphere in the Silicon-10 spectral line, using a much higher-resolution camera mounted on NASA's High Altitude Student Platform during the 2024 total solar eclipse. This line is not visible from the ground due to interference from the lowest layer of the atmosphere, and has not been rigorously studied thus far.

Acknowlegements: Montana Space Grant Consortium (MSGC)

Claire Leindecker Lundberg: Physics
Mentor: Keith Johnson – Physics
Nature of Science Implementations with Changing Epistemological Beliefs

This research examines the changing epistemological beliefs within an undergraduate introductory astronomy course regarding nature of science. The values, beliefs and assumptions that lie behind scientific knowledge and how that knowledge is developed is the basis of nature of science. The study was conducted for five years, in which two years of baseline data had no nature of science material implemented whereas the remaining three did. To monitor students' beliefs structures over time, the Epistemological Beliefs About the Physical Sciences (EBAPS) assessment was used to collect data from the students before and after each term. The data was then analyzed according to variables including Degree (BA/BS), Status (Freshman, sophomore, etc.), College (Science, English Business) and Gender (Male/Female). The results indicate that students' initial beliefs on whether they are innately good at science or can learn science as they progress did not change, staying a firm construct within student epistemologies.

Rudi Lien: Earth Sciences
Mentor: Eric Boyd – Microbiology & Immunology
Mechanisms of Microbially Mediated Dolomite Formation in the Great Salt Lake

Dolomite is a carbonate mineral common in ancient marine sedimentary rocks but rarely found in modern sedimentary rocks, a phenomenon commonly referred to as "The Dolomite Problem." I have been testing the hypothesis that the microbial processes of fermentation and sulfate reduction in the Great Salt Lake (GSL), when acting together, facilitate the replacement of calcium (Ca) in travertine [CaCO3] with magnesium (Mg) forming dolomite [CaMg(CO3)2] in GSL sediments. Predetermined optimal growth conditions were used to grow an isolated fermenter/sulfate reducer consortium from GSL in the presence of travertine – a form of CaCO3 – in an attempt to replicate the dolomitization process of GSL. Once growth was confirmed in our enrichment cultures, the mineralogical composition of sediments in biological and abiological control vials was determined via X-ray diffraction (XRD) to search for a transition from travertine only to travertine + dolomite. The XRD results indicated the presence of magnesium in CaCO3 in one of the tested conditions, but complete precipitation of dolomite did not occur. Revised experiments with the consortium have been started to better understand these results, as well as to characterize the relationship between the fermenter and sulfate reducing bacteria. The results from this project will provide a potential explanation for the reported detection of dolomite in recently deposited sediments in GSL and other marginal hypersaline environments. Mineralogical dolomite growth structures identified in GSL sediments, if confirmed to be of biological origin, could serve as a biomarker to better understand the evolution of life on Earth and the potential for life on other planetary bodies.

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Katrina Lyon: Microbiology & Immunology
Mentor: Diane Bimczok, Mandi Roe – Microbiology & Immunology
Examining the Proliferative Behavior of Helicobacter Pylori-Infected Gastric Epithelial Organoids Treated with the Extracts of Black Raspberries

Helicobacter pylori infection can have damaging effects on the gastric mucosa, leading to complications such as gastritis, ulceration, MALT lymphoma, and gastric adenocarcinoma. Gastric organoids are three-dimensional, primary epithelial cell cultures that closely replicate the anatomy and physiology of the stomach and may serve as preclinical models for gastric cancer–a disease caused by uncontrolled gastric epithelial cell proliferation. It has been reported that the extracts of berries have demonstrated antimicrobial and chemopreventive activity. We hypothesize that the black raspberry extract will have an antiproliferative effect on H. pylori-infected gastric organoids, and would present the potential for gastric cancer prevention, therapy, and treatment. After

experimentation with cell proliferation assays using carboxyfluorescein succinimidyl ester (CFSE), CellTrace Violet (both fluorescent dyes), and PE anti-human Ki-67 antibody, the Ki-67 assay was found to be the most effective method for measurement of gastric organoid cell proliferation. Several organoid viability assays using 7-Aminoactinomycin D (7-AAD) confirmed an ideal treatment concentration of 2.5 µg/mL Mitomycin-C in L-WRN media, which has an antiproliferative effect on the organoids, for use as a negative control in proliferation assays with the berry extracts. Further testing confirmed maximum organoid viability at a black raspberry extract concentration of 0.8 µg/mL Once organoid proliferation has been measured under the isolated influences of both black raspberry extract and H. pylori infection, this concentration of the berry extract will be analyzed for its effectiveness in inhibiting the increased proliferation that is induced upon H. pylori infection in the infected gastric organoids.

Acknowledgements: IDeA Network of Biomedical Research Excellence (INBRE)

Luke MacHale, Rebecca Hanscam: Chemistry & Biochemistry
Mentor: Robert Szilagyi, Eric Shepard – Chemistry & Biochemistry
Ab Initio Study of Aqueous [Fe-S] Clusters: Computational Modelling of Stepwise Fe-S Cluster Building

Holding a key to the origins of life and chemical function of extant metalloproteins found in every domain of life, iron-sulfur (Fe-S) clusters take a central role in bioinorganic and metalloenzymology research. My use of quantum computational methods complements the experimental side of the superfamily of radical S-adenosylmethionine (SAM) enzyme research that are the focus of the SAM Maquette laboratory group at Montana State University. In my work, I utilize the level of theory that was shown to be most accurate for Fe/S systems and supplement this theory with implicit solvation I previously validated for the hydration of iron and sulfur ions. These ions combine, form a cascading series of Fe-S clusters and nanoparticles before the bulk FeS (mackinawite) phase appears. Geochemical characterization of Fe-S precipitation indicates a barrier less, spontaneous cluster formation process. Utilizing a two-step computational treatment that includes corrections to translational entropy and inclusion of empirical dispersion has the potential for reproducing experimental thermodynamic values within an order of magnitude. This validated method was used to predict specific stoichiometries for Fe-S clusters that represent deep thermodynamic wells along the spontaneous recombination processes of geochemically relevant species on the path toward the formation of site-differentiated [4Fe-4S]2+ clusters found in radical SAM metalloenzymes. Results from the enthalpy of step-wise addition to the [4Fe-4S]0 was characterized into a variable matrix, through which the enthalpy was predicted for higher order clusters. A complete characterization of the coulombic interactions allows for the prediction of any neutral cluster's enthalpy to be predicted given an initial set of conditions.

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Matthew Magoon, Canberk Kayalar: Chemistry & Biochemistry, Chemical & Biological Engineering
Mentor: Stephanie McCalla – Chemical & Biological Engineering
Using DNA Aptamers to Detect Vascular Endothelial Growth Factor

DNA aptamers are short segments of single-stranded DNA that can be used to detect biological materials. This project aims to measure protein sensitively, especially the tumor biomarker Vascular Endothelial Growth Factor, concentrations like an Enzyme-Linked Immunosorbent Assay but with fewer washing steps due to the replacement of antibodies with aptamers. This is an ongoing project, but this semester's research has focused on materials for immobilizing aptamers – cellulose membranes, polyacrylamide (PA) gels, and magnetic streptavidin beads. Two membranes were investigated, and both were found to be problematic for quantifying protein concentration. Commercial membranes autofluoresce and homemade CDI-activated membranes have high nonspecific binding (NSB) to the fluorescent dye, SYBR Gold. The high background fluorescence makes the membranes unable to reliably support sensitive protein quantification using fluorescent microscopy. The use of polyacrylamide (PA) gel

was also investigated, but this material was found to inhibit the reaction that amplifies the signal to a detectable output due to the presence of trace amounts of ammonium persulfate in the PA gel. Finally, streptavidin beads were investigated as a surface for immobilizing aptamers and show promise. The largest challenge with these beads is preventing the NSB of both aptamers and proteins to the aptamer-immobilizing material. Ongoing research is being conducted into the feasibility of sufficiently diluting the ammonium persulfate in PA gels and determining a combination of protein blockers capable of preventing the NSB of target proteins to streptavidin beads. Ultimately, replacing antibodies with aptamers should enable sensitive assays to be developed, especially for resource-limited settings.

Acknowledgements: Undergraduate Scholars Program (USP)

Ashley Micklewright: Ecology
Mentor: Christopher Guy, Hayley Glassic – Ecology
Diet Analysis of Invasive Lake Trout (Salvelinus namaycush) in Yellowstone Lake

Lake trout, an invasive apex predator, have decimated the largest pure Yellowstone cutthroat population currently in existence. The National Park Service actively suppresses the lake trout; however, a healthy population persists, thus preventing the recovery of cutthroat in Yellowstone Lake. To better understand the dietary aspects and behavior of lake trout, we conducted a dietary analysis. The purpose of this study is to understand the dietary behavior of these lake trout, which is essential in further understanding how to properly suppress the population. We gillnetted for lake trout, extracted stomachs, and identified diet contents to order level for invertebrates and species level for fish. We separated prey according to taxon and measured a blotted wet weight for each. We analyzed 45 lake trout diets consisting of 27 lake trout with ventral abrasions and 18 lake trout without ventral abrasions. A two-sample t-test indicated that no significant difference exists in diet composition between lake trout with and without abrasions. For our sample of the lake trout population, no conclusive data exists to suggest that the presence or absence of ventral abrasions is a result of feeding behavior. We suggest investigating the influence of different capture methods on presence or absence of abrasions if more research is conducted. Our study provides insight into lake trout behavior and can be used by managers to improve lake trout suppression methods.

Acknowledgements: Todd Koel (National Park Service) – Ecology, Philip Doepke (National Park Service)

Hannah Monaghan: Microbiology & Immunology
Mentor: Margaret Eggers – Microbiology & Immunology
A Comprehensive Study of E-Cigarette Use on a College Campus

During the last few years, e-cigarette usage has increased in student populations across the United States. There is a misperception by the public that e-cigarettes are “safe”, but many studies have found negative health effects caused by exposure to and inhalation of nicotine and other chemicals. These products are not regulated by the FDA and, therefore, are not required to list all ingredients or accurate percentages on the labels. Due to this, many users are not aware of the ingredients of the products. This project was submitted to MSU’s Institutional Review Board and deemed exempt. The MSU Office of Health Advancement and the Tobacco Expert at the Gallatin City-County Health Department were consulted throughout this process. A report will be submitted to both organizations. An online anonymous survey was adapted from the Center for Disease Control’s National Adult Tobacco Survey to focus on MSU students’ motivations for using and perceptions of e-cigarettes. It was distributed through social media, word of mouth, and class presentations. Students were offered the opportunity to submit their name and last four of their GID to receive 1000 Champ Change points for completing the survey. Their responses are not linked to their name. This data will be used to assess MSU students’ habits and knowledge of e-cigarettes. MSU’s “Tobacco Free Campus” physical signs and “We’re Tobacco Free” digital campaign signs were mapped to determine the visual feedback to students of MSU’s policies.

Acknowledgements: IDeA Network of Biomedical Research Excellence (INBRE)

Anna Mounsey: Microbiology & Immunology
Mentor: Margaret Eggers – Microbiology & Immunology
Investigation of Wastewater Contamination from Septic Systems on Bozeman and Matthew Bird Creeks Using a Multi-Tracer Approach

A 2013 study conducted on Bozeman Creek found high E. coli contamination and suggested a need for further investigation. Currently, Bozeman is on the Montana Department of Environmental Quality (DEQ) 303(d) List of Impaired Waters due to excessive concentrations of E. coli. Further investigation was needed to discern the source of contamination between humans and animals. This study used a multi-tracer approach to determine if human wastewater is contributing to the E. coli contamination of both Bozeman and Matthew Bird creeks. Throughout the fall of 2018, water samples were collected from both creeks and analyzed for E. coli and coliform bacteria, as well as optical brighteners and human bile acids, which are biomarkers (tracers) of human wastewater. Every site sampled along Bozeman and Matthew Bird Creeks tested positive for optical brighteners, human bile-acids, E. coli and coliform bacteria, indicating widespread contamination from human wastewater. These results confirmed that the high levels of E. coli in Bozeman and Matthew Bird Creeks result at least in part from human-sourced contamination due to failing/absent home wastewater treatment systems and/or other influences. The optical brightener method presented an efficient and cost-effective alternative to expensive microbial source tracking methods. Results were presented to the Board of the Gallatin Local Water Quality District. The Gallatin City-County Health Department has consequently designated sections of both Creeks as a Special Management District for enforcement of septic system permitting.

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Gavin O'Boyle: Chemistry & Biochemistry
Mentor: Jennifer DuBois – Chemistry & Biochemistry
Identifying Thermophilic Enzymes Capable of Catabolizing Poly(ethylene terephthalate)

PET, or poly(ethylene terephthalate), is a common plastic polymer used in a variety of consumer and industrial products. As with all plastics, PET is not biodegradable and there is no inexpensive way to properly dispose of the plastic as it is more efficient to produce more than it is to recycle the product. Therefore, it has led to a buildup in oceans, rivers and streams, and even into the fish populating the waterways in the form of micro plastics. In 2016, a first step towards a solution may have been discovered; the discovery of an enzyme that allows the bacterium Ideonella sakaiensis to use PET as its primary carbon source, termed a PET hydrolase (PETase). Based off of their discovery (Yoshida et al.) and research done by collaborators in England (Austin et al.), a series of assays was developed to identify the best possible PETase candidate. The two keys to a functional PETase are to be able to degrade PET, and for the best efficiency, to be able to withstand temperatures greater than 75oC for extended lengths of time. At or past 75oC, the PET polymeric structure will begin to fall apart, allowing for easier accessibility by an enzyme. To determine a candidate enzyme's possible effectiveness for depolymerizing PET, we developed 4 activity assays that would indicate possible effectiveness. These were assays for: esterase activity, lipase activity, and cutinase activity, and PETase activity. Along with activity assays, there were pH and temperature assays. These assays are done with the hope that we can identify a suitable enzyme able to catabolize PET and have thermophilic properties at the same time.

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Elizabeth Pacella: Sociology and Anthropology
Mentor: Jennifer Woodcock-Medicine Horse – Native American Studies
Language Revitalization Comparison Between Plains Tribes

Language revitalization among Native American tribes on the Plains varies. The Kootenai (Ktunaxa) tribe in the northwest corner of Montana are the only tribe in its language family making revitalizing their language much more difficult compared to other Plains tribes like the Blackfeet who are apart of the Algonquian language family, which is a large language family. The Kootenai have few people who are still fluent in the language so teaching the younger generation is difficult. There are also some struggles within the younger kids to find the motivation to want to learn the language. Language is important to a groups culture and with the loss or the losing of a language a tribe may feel lost themselves. The comparison between these tribes gives a good outlook on why the Kootenai language revitalization is so important and how they can look to other tribes for guidance on how to keep their language thriving. Looking to the leaders of these tribes this research paper will examine different aspects of language among these Plains tribes such as history of the language, revitalization programs they have in place now and what each tribe can learn from the way the other deals with language.

Allison Perez: Microbiology & Immunology
Mentor: Ed Schmidt, Colin Miller, Justin Prigge – Microbiology & Immunology, Chemistry & Biochemistry, Microbiology & Immunology
Understanding Redox Balance Disruptions: Synthesis, Characterization, and Biological Validation of an Isotopically Labeled Amino Acid, 34S-L-Cysteine

The sulfur (S) amino acids, cysteine (Cys) and methionine (Met), are used by all cells to synthesize diverse S-containing molecules. Although Cys, Met, and their derived proteins are vital to cellular metabolism and redox balance, their consumption is still not well understood. The recent discovery of a Met-dependent, NADPH-independent disulfide reducing pathway in the Schmidt lab, using genetically designed mutant mouse livers, served as the catalyst for the current project aimed at studying altered Cys and S-containing metabolite metabolisms in these livers. These metabolic realignments will be key to understanding how typical cells survive severe oxidative stress. However, stable-isotope-labeled Cys is not commercially available, thus the main focus of this research to this point has been synthesizing and purifying 34S-L-Cys. This synthesis has involved both chemical and biological steps, each of which have been completed on the most common S isotope, 32S, and is currently being optimized before work begins on the 34S isotope. Future work will involve introducing the labeled Cys to human cells in culture and mouse livers to track the use of Cys in cells that are functioning normally and cells that are under oxidative stress.

Garrett Peters: Microbiology & Immunology
Mentor: Seth Walk – Microbiology & Immunology
Metabolic Fitness Allows Escherichia coli to Reside in the Human Gut

Little is known about the forces that drive population dynamics within the gut microbiome. To address this gap in knowledge, the Walk Lab collected weekly fecal samples from a group of eight healthy adult volunteers for two years. With these samples we examined the overall community structure of the microbiome with 16S rRNA sequencing and the population dynamics of Escherichia coli using culture dependent techniques. With a collection of over 32,467 E. coli isolates, we identified transient clones that persisted within the gut for less than 2 weeks and resident clones that persisted for greater than 14 days. The purpose of this project is to determine the metabolic differences between resident and transient strains of E. coli in the same individual. To assess the utilization rates of 285 carbon, nitrogen, and sulfur nutrient sources in resident and transient clones, we are using the Biolog OmniLog Phenotyping MicroArray technology. Results to date suggest that resident clones use a smaller array of carbon nutrients than transients but utilize them more efficiently. This work indicates that transient and resident E. coli are metabolic generalists and specialists, respectively. We are further testing resident-transient interactions using in vivo and in vitro experiments in order to examine the role of metabolism in residency. By understanding the forces that drive population dynamics in the human gut, there may be opportunities to engineer more efficient probiotics that can persist for long periods of time.

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Gavin Pirrie: Earth Sciences
Mentor: Drew Laskowski – Earth Sciences
Early insight into lithium prices with respect to the electric vehicle industry

Global lithium production has risen with an increased demand in lithium-ion batteries. The primary processed product of lithium is batteries and an increase in demand for electric vehicles has driven lithium production. A major concern regarding current electric vehicles is that they are too expensive for the average consumer. The goal of this study is to determine how electric vehicle demand has affected lithium prices as well as identify variables and methods that would lead to decreased cost of lithium extraction. Exploring two deposits for possible lithium extraction, salars and hard ore pegmatites, demand for lithium and price of lithium are tracked over time. United States Geological Survey data was used for historic production, price, and trade imports/exports of lithium. Forecasted prices of lithium were also explored and compared to current prices of lithium to determine if current prices reached forecasted prices. Lithium production has increased exponentially over the last ten years and this has correlated with an increase in the number of electric vehicles produced in the same time period. Current prices stayed flat over the five-year period data was available suggests a possible trend of over forecasting lithium prices in the future. Modeling lithium prices and production variables as well as predicting a "break-even" lithium unit price that will result in economically viable hard rock ore deposits in the future could result in decreasing the pressure on mining salars. The final result is an electric car that is affordable and less expensive to average consumers.

Mark Poston, Scotty Tilton: Mathematical Sciences
Mentor: David Ayala, Eric Berry – Mathematical Sciences
Homologies of Grassmannians via Exit-Path Categories

This project has two main focuses. The first and more important of which is to compute homology groups of Grassmannians, at least in low degrees. The second focus is to work through some of the standard techniques and concepts in algebraic topology as a way of expanding on the standard methodology of computing homology groups. Grassmannians are the collection of k-planes in n-dimensional Euclidean Space. Homology is a way of assigning algebraic objects, such as groups, to topological spaces. Homology is computable and a relatively strong invariant. Computing homologies of Grassmannians is a natural and well-examined problem. We, however, are using a novel approach, which lends itself nicely to induction. We focus on the Schubert cell-structure on Grassmannians. In this way we are able to do induction via the exit-path infinity-category of the Schubert stratification of Grassmannians. The Schubert cell structure on Grassmannians is 'nice' in that the cells assemble with enough regularity to define a stratification. For a stratified space, X, its exit-path infinity-category, a version of its fundamental group, organizes the strata of X as well as how they meet along their links. In the case of the Grassmannian, each stratum is contractible, and each link is, essentially, a lower Grassmannian. Hence the natural phrasing of induction.

Acknowledgements: Undergraduate Scholars Program (USP)

Joe Poteat: Liberal Studies Degree
Mentor: Jennifer Woodcock-Medicine Horse – Native American Studies
Native Americans of the Yellowstone region

I am interested in writing about how the Native tribes used the Yellowstone region collectively. I want to focus on how tribes shared the area, and did not fight over the territory but used it as a common space. This will help gain insight on how people today can use this knowledge, and apply it towards management of public areas in present

times. It will also be interesting to look into how Yellowstone is managed today, and how it could be improved upon based on the management principals of the Native Americans. The research approach to answering, and better understanding these questions will result from detailed research on individual tribes. This will be accomplished by researching how different tribes of the Yellowstone region used the area. By doing this, I will find out how the tribes were able to benefit from the area while not getting into conflict over the resources. I will look into how the area was used in the Summer, and Winter as well as if there is a connection on how tribes shared the area based on seasons, and how much time a tribe was allocated. It will be interesting to learn if shared use was divided into sectors of the region, or by times of the year. This insight will be interesting to learn how it can be applied to modern day resource management.

Willis Pullman: Chemistry & Biochemistry
Mentor: Jovanka Voyich, Tyler Nygaard – Microbiology & Immunology
Phosphorylation of SaeR

S. aureus is one of the most successful human pathogens and it causes a diverse range of infections due to its many different virulence factors. In recent years there has been an uptick in cases of CA-MRSA. It has been demonstrated that *S. aureus* avoids being eliminated by the immune system using the SaeR/S two-component gene-regulatory system that regulates genes enabling the pathogen to survive neutrophil phagocytosis. Mouse models have also demonstrated that the SaeR/S system also plays a significant role during pathogenesis of *S. aureus*. It is generally accepted that the sensory kinase, SaeS, auto phosphorylates when a stimulus is detected. This detection leads to auto phosphorylation of SaeR and subsequent binding of SaeR to promoter regions of virulence factors containing its binding domain. However, if phosphorylation is really required for the SaeR component to bind to DNA has not yet been proven. To address this absence in knowledge, we purified the wildtype SaeR protein and protein from genetically modified SaeR strains. These mutants swap the aspartic acid residue (D) at D51 D46 and D61 in SaeR for the amino acid alanine, which is known to not be phosphorylated. To purifiy the recombinant proteins we used *E. coli* protein expression methods. Briefly, IPTG was added at the stationary phase of the *E.coli*'s growth in order to cause mass expression of the protein, which was used for analyses. The goal of this study was to find whether the phosphorylation of aspartic acid residue (D) 51 is necessary or not for DNA binding using electrophoretic mobility shift assays. Preliminary studies suggest, affinity for binding promoter regions of DNA by SaeRD51 is significantly reduced compared to wildtype SaeR. If phosphorylation at the D51 amino acid is necessary for DNA binding, this could be this historically successful pathogen's Achilles heel.

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Seth Putnam: Chemistry & Biochemistry
Mentor: Nicholas Stadie – Chemistry & Biochemistry
Hydrogen Storage in Bulk Boron-Doped Graphitic Carbon

Limited hydrogen storage capacity is one of the primary barriers to viable hydrogen fuel cell vehicles. The DOE has specified a target of 4.5 weight percent hydrogen at ambient conditions in order to meet the requirements of a mobile passenger vehicle. Theoretical studies predict crystalline BC3 (a bulk graphite-like material) to have a much greater hydrogen storage capacity than related pure carbonaceous materials. One study predicts a reversible storage capacity of 6.1 weight percent hydrogen under near ambient conditions. The objective of this research project is to characterize the hydrogen uptake of bulk boron-doped graphitic carbon and determine its viability for hydrogen storage. A Sieverts apparatus was designed, constructed, and commissioned for hydrogen sorption measurements between temperatures from 298-400 K and pressures from 0-12 MPa. By application of the Unilan model, the absolute quantity of adsorption and the isosteric enthalpy of adsorption were determined.

Acknowledgements: Devin McGlamery (MSU Graduate Student) – Chemistry & Biochemistry, Undergraduate Scholars Program (USP)

McKay Reed, Ashley Voegele: Microbiology & Immunology
Mentor: Margaret Eggers – Microbiology & Immunology
Investigation of Human-Sourced Contamination in Bozeman Creek and Matthew Bird Creeks: Optical Brightener Approach

Human wastewater contamination is a global issue with 1.2 trillion gallons of untreated sewage, and other waste being dumped into US waterways annually, and similar practices existing around the world. Bozeman Creek and Matthew Bird Creek, which are in central Bozeman, have previously tested positive for high levels of E. coli. E. coli is often an indicator of other harmful pathogens including norovirus, Cryptosporidium, Giardia, Campylobacter jejuni, and Salmonella enterica. Many locals use these creeks for recreation and these pathogens could put people at risk. We hypothesized that leaking septic systems are the major cause of this contamination. A marker of human wastewater, optical brighteners are chemical brightening agents that are used to enhance the color of fabrics and paper, and hence are abundant in wastewater. The Gallatin Water Quality District hypothesized that optical brighteners would be a cheaper tracer than the previous human wastewater detection methods (microbial source tracking and mass spectrometry). We left optical brightener pads in the streams at 17 sample sites for 3, 7 and 10 days and analyzed the pads under UV light for the presence of optical brighteners. Our results showed that in September 100% of the sites tested positive for optical brighteners. In October 44% of our sample sites tested positive for optical brighteners. Our results allowed us to conclude that Bozeman Creek and Matthew Bird Creek were contaminated with human wastewater and that the optical brightener detection method was valid. Using optical brighteners as an indicator is an extremely cheap and viable method to indicate human wastewater contamination and address this growing issue.

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Elizabeth Rehbein: Physics
Mentor: Joseph Shaw – Electrical & Computer Engineering
Determination of cloud thermodynamic phase using artificial neural networks

The interaction of clouds with solar and terrestrial radiation generates feedback loops which play a significant role in the regulation of Earth's climate. Cloud thermodynamic phase (whether a cloud is composed of polyhedral ice crystals or spherical water droplets) has a significant impact on Earth's radiative effects and is a prerequisite for understanding other cloud microphysical properties. A zenith-pointing dual-polarization lidar probed the atmosphere and collected backscattered light from clouds, which is then used to deduce the thermodynamic phase by taking the ratio of the co- and cross-polarization states. Optically thin water clouds exhibit a cross-polarization ratio (i.e., the ratio of co-polarized to cross-polarized light) of less than 3%, whereas ice clouds exhibit higher cross-polarization ratios. An examination of the polarization data is therefore useful for determining cloud thermodynamic phase. To better manage the large quantity of data returned by the lidar system, an artificial neural network is currently in development to computationally classify cloud phase. The neural network's current objective is to classify one ice or water cloud as well as clear sky. To achieve this, we manually created a training set by flagging ice, water, and clear-sky conditions based on the co-polarized return and the cross-polarization ratio. Through modification and new training sets, the neural network has the potential to classify additional thermodynamic cloud phases, multiple phases, and low-altitude aerosols.

Acknowledgements: Martin Jan Tauc (MSU Graduate Student) – Electrical & Computer Engineering, Bryan Scherrer (MSU Postdoc/Research Scientist) – Electrical & Computer Engineering

Megan Robinson: Ecology
Mentor: David Willey, John Winnie, Erik Beever – Ecology
Investigation of the Distribution of the American Pika (Ochotona princeps) of Southwest Montana in Relation to Potential Climate Changes

Mountain ecosystems in North American may be one of the most threatened environments worldwide due to potential negative effects of climate change on the delicate thermal balance of alpine systems. One of the most understudied aspects of these mountain habitats is the effect of climate change on the micro-ecosystems and associated organisms that dwell in small isolated and specialized habitats, for example talus slope-alpine meadow communities. Even though these habitats may represent a small fraction of the overall ecosystem, they play an important, yet unobvious, role in the surrounding communities, including genetic connectivity, propagation and dispersal of species, and energy flow between isolated habitats within mountain ranges. There are many organisms in these habitats that have shown sensitivity thresholds to environmental perturbations, including recent climate changes, thus these species may serve as relevant indicator species to monitor proper ecological function and health. The American pika (Ochotona princeps), a small lagomorph, inhabits rocky alpine slopes of the western United States. The pika inhabits mountainous habitats that are experiencing the effects of climate change and previous research has documented local population extinctions. In this paper, I will be presenting a study that examined the relationship between American pikas and their responses to various environmental conditions. Within this study, we found strong positive correlation between elevation and population densities. Finally, I will discuss the potential impacts of observed habitat changes on alpine communities, and the importance of closely monitoring long-term changes in this study system in southwestern Montana.

Haley Rogers: Cell Biology & Neuroscience
Mentor: Ganesh Balasubramanian, Margaret Eggers, Lori Christenson – Chemistry & Biochemistry, Center for Biofilm Engineering, Other
Mass Spectrometry Based Water Quality Assessment: a community based approach

In the last two decades, Montana state's Gallatin County has experienced significant growth in its population creating a pressure in quantity of the wastewater requiring treatment. The specific increase in rural development, along with increase in the amount of septic systems being used, raises the potential degradation of Gallatin County's water quality. Bozeman Creek, located in the southern part of the county, has been compromised with excess concentrations of E. coli. The study utilizes methods of advanced mass spectrometry-based tracer approach to identify the potential sources of contaminants in Bozeman creek. Water samples were prepared for analysis with LC-MS. Analysis will look for optical brighteners (OBs), caffeine, and other human contaminants â€“ such methods offer valuable data to confirm wastewater sources. The goal is to expand the limited understanding of Gallatin County's water quality and its implications on public health. The information gathered from this study will be communicated with Big Sky Watershed Corps and Gallatin county water quality district officials, representing a valuable partnership between undergraduate research and a community agency. The collaborative efforts between the Montana State University and Gallatin County Water Quality officials allows for a unique perspective to study the integrity of creek water. The methods developed here may be expanded to other rural counties that rely on natural water sources.

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Chance Ronemus: Earth Sciences
Mentor: Devon Orme – Earth Sciences
Detrital zircon geochronology of Mesozoic strata exposed in the Bridger Range, SW Montana

Mesozoic sedimentary strata exposed in Montana's Bridger Range records the development of the North American Western Cordillera, preserving evidence of the co-development of the orogenic and foreland basin systems. To reveal these relationships, this study presents provenance analyses from key stratigraphic intervals exposed in this mountain range. We report ~900 U-Pb detrital zircon dates obtained through LA-ICP-MS analysis of field samples of the Jurassic Swift Formation, Jurassic Morrison Formation, and Cretaceous Kootenai Formation. These dates are compared to potential North American source regions to untangle the provenance of detritus through time. Dates

from the Swift and Morrison formations will better constrain the timing of the transition between eastern and western provenance in the SW Montana segment of the North America Cordillera. Previous work on time-correlative strata in NW Montana and northern Wyoming interpret that provenance within the foreland basin became dominated by western sources by Middle-Late Jurassic time; this study seeks to show whether this signal remains dominant as far south as the Bridger Range. Additionally, data from the Morrison will help to resolve the "phantom forebulge" debate over the depositional setting of this unit. Data from the Kootenai will shed light on paleogeography of the Cordilleran foreland basin system during Cretaceous time. This work is part of a larger research group effort to characterize and compare Neoproterozoic through Mesozoic strata in this region. Broadly, this work helps create a more detailed picture of the development of this region and the Western Cordilleran system.

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Alpha Scheel: Cell Biology & Neuroscience
Mentor: Frances Lefcort – Cell Biology & Neuroscience
Investigating the Role of the Gut-Brain Axis in a Mouse Model of Familial Dysautonomia

Familial Dysautonomia (FD) is a rare sensory and autonomic neuropathy caused by a mutation in the gene ELP1. The recessive hereditary disease is both a developmental and progressive neurodegenerative condition that primarily affects the peripheral nervous system. ELP1 encodes the protein IKAP, which plays a key role in translation and is required for neuronal survival, cytoskeletal organization, and vesicle trafficking. FD patients experience cardiovascular instability, baroreflex failure, frequent autonomic crises, and gastrointestinal problems including motility dysfunction, constipation, diarrhea, and gastroesophageal reflux. Additionally, FD patients exhibit metabolic dysfunction, dysbiosis, mitochondrial impairment, and low body mass index. The goal of this project is to characterize the phenotypic changes in the enteric nervous system and the extrinsic innervation of the gut in a mouse model of FD, and to determine the relationship between neurons, glia, and gut epithelia in producing the observed phenotype. Using immunohistochemical analysis of the duodenum, we observed decreased vagal innervation of the proximal duodenum, indicated by decreased frequency of TrkB+ axons in the duodenal villi of conditional knockout mice. These results are further being examined via immunohistochemical analysis of the vagus nerve to confirm the presence of TrkB+ axons. The vagus plays key roles in regulating gut activity and is the conduit connecting the brain and gut. These data will provide us with a deeper understanding of the impact of neurodegeneration on the gastrointestinal tract, and may lead to the discovery of novel targets for mediation of the neurological and metabolic changes that occur in neurodegenerative diseases.

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Sage Schiller: Microbiology & Immunology
Mentor: Valerie Copie – Chemistry & Biochemistry
Investigating the metabolic and gene expression changes in human macrophages co-cultured with Pseudomonas aeruginosa biofilms

Pseudomonas aeruginosa is a Gram-negative, facultative anaerobic bacterium that has been associated with acute and chronic wound infections. Contrary to acute wounds, chronic wounds fail to progress through the normal stages of wound healing in a timely, orderly manner and instead feature a prolonged inflammatory response. Over 50% of chronic wounds in the United States demonstrate colonization by P. aeruginosa biofilms, immobile microbial communities encased in an extracellular polymeric substance. Bacterial cells growing within a biofilm have several advantages over planktonic microbes, including greater resistance to antibiotics and an enhanced ability to evade the endogenous immune system. Wound healing is achieved through the coordinated efforts of multiple host cells, including but not limited to neutrophils, macrophages, and fibroblasts. Macrophages, a type of white blood cell, are of notable interest in the context of chronic wounds because they are heavily involved in the

transition from inflammation to proliferation during wound healing. Since this transition is delayed in chronic wounds, we are investigating the impact of P. aeruginosa biofilms on human macrophages using a simplified in vitro co-culture model. Using 1D 1H NMR-based metabolomics, our studies indicate that macrophage metabolism is perturbed in the presence of P. aeruginosa biofilms. Currently, we are utilizing quantitative PCR arrays to determine alterations in macrophage gene expression upon co-culture with P. aeruginosa biofilms. By correlating our metabolomics and transcriptomics data sets we will gain a better understanding of how P. aeruginosa biofilms impact macrophage metabolism and function to interfere with the host innate immune response.

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Rebecca Schnabel: Cell Biology & Neuroscience
Mentor: Steven Stowers – Cell Biology & Neuroscience
Investigating Vesicular Nucleotide Transporter (vNUT) Expression and Function in Drosophila

Vesicular nucleotide transporters have been studied far less than other vesicular transporters which is one of the main motivations of this work. Better understanding the vesicular nucleotide transporter (vNUT) could give insight regarding the co-release or co-transmission of ATP, a nucleotide that vNUT is responsible, and neurotransmitters. (Figure 1.) vNUT is expressed in all neurons which means it most likely has a relationship with the vesicle transporters for neurotransmitters such as acetyl choline or glutamate. The main objective of this work is to better understand how vNUT interacts with neurotransmitters such as these by using CRISPR/Cas9 nonhomologous end joining and homologous recombination techniques.

Acknowledgements: Hannah McKinney (MSU Graduate Student) – Cell Biology & Neuroscience, McNair Scholars Program, TRiO

Jenna Severson: Chemistry & Biochemistry
Mentor: Michelle Flenniken – Plant Sciences & Plant Pathology
Efficacy of putative antiviral treatments for laboratory-based honey bee deformed wing virus experiments

Honey bees (Apis mellifera) play an integral role as plant pollinators in native, wild, and agricultural ecosystems. Annually, insect-pollinated crops are valued at approximately $175 billion worldwide. Annual losses of honey bee colonies in the US have averaged 33% since 2006. Multiple factors impact honey bee losses, such as pathogens (i.e., viruses, mites, bacteria), agrochemical exposure, colony genetics, weather, and nutrition. Deformed wing virus (DWV), a (+)ssRNA virus in the Iflaviridae family, is one honey bee pathogen that is frequently detected in samples obtained from honey bee colonies and is associated with colony losses. Presently, there are no antiviral agents available to treat honey bee virus infections. The objective of this project is to evaluate and quantify the ability of promising antiviral agents, such as thyme oil and fungal extracts like Fomes fomentarius (Amadou), to stimulate the honey bee immune system and decrease viral abundance. Reduced abundance of DWV may mitigate illness and/or death of the honey bee. To examine the efficacy of putative antiviral agents, honey bees were infected with DWV via injection in laboratory-based experiments and fed one of two putative antiviral treatments (i.e., Amadou or thyme oil). Over three days, morbidity and mortality of individual bees were examined, and after three days, viral abundance was assessed using quantitative polymerase chain reaction (qPCR). Preliminary analyses indicate that neither Amadou nor thyme oil treatments reduced DWV-infection in honey bees. Additional studies are needed to support this data (i.e., obtain a higher sample size) and examine if this treatment has efficacy against other honey bee infecting viruses.

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Veronika Shchepetkina: Chemistry & Biochemistry
Mentor: Matthew Cook – Chemistry & Biochemistry
Novel Synthesis of Nitrile-Containing Molecules for Pharmaceutical Applications

Nitriles are compounds containing a cyanide (CN) functional group that are commonly found in the structures of pharmacologically active compounds. Over 30 drugs containing nitriles are currently being prescribed to patients for conditions including cancer, viral infections, bacterial infections, CNS disorders, cardiovascular and respiratory diseases, and many others (Fig 1). Although cyanide anions are extremely toxic, they are not readily released when incorporated into organic compounds. In fact, the nitrile functional group has a series of properties that contribute to the effectiveness of a drug. Furthermore, the formation of nitriles on complex molecules allows for chemists to synthesize pharmaceuticals with great specificity, an extremely important factor when designing drugs for specific biological targets. Previously, I was interested in forming cyclopropanes on nitrile containing molecules, however synthesizing this compound was extremely difficult. As a result, my project shifted focus to investigate how previously synthesized nitrile compounds can formed with better selectivity and efficiency using palladium catalyzed chemistry. I propose that by manipulating the additives of the reaction, I can synthesize the branched form of the nitrile with enantiomeric selectivity.

Acknowledgements: Juliana Alexander (MSU Postdoc/Research Scientist) – Chemistry & Biochemistry, Kate Baddeley (MSU Postdoc/Research Scientist) – Chemistry & Biochemistry, IDeA Network of Biomedical Research Excellence (INBRE)

Austin Simonpietri: Ecology
Mentor: Amy Trowbridge – Land Resources & Environmental Sciences
Assessing the interactive effects of drought and herbivory on defensive volatiles from ponderosa pine
Ponderosa pine (Pinus ponderosa) must cope with a constant onslaught of biotic and abiotic stresses including bark beetles and drought. Bark beetles (Curculionidae: Scolytinae) physically harm the tree by burrowing past the bark and into the vascular tissue. One dominant class of toxic compounds in the oleoresin of conifers is monoterpenes (C10H16), which are known to play complex roles in bark beetle-conifer ecology depending on their concentrations. While drought can alter the quantity and composition of monoterpenes by potentially limiting carbon uptake and allocation toward defense, herbivory, on the other hand, tends to result in an increased investment in carbon and enhanced defenses. The impact of both drought and herbivory on monoterpene emissions, however, remains unknown. To address this gap in our knowledge, we used 2-year old ponderosa pines and exposed them to simulated herbivory using a phytohormone, methyl jasmonate (MeJA) under three levels of drought stress (mild, moderate, and severe) over a seven week period. Results showed that herbivore-induced emissions are suppressed under moderate and severe drought, but no more than what is observed under drought stress alone. This suggests that drought is an overriding factor in determining ponderosa pine's stress responses and provides insight into how drought limits a tree's ability to induce appropriate defense responses against a bark beetles, resulting in increased susceptibility and mortality.

Acknowledgements: Undergraduate Scholars Program (USP)

Griffin Smith: Mathematical Sciences
Mentor: Dominique Zosso – Mathematical Sciences
Geometric Data Analysis

Big data often takes the form of high-dimensional point clouds: collections of data-points that can be represented as samples of a complicated feature space. For effective machine learning, we need to exploit the fact that information is almost always sparse and tends to have relevant low-dimensional features. For analysis, we study the geometry of the data point cloud and its underlying structure. In this project, we use tools from "geometric probability" and consider the properties of a virtual collection of balls placed at each data point. As the ball radius varies, their area with multiplicity grows as a polynomial, with coefficients capturing the geometric properties of the underlying shape. Developing a working code prototype that performs graph-based geometric data analysis in

2D, naively, has been the primary goal. In this project, I've used MATLAB to implement models and create synthetic datasets. We start by considering a simple shape, such as a triangle in a plane. Its geometric properties such as perimeter and area are easy to calculate for reference. From this shape, we sample points and estimate the underlying triangle's geometry by studying the point cloud. We numerically compute ball volumes and fit a polynomial to it. The recovered coefficients will then be compared against the known underlying geometric properties of the simple starting shape. We expect our research to lead to powerful machine learning tools in the context of various "shape from samples" problems.

Acknowledgements: Undergraduate Scholars Program (USP)

Eli Snyder: English
Mentor: Allison Wynhoff Olsen, Nigel Waterton – Education
The Vocational Lens: Generating a Sense of Critical Vocational Literacy

Borrowing from theoretical frameworks that have changed the shape of socially-responsible teaching, this research introduces a Vocational Lens to promote a sense of critical vocational literacy, or a stance where students and teachers alike seek to critically examine texts to expose pervading beliefs about blue-collar jobs. A Vocational Lens contains an approach to textual analysis that seeks to analyze and problematize how projections of nonacademic trajectories are illustrated. Centering specifically on one canonical text and one contemporary young adult text, this research explores how a Vocational Lens provides a new approach to critically interpreting texts within the English classroom in order to promote a more pluralistic space for students seeking a life outside of a college degree. Specifically, this research a) illuminates the gap between the trajectories high schools celebrate and the realities of post-graduation life for students; b) problematizes the current research on generating a more pluralistic space within the classroom; c) provides an explanation of the Vocational Lens, including entry points for using a Vocational Lens; d) analyzes both a canonical text and a contemporary young adult text through a Vocational Lens; and, e) offers specific possibilities for future research in how to further systematize and codify a Vocational Lens.

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Tillie Stewart: Microbiology & Immunology
Mentor: Ellen Lauchnor, Margaret Eggers – Civil Engineering, Microbiology & Immunology
Characterization of Arsenic Distribution on the Crow Reservation

Arsenic (As) is a common heavy metal contaminant of groundwater in many areas of the world due to anthropogenic and naturally occurring geologic sources. On the Crow reservation, health screenings and well water testing has identified areas on the reservation of high concern for contaminated drinking water sources. The first objective of this research is to assess co-localization of high As levels with potential anthropogenic sources such as livestock dipping stations and the railroad corridor. Soil will be sampled from former cattle dipping locations, the railroad corridor and locations that have been identified as high in As. Our team will take GPS measurements and soil samples and measure parameters that may impact As toxicity. The soil analyses will be conducted at MSU using EPA soil digestion methods. A GIS map including these data layers will be prepared with results. The findings of this project will improve health of tribal members by reducing their exposure to arsenic. Maps and interpreted results will be presented to the community and the data will get to the homes that may be impacted by higher arsenic levels. Efforts will include free well water testing, explanation of identified risks, and the discussion of mitigation options.

Acknowledgements: Kyle Paine (MSU Graduate Student) – Civil Engineering

Hans Swenson: Chemistry & Biochemistry
Mentor: Nicholas Stadie – Chemistry & Biochemistry
Measuring the Extent of Helium Adsorption in Microporous Materials

Gas physisorption is an analytical technique which can be used to determine surface characteristics of a material. If an amount of an adsorptive gas (such as nitrogen) is introduced to a degassed sample under vacuum, a measurable amount of the gas is adsorbed onto the surface of the material. By incrementally adding nitrogen, this quantity of adsorbed gas increases, and can be measured if the free space or total void volume accessible to the nitrogen is known. Currently, free space measurements are performed using helium, because it is assumed not to interact with the surface of the analyte. The purpose of this research project was to challenge that notion, and quantify the true extent of helium adsorption on high-surface area materials. Helium adsorption was explored by measuring helium isotherms of two materials at temperatures from 77 K to 500 K and comparing these results to those of empty sample tubes. By applying the Clapeyron equation to these isotherms, the isosteric heat of adsorption was calculated, which is a useful metric to compare helium adsorption with that of typical adsorptive gases: hydrogen, nitrogen, and carbon dioxide.

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Jeremy Tate: Mathematical Sciences
Mentor: Mark Greenwood, Yiyi Wang – Mathematical Sciences, Civil Engineering
Ridership: a Computational Approach to Estimating Origin Destination Flows of Bus Passengers

If a civil engineer has knowledge of passenger origin-destination (O-D) flows, the traffic engineer will be able to improve bus route planning and modification. An O-D flow is the route that a passenger takes, from boarding to alighting. Aggregate O-D flows are often estimated by an iterative proportional fitting method. However, these aggregate O-D flows are inherently limited since they fail to reveal the route of an individual passenger. This presents the need for a method that efficiently detects individual O-D flows. Smartphones emit WIFI data which can be collected relatively easily and used as a proxy for bus passengers. However, other devices such as routers, printers, and smart devices may also be detected and the problem remains of determining which devices actually belong to bus riders. In this project we introduce an R package (ridership) for detecting bus passengers and O-D flows from data collected by a modified Raspberry Pi. The ridership package uses supervised classification and ideas from topology to detect bus riders from location and WIFI data. Ridership introduces a way to detect aggregate and individual O-D flows. Ridership was tested using data collected on the Bozeman Streamline bus service; however, the set of functions is robust to the location the data are collected and can be used anywhere in the world. Integration with other R packages provides an interactive interface for viewing a map of the results. We will discuss the creation and limitations of the ridership package as well as future applications to traffic data.

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Kole Tison: Cell Biology & Neuroscience
Mentor: Steve Stowers – Cell Biology & Neuroscience
A novel epitope tag multimerization strategy utilizing the Gibson Cloning reaction for high sensitivity detection of proteins at endogenous expression levels

CRISPR/Cas9 genome editing allows tagging of genes to determine their endogenous spatial and temporal expression patterns. A limitation of this strategy is that the expression level of many genes is too low to be easily detected. To overcome this limitation, we serendipitously discovered a characteristic of the Gibson Cloning reaction whereby epitope tags are multimerized. Epitope multimerization was optimized by varying the time and concentration of component DNA fragments in the Gibson reaction. Our optimization routinely generated seven tandem copies of epitope tags with a maximum of 10. As proof-of-principle, we implemented this strategy using the Drosophila gene coding for the vesicular Acetylcholine transporter (vACht). This conditionally expressible,

epitope-tagged vesicular transporter was used to assess cholinergic neurotransmitter identity and cholinergic synaptic vesicle localization. Due to the robust signal generated by the multimerized epitope tag, we were able to visualize vACht within individual neurons

Acknowledgements: Hannah Mckinney (MSU Graduate Student) – Cell Biology & Neuroscience, IDeA Network of Biomedical Research Excellence (INBRE)

Paige Tolleson, Lexi Kyro: Microbiology & Immunology
Mentor: Margaret Eggers – Microbiology & Immunology
E. Coli and Coliform in Bozeman and Matthew Bird Creeks

Many homes in Bozeman, Montana use septic systems to treat wastewater however some are not properly maintained or are unpermitted. This can lead to creeks becoming contaminated by septic wastewater. Conducting research along Bozeman and Matthew Bird Creek helps gain knowledge on the sources of E. coli contamination. By using a multi-tracer approach the results from the research are more conclusive to whether the contaminants are coming from human wastewater or other sources. Optical brighteners, which are found in laundry detergent and clothing were collected using OB pads. Wastewater tracers including caffeine and other chemicals were also collected through grab samples. These methods, along with bacteria analysis of stream water grab samples, were performed to determine if the human wastewater was contributing to the E. coli contamination. The data shows that the E. coli levels in Bozeman and Matthew Bird Creek were much higher than the EPA limit for recreational activities. Coliform and E. coli levels are not correlated and showed different levels. The presence of E. coli in Bozeman and Matthew Bird Creek provides important evidence that there is a potential of human sourced contamination in the creek.

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Paige Tolleson: Microbiology & Immunology
Mentor: Margaret Eggers, Lori Christenson – Microbiology & Immunology
Research and development of a roadmap for a septic maintenance district for permitted and unpermitted wastewater treatment systems along Bozeman and Matthew Bird Creeks

Septic systems are underground tanks that hold wastewater and allow for basic treatment. They are a simple type of onsite sewage facility that are found in many Bozeman, Montana residences. However, many of these systems are not properly maintained or are unpermitted. It appears that this is a potential source of contamination of several local waterways. Research from MSU students found that the E. coli levels in Bozeman and Matthew Bird Creek were much higher than the EPA limit for recreational activities. The GCCHD has partnered with Montana State University and the Gallatin Local Water Quality District to address this problem. Through cooperative efforts, the groups have explored different approaches to address E. coli contamination along Bozeman Creek. This includes a thorough analysis of the age distribution of permitted septic systems and intensive research for unpermitted septic systems. Research of the septic system permits was conducted by a spatial analysis using a GIS approach to match permit records maintained by the County to property addresses along Bozeman and Matthew Bird Creek. A literature review has been conducted to better understand different approaches that GCCHD could use to facilitate septic system maintenance and education for residents along these creeks. With the use of materials prepared from Lewis and Clark City-County Health's Helena Valley Septic System Maintenance District, a draft for a Septic Maintenance District for Gallatin County will be created. Permit research along Bozeman and Mathew Bird Creek has shown that 15% of the septic systems along these creeks are unpermitted. Additionally, the presence of high E. coli levels in these creeks provides evidence of a potential human-sourced contaminate. Preliminary research suggests that a septic maintenance district is crucial for the health of the community and the creeks.

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Zariah Tolman: Cell Biology & Neuroscience
Mentor: Catherine Woods, Margaret Eggers – Liberal Studies Degree, Microbiology & Immunology
Contribution of Resource Deficits to Compassion Burnout of Ugandan Health Care Workers

Introduction: Uganda, a country in sub-Saharan Africa, employs a single-payer universal health care system to provide each citizen with a minimum health care package. Public health care is entirely funded and resourced by the government. Uganda contributes to the global burden of disease with staff shortages (only 38% of healthcare posts are filled) and deficits in supplies, ranking 186th out of 191 countries by the World Health Organization in health care performance. Patients are negatively impacted as health care workers suffer from compassion fatigue and/or compassion burnout, which contribute to the shortage of human resources as vulnerable health care professionals less effectively deliver care (Raab, 2014). Compassion burnout of health care workers is caused by environmental factors such as the lack of supplies and results in depersonalization, emotional exhaustion, cynicism, and loss of professional efficacy. In contrast, compassion fatigue results from dynamic relationships between clinician and patient (Gallagher, 2013). Methods: Well-established instruments, adapted from other researchers, were compiled using RedCap software into a survey that was distributed and collected by the poster author in three public health care facilities in Uganda. Results: The survey results showed high self-efficacy, good implementation of mindfulness techniques, adequate workplace resources (relationships and support) and demands, low compassion fatigue, and very high compassion burnout. Discussion: The resource deficits in Ugandan public health care are the largest contributors to high compassion burnout among health workers. Interventions to address the high burnout include integration of community health workers, improving mindfulness, and influencing health policy to address the resource deficits.

Acknowledgements: IDeA Network of Biomedical Research Excellence (INBRE)

Shelby Towe: Chemistry & Biochemistry
Mentor: William Dyer – Plant Sciences & Plant Pathology
The Linkage Between Heat Shock Proteins and Herbicide Resistance

The 2006 wild oat (Avena fatua) population from central Montana has become resistant to more than 11 different herbicides over the last decade or so. As compared to a population collected in 1993 that is resistant to only two herbicides, they have also evolved increased tolerance to heat stress: we propose that these two phenotypes are linked. We hypothesize that resistance to herbicides may be due to changes in heat shock protein (Hsp) mechanisms. Hsps are constitutively expressed in all cells, and they assist damaged proteins in proper refolding, and prevent undamaged proteins from becoming denatured. We are specifically interested in Hsp 70 and Hsp 90. We recently showed that the 2006 herbicide-resistant wild oat population is tolerant to heat stress, while the 1993 population is not. We also know from western immunoblots that 2006 plants constitutively express much less Hsp 70 than susceptible plants, and its induction after heat stress is much slower. Current work involves quantifying Hsp 70 and Hsp 90 levels in 1993 plants as well as using quantitative polymerase chain reaction (qPCR) assays to validate expression levels of known resistance genes in response to heat shock and other abiotic stresses.

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Hagan Vincent: Microbiology & Immunology
Mentor: Matthew Taylor – Microbiology & Immunology
Visualizing and Quantifying Intercellular Spread of Pseudorabies Virus

The global burden of HSV-2 infection is substantial, leaving over 400 million people at increased risk of genital ulcer disease, HIV acquisition, and transmission of HSV-2 to partners or neonates. These estimates highlight the critical need for development of vaccines, microbicides, and other new HSV prevention strategies. To contribute to this need, I have initiated a research project to investigate alphaherpesvirinae transport in porcine kidney cells (PK15)

with pseudorabies virus (PRV) as a model organism. Becker 180 is the WT strain of PRV. Bartha PRV 765 is an attenuated vaccine strain of PRV with multiple genetic mutations in the Us and Ul regions of its genome, causing defects in retrograde and anterograde spread. BaBe 446 is a chimeric hybrid of Becker and Bartha. It has a US9 deletion, the Ul region of Becker, and the Us region of Bartha. BaBe also has deletions of the gE and gI glycoproteins, which prevents the strain's ability to travel in the anterograde direction. In order to visualize virus behavior in the infected PK15 cells, the viruses have been given a red mRFP fluoresce label that directly fuses to the VP26 protein. This allows me to visualize individual capsid assemblies and propagation of infection in the samples. To accomplish my research goals, I have characterized the mutant strains of PRV by infecting PK15 cells then observing plaque formation characteristics and kinetics. Further analysis of PRV pathogenicity kinetics with a mathematical model will allow me to contribute to the scientific community's understanding of alphaherpesvirinae infection.

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Elizabeth Vinson: Physics
Mentor: Recep Avci – Physics
Investigation of Graphitic Coatings as an Anticorrosive on Copper and Nickel Foils

Graphene has previously been identified as a possible anticorrosive. Graphene coated nickel and copper foils were placed in biocorrosive reactors alongside aerobic and anaerobic bacteria. The coatings prevented bacterial growth and may have decreased corrosion on the coated samples compared to uncoated controls. This was analyzed via cryo stage scanning electron microscopy, x ray photospectroscopy, and additional measurements taken using the MSU Imaging and Chemical Analysis Lab's Auger Nano Probe. Corrosion product data and other measurements are being analyzed and will be present for this session along with data from a set of foils that is currently being prepared for March's experiment. These results support the use of graphitic coatings to prevent biocorrosion.

Acknowledgements: Undergraduate Scholars Program (USP)

McCall Voy: Sociology and Anthropology
Mentor: Elizabeth Rink, Ada Giusti, Shelly Hogan – Health & Human Development, Modern Languages & Literatures, McNair Scholars Program
Sexual and Reproductive Health in Greenland and the Colonization Mindset of the French

There is a dearth of research related to gender in Greenland. My mentor, Dr. Elizabeth Rink, has been working in Greenland for well over a decade in the field of public health, but more specifically in sexual and reproductive health (SRH). This research project is not necessarily new, but rather a continuation of her research into an unexplored branch of her longstanding project. I have been aiding Dr. Rink by providing anthropological insight into an under-researched and critical area of circumpolar health. My objective is to affect change by gaining insight into how gender affects SRH in Greenland. Reproductive health has been studied in Greenland, but gender in relation to reproductive health has not. Gender plays a crucial role in all cultures and societies, and its effect on health needs to be studied. If one just studies SRH without studying gender, the effects of various policies and practices cannot be fully understood. While in Greenland, I conducted interviews, and the main findings of my analysis are 1) families influence the SRH decisions of women and men; 2) education about SRH is based on the assigned gender of an individual, which is somewhat fluid; and 3) STDs are very common and relatively destigmatized. The goal is to share the outcome of the fieldwork to those who are best able to affect change in the area of public health care: politicians and healthcare workers.

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Jocelyn Waggoner: Cell Biology & Neuroscience
Mentor: Christa Merzdorf – Cell Biology & Neuroscience
Zic transcription factors that influence convergent extension

My research is focused on a specific time frame during embryonic development called gastrulation, in which intricate cell movements give rise to the ectoderm, mesoderm and endoderm layers of the embryo. The mesoderm layer undergoes movements called convergent extension, which allow cells to intercalate and move inside the embryo. The Zic family of zinc-finger proteins have a crucial role in gastrulation and neurulation. Based on findings from our lab (K. See and Merzdorf, in preparation) and others (Cast et al., 2012), I hypothesize that zic genes are required for convergent extension during gastrulation. Since there are 5 different, but very similar, zic genes, I will test each of these genes for a role in convergent extension during gastrulation. A knockdown method for each of the 5 zic genes in embryos of the model organism Xenopus laevis will be combined with a method called Keller Explants to allow analysis of convergent extension. In my experiments, I have ruled out zic 2 as a regulator of convergent extension. My current hypothesis is that zic3 is the most likely candidate because of its known roles in neural tube formation and other reasons. I will also analyze zic1,4, and 5 for convergent extension regulation.

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Elizabeth Waymire: Chemistry & Biochemistry
Mentor: Brian Bothner – Chemistry & Biochemistry
Characterization of the Effects of the Binding of anti-CRISPR AcrF9 to the CRISPR Type IF Surveillance Complex

The high specificity of DNA recognition in CRISPR-Cas systems has allowed this system to be used as an affordable, cutting-edge genetic engineering tool. CRISPR is currently being used to combat prevalent genetic diseases and viral infections such as sickle cell anemia, hepatitis B virus, and human papilloma virus. The discovery of small viral proteins that block CRISPR function (anti-CRISPRs) provides a way to regulate the CRISPR system's genetic engineering activity by acting as an on/off switch. It is known that the anti-CRISPR, AcrF9, prevents binding of dsDNA to the Type IF CRISPR interference complex, Csy, thus preventing DNA degradation but the mechanism of this is unknown. Preliminary research has included native mass spectrometry (NMS), chemical cross-linking mass spectrometry (XL-MS), and hydrogen deuterium exchange mass spectrometry (HDX-MS) to determine the changes in protein dynamics and conformation of the Csy complex upon binding of the AcrF9. From these experiments it was found that multiple AcrF9 proteins bind to each Csy complex, and that the binding was localized to the middle and tail of the complex. It was also found that the anti-CRISPR causes conformational changes where there is tightening at the head of the complex and loosening at the tail. The next step in this project is to apply peptide level hydrogen deuterium exchange mass spectrometry experiments to identify higher resolution conformational changes and the binding mechanism of AcrF9 and Csy. I predict that there will be less hydrogen-deuterium exchange at the head of the complex and more exchange at the tail of the complex upon Acr binding based on preliminary data. I also predict that the AcrF9 will bind to the Cas7 subunits shown by less hydrogen-deuterium exchange on the peptides that are shielded from exchange upon Acr binding. By understanding the changes in dynamics that occur upon AcrF9 binding, we can understand the mechanism that allows the AcrF9 to turn off the Csy complex. This understanding could allow for the strategic use of AcrF9 in gene editing thus adding an additional level of temporal control which is currently lacking.

Acknowledgements: IDeA Network of Biomedical Research Excellence (INBRE)

Dakota Wise: Chemistry & Biochemistry
Mentor: Patrik Callis – Chemistry & Biochemistry
Water - An Obligatory Cofactor of Orotidine 5'-phosphate Decarboxylase

Orotidine 5'-phosphate decarboxylase (OMPD) is an essential enzyme in the synthesis of pyrimidines. Of the known enzymes, it is one of the most efficient, with catalytic rates of up to 17 orders of magnitudes faster than in water. Its action is straightforward – OMPD removes a carboxylate from an Orotidine ring to generate the RNA base uridine monophosphate. Despite this simple action, the exact mechanism behind OMPD's enzymatic action

has never been elucidated. Over the years, many possible mechanisms have been proposed. Although biochemists have been unable to agree upon the mechanism behind OMPD's action, each of these proposals has shared an important characteristic – ignoring water within the active site. Literature throughout the years has established that water is an often-overlooked molecule. It is our belief that the amount of water located within the active site of OMPD is greatly underestimated. Our work has focused around an unbiased approach, in which a quantum mechanical- molecular mechanics (QMMM) molecular dynamics scheme is applied to the active site of OMPD and its substrate with full solvation of water. Our recent work has focused on analysis of the strong electric fields present in the active site of enzymes. It is the belief of the Callis group that the electric fields created by charged residues within the active site greatly increase the rate of ionization for water. We believe this process results in the creation of hydronium, which is likely required for catalysis to occur. As such, we propose that water is an obligatory cofactor for OMPD.

Acknowledgements: IDeA Network of Biomedical Research Excellence (INBRE)

Jamie Woolman, Summer Whillock: Psychology
Mentor: Michelle Meade, Brandon Scott – Psychology
The Effects of Anxiety on Age Differences in Memory

The primary goal of the current study is to examine the possibility that anxiety may predict memory performance in older adults. Further, we wish to investigate the effect of anxiety on specific monitoring mechanisms that go beyond general memory performance. To examine this relationship, undergraduate students (18-25 years) and older adults (65 years and older) will be given a battery of anxiety assessments that include measures of general and memory anxiety, followed by a memory test that is either forced or free recall. The forced and free recall conditions allow for the specific source monitoring mechanism to be investigated. Undergraduate students will be included to examine age-related differences in memory and to consider if anxiety deferentially influences memory in young and older adults. We predict that older adults with high anxiety will more carefully evaluate their responses on a memory test and so demonstrate better monitoring than older adults with lower anxiety. Further, we expect to see greater effects of anxiety in the free recall condition for younger and older adults. The results of this study will offer novel insights into individual differences in aging and how anxiety may help predict those differences.

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Max Yates: Chemistry & Biochemistry
Mentor: Patrik Callis – Chemistry & Biochemistry
Unbiased Quantum and Molecular Dynamics Simulations of Triosephosphate Isomerase

In the world of enzymes, clear visual representation of how catalytic events occur on the quantum level is significantly lacking. While atomic level simulations have been performed in the past, such runs have subjected the protein to a predetermined path for catalysis, making these simulations biased. By creating an unbiased quantum level view of how enzymes are able to catalyze reactions at such a phenomenal rate, greater insight can be gained on specific mechanisms leading to far reaching implications for fixing enzymatic mutations and modifying enzymes in the lab. To make progress towards this goal, the enzyme Triosephosphate Isomerase was studied due to its integral role in glycolysis to drastically increase ATP yields. A crystal structure of this enzyme was subjected to molecular and quantum dynamics simulations of the active site. These unbiased quantum simulations on the substrate and integral surrounding residues generated short movies and allowed programs to calculate electrostatic fields and atomic distances, with which the mechanism of this isomerization has been sought to be revealed. Thus far, it has been found that the water residues play a large role in this mechanism, as they experience electrostatic fields in the active site that are greater than double the fields experienced by bulk water. Furthermore, some water molecules become locked into the active site for nanoseconds during the runs, suggesting potential importance of these molecules. When a hydroxide was introduced, catalytic events were

induced, indicating that water could be the missing component to enzymatic catalysis. Similar tests on other enzymes are being conducted as well as on different crystal structures of Triosephosphate Isomerase to further explore the validity of findings.

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MONTANA INBRE NETWORK STATEWIDE SYMPOSIUM PRESENTERS

Chelsea Coons, Kyler Pawlowski: Biology (Montana State University – Billings)
Mentor: David Butler, Kurt Toenjes – Biology
Investigating the Binding of BH3I-1 Derivatives to Anti-Apoptotic Bcl-2 Proteins

Candida albicans is a leading cause of superficial and life-threatening fungal disease. The ability to grow as filamentous cells is an important virulence trait for this fungus. Thus, molecules that block filamentous growth may form the basis for a novel approach to controlling infections by C. albicans. We have characterized a small molecule called BH3I-1 that specifically inhibits filamentous growth, but not yeast-form growth. BH3I-1 is not likely to be a good candidate for an anti-fungal drug, as it targets human Bcl-2 proteins and has the potential to induce apoptosis in human cells. The goal of our project is to identify structural derivatives of BH3I-1 that retain anti-fungal activity, but not Bcl-2 binding activity.

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Ethan Harbo, Jaron Reynolds: Biology (Flathead Community College)
Mentor: Mirabai McCarthy, Ruth Wrightsman – Biology
Antibiotic Potential of Flathead Fungi and Flora

Widespread use of antibiotics in medical and agricultural industries has resulted in extensive antibiotic resistance at the global level, which poses an immediate threat to human health. The most commonly used antibiotics are currently synthesized from fungi and bacteria, yet other organisms such as lichens, bryophytes and pteridophytes have sparked scientific interest as potential sources of antimicrobial compounds, but only a small fraction of species have been tested. The overarching goal our research is to determine whether locally occurring fungi, lichens, bryophytes, and other vascular plants, have antibiotic potential against various pathogenic bacteria including, Staphylococcus epidermidis, S. aureus, Pseudomonas aeruginosa, Enterococcus faecalis, Bacillus cereus, and Escherichia coli. Two-hundred-and-nine plant, lichen, and fungal specimens were collected, identified, dried, and deposited in the FVCC herbarium. Samples were later prepared for antibiotic analyses using ethanol extractions and tested using the Kirby-Bauer disk diffusion method and MIC plate methods. Extractions from twenty lichens, four bryophytes, six pteridophytes, and three fungal species inhibited growth of various bacteria, but none inhibited that of E. coli. Our continued research in this area will include utilizing various solvents for our extraction methodology, such as water and methanol, as well as sampling additional plant, lichen, and fungal species against these bacteria.

Acknowledgements: Raser Powell (Flathead Community College Undergraduate Student) – Biology, IDeA Network of Biomedical Research Excellence (INBRE)

Zach Hart: Microbiology & Immunology (Montana Tech – The University of Montana)
Mentor: Joel Graff – Biology
Investigating the Function of TRIM22 and TRIM34 with a Yeast-Two-Hybrid Screen

TRIM34 and TRIM22 are proteins within the conserved superfamily of TRIM proteins. These proteins are E3-ubiquitin ligases, meaning they add ubiquitin molecules to proteins, targeting them for degradation. Both TRIM34 and TRIM22 have additional known functions, and this project sought to confirm these functions or find novel functions of both TRIM22 and TRIM34. Genes encoding both proteins were recombined into the yeast two-hybrid bait vector, pGBKT7. Next, these constructs were transformed into yeast and mated with a human cDNA prey

plasmid library to initiate a yeast-two-hybrid screen on selective nutrient drop out media lacking tryptophan, leucine, histidine, and adenine. Bait and prey plasmids were isolated from the yeast colonies and transformed back into bacteria. The prey plasmids have been sent out for sequencing to determine the identity of the protein encoded by the prey plasmid insert. In a separate set of experiments, the genes encoding TRIM22 and TRIM34 were each cloned into two plasmids encoding fluorescent proteins. The blue and green fluorescently-tagged proteins will be expressed in human cells to determine whether these proteins, like other members of the TRIM family, form complexes via homotypic and heterotypic interactions. Moreover, we will evaluate the stability of the TRIM-interacting proteins, which we predict will be degraded following ectopic expression of the TRIM proteins.

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Skye Hatfield, Keith Moore, Shannon Cushing: Field Botany (Flathead Community College)
Advisor: Ruth Wrightsman – Biology
Antibiotic Potential of Lichens, Fungi, and Bryophytes in Northwest Montana

Over-prescription of antibiotics has resulted in the selection of antibiotic-resistant bacteria. As a result, there are currently bacterial strains which are resistant to nearly all antibiotics. The crisis of antimicrobial resistance adds an enormous burden to the cost of healthcare in the U.S. The Centers for Disease Control and Prevention has estimated that treating infections due to antibiotic-resistant organisms adds over 20 billion dollars annually to direct healthcare costs and another 35 billion dollars in lost productivity. To combat this growing issue, one research focus is testing natural sources, such as fungi and lichens, for the presence of antibiotic compounds. This project has focused on testing extracts from lichens, fungi, liverworts, ferns, and angiosperms collected in the Flathead Valley for their ability to inhibit the growth of four Gram-positive and two Gram-negative bacterial species with the hope of finding new antibiotic agents. Kirby-Bauer disk-diffusion assays have provided informative results regarding inhibition of bacterial growth. To date, we have conducted over 350 disk-diffusion assay plates and have recorded their results to our database. From this work, we have identified 20 species which exhibit antibiotic properties. We are now focused on developing a minimal inhibitory concentration (MIC) assay using plate-based microtiter method to gain a more quantitative measure of antimicrobial extracts. The ultimate goal of this research is to identify the antimicrobial compounds present in the extracts displaying inhibition of microbial growth.

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Ozzie Indreland: Microbiology & Immunology (Montana Tech – The University of Montana)
Mentor: Joel Graff – Biology
Identifying Proteins that Interact with the Really Interesting New Gene Protein RNF166

The ubiquitin proteasome system degrades target proteins that are tagged with ubiquitin proteins via an E1, E2, and E3 enzyme cascade. The human genome encodes two E1 (ubiquitin activating) enzymes, dozens of E2 (ubiquitin-conjugating) enzymes, and 500-1000 E3 (ubiquitin ligase) enzymes, the latter of which can be categorized according to protein domains such as the really interesting new gene domain (RING)-containing proteins. While our laboratory has previously focused on tripartite motif (TRIM) proteins, this project describes our initial work with all four members of the RING-UIM (ubiquitin-interacting motif) protein family. Like TRIM proteins, we hypothesize that RING-UIM proteins will act as E3 ubiquitin ligases to influence antiviral defenses either by acting on interferon and autophagy signaling pathways or by targeting viruses directly. Because ubiquitin ligases act via protein-protein interactions, we will use a yeast-two hybrid (Y2H) assay to detect novel RING-UIM interacting proteins. We have cloned genes for all four RING-UIM members (RNF114, RNF125, RNF138, and RNF166) as well as the known transcript variants of these genes into a Y2H bait plasmid and a human cDNA prey plasmid library is being screened to identify RNF166 isoform 1-interacting proteins. We expect that the shorter versions of RNF166 (isoforms 2 and 3) will be either unable modify targeted proteins with ubiquitin or unable to

interact with the RNF166 isoform 1 targets and thus act in a dominant negative manner. These studies will not only identify functional roles for RING-UIM proteins but also provide insights into often neglected shorter protein isoforms.

Acknowledgements: IDeA Network of Biomedical Research Excellence (INBRE)

Camille McEwen, Kristine Jordan: Microbiology & Immunology (Montana Tech – The University of Montana)
Mentor: Joel Graff – Biology

Fluorescent and Bioluminescent DNA Labeling to Determine TRIM Protein Interaction in Signaling Pathways and Roles in Innate Immunity

Microscopy, fluorescent DNA tagging, transfection sand luciferase assays are all common lab techniques used in the exploration of cellular processes and manipulations. In this experiment, tripartite motif (TRIM) family protein roles are explored through transfected HEK293 cells. The cells were transfected with fluorescent tagged TRIM5α, TRIM13, TRIM6v2, TRIM62, TRIM34 and MAGEA2B DNA and observed under a fluorescent microscope. Localizations of the protein DNA were observed in the transfected HEK293 cells. Cross transfections were performed using the same TRIM DNA with reporter plasmids pNF-κB, pAP1 and pINFβ, along with firefly luciferase reporter assays. Interaction was measured to determine TRIM gene expression whether a protein influences any of the reporter plasmid signaling pathways. Reporter plasmid/TRIM gene transcription was observed in TRIM5α-NF-κB, TRIM5α- pAP1, TRIM13-pNF-κB, TRIM62v2-pNF-κB, TRIM34-pINFβ and MAGEA2B-pNF-κB. These results suggest that each TRIM exhibiting an interaction is either antagonizing or enhancing the signaling pathway of the reporter plasmid. Virally-infected cells produce cytokines such as type I interferons that induce antiviral defense mechanisms not only in the infected cell but also in nearby cells. The upregulation of hundreds of interferon-stimulated genes (ISGs), which coordinate the immune response. We have focused our attention on characterizing ISGs from the tripartite motif (TRIM) family of RING domain-containing E3 ubiquitin ligases. We hypothesize that TRIM proteins act by targeting the degradation of either antiviral proteins or components of interferon-associated signaling pathways. TRIM5α homodimerized to formed cytoplasmic foci in human cells as expected, while the other TRIM family members had distinct localization patterns. Using luciferase reporter assays, we found that ectopic expression of TRIM5α enhanced both NF-κB and AP-1 signaling pathways. TRIM13, TRIM62v2, as well as a TRIM-associated protein, MAGEA2B, all enhanced NF-κB signaling. Finally, TRIM34 overexpression increased expression of a luciferase reporter under control of the IFNβ enhanceosome promoter. It is currently unclear whether TRIM34 influenced the NF-κB, IRF3, and/or AP-1 signaling pathways for this final observation. We will use two approaches to determine the mechanisms by which the TRIM proteins are affecting these signal transduction pathways. We will 1) perform yeast two-hybrid screens to identify TRIM-interacting proteins and 2) use biochemical approaches to identify the signaling step that is being influenced by these understudied ubiquitin ligases. Improved understanding of antiviral defense responses will identify novel therapeutic targets.

Acknowledgements: IDeA Network of Biomedical Research Excellence (INBRE)

Ian McRyhew, Ashley Gervais, Stephanie Thomas, Marcy Mead, Virgil Dupuis (Salish Kootenai College)
Mentor: Selena Ahmed, Carmen Byker-Shanks: Health and Human Development

Advancing Healthy and Sustainable Diets for All through a Social Media and Nutrition Education Intervention on the Flathead Reservation of the Confederated Salish & Kootenai Tribes

The Healthy and Sustainable Diets for All focus is on research and educational intervention to mitigate food system and diet related health disparities on the Flathead Indian Reservation. Salish Kootenai College Extension and Montana State University Department of Health and Human Development partnered to engage forty low-income participants of the Food Distribution Program on Indian Reservations, Supplemental Nutritional Assistance Program, and local Foodbanks in a six month study addressing the research question: What are the effects of an integrated social media and nutrition education intervention on food choices, dietary quality, health outcomes, nutrition knowledge, and perceptions of study participants? The specific aims are to: Characterize impacts of an

integrated social media and nutrition education intervention; Evaluate impacts of nutritional and healthy cooking education intervention on waist circumference, body mass index, blood pressure, and blood glucose; Determine impacts of intervention on nutrition knowledge and perceptions to elucidate linkages between food choices, dietary quality, health outcomes, and nutrition; and, Assess barriers and opportunities for increasing consumption of locally produced fruits and vegetables, whole grains, and legumes. Survey tools measuring food choices, dietary quality, nutrition knowledge, and motivation document participant perceptions of food. Interventions include nutrition and sustainability curriculum, cooking demonstrations, a cookbook, using local vegetables, whole grains, and legumes, mindfulness activities associated with food, Facebook, on-line information on meu planning, cooking, and a project website for archiving information. An inventory of tribal food use and a barriers survey will assess potential to utilize local food in tribal schools, restaurants, and assistance programs.

Acknowledgements: IDeA Network of Biomedical Research Excellence (INBRE)

Kyle Montgomery, Chase Skelton: Biology (Flathead Community College)
Mentor: Ruth Wrightsman – Biology
Cytotoxicity Testing of Antibiotic Extracts from Northwest Montana Lichens, Bryophytes, and Fungi

Student researchers at Flathead Valley Community College have focused on testing extracts from lichen, fungi, and bryophytes as potential sources of antibiotics. In order to further characterize the potential of these compounds, additional testing procedures are being developed to test the selective toxicity of these extracts against mammalian host issues. There are two integral parts of the purpose for this testing: 1) selective toxicity of an extract against microbes compared to host tissue is a key requirement of an antibiotic and 2) selective toxicity against host tissue could be indicative of anticancer uses. The initial problems proposed by research of this nature is establishing a mammalian cell line for testing the cytotoxicity nature of the extracts and then establishing a method for measuring the viability of the cells following exposure. While we do have an established mouse 3T3 cell line, a method for determining cell viability by measuring metabolic activity using a XTT dye-reduction method is currently being developed. Past protocol has involved the use of resazurin dye-reduction to measure cell viability, but the XTT dye-reduction is thought to give better results. The optimal concentration of cells for the XTT cell proliferation assay is currently being determined. The next step will be the testing of extracts with known antibiotic activity for their potential toxicity against mouse 3T3 cells.

Acknowledgements: IDeA Network of Biomedical Research Excellence (INBRE)

Kyle Pickens: Chemistry (Montana State University – Billings)
Mentor: Matt Queen – Biological and Physical Sciences
Exploration of Ligand Lability in Carbon Tetrachloride Dechlorination Technologies

Carbon Tetrachloride (CT) is a carcinogenic industrial solvent, and known environmental contaminant. The Department of Energy's Hanford Site has been identified as a Superfund Site. CT, is just one of the many environmental concerns. Environmentally CT dechlorinates in a stepwise manner forming lesser chlorinated intermediate complexes that pose a health threat to humans. [Cu(PDTC)L] is a small coordination compound capable of dechlorinating CT into less harmless decomposition products: CO2 and Cl-. In this study we draw a correlation between the dechlorination kinetics of CT of [Cu(PDTC)L] and the ligand liability of the L ligand. We use P K-edge X-Ray Absorption Spectroscopy to quanititate the phosphorus covalency of a series of PR_3 transition metal ligands [Cu(PDTC)L] (L= PPh_3, and PCy_3). Our results show that there is no correlation between the covalent character of Cu-P bonds and the kinetics of dechlorination. Instead, we propose that the correlation has a greater correlation with the solubility of a ligand in a given solvent system.

Raser Powell: Biology (Flathead Community College)
Mentor: Mirabai McCarthy, Ruth Wrightsman – Biology
Fungal Morphology in the Flathead

The growing crisis of infections due to antibiotic-resistant organisms poses a huge threat to human health, and creates a need for antibiotic discovery. Various fungi, and plants hold promise as potential sources for new antimicrobial compounds, but only a small fraction of species have been tested. The overarching goal our research is to determine whether locally occurring fungi, lichens, bryophytes, and other vascular plants, have antibiotic potential against various pathogenic bacteria, but without proper identification, species determinations could not be made. Therefore, we are working towards creating a field guide that will facilitate the process of identifying plant and fungal species in and around the Flathead Valley. Over two-hundred specimens were collected, photographed, identified, dried, and deposited in the FVCC herbarium. Approximately 6000 images of plant, lichen and fungal species were properly identified using various dichotomous keys, and organized by morphology. Here we present results from our fungal collections. We hope that creating this field guide will support our continued progress of fungal identification for the greater antibiotics project, and also help to engage people in mushroom identification, promote literacy and interest regarding these unique organisms, and provide a resource that can be utilized as an outreach tool to promote conservation awareness throughout our community.

Acknowledgements: Ethan Harbo (Non-MSU/Other), Jaron Reynolds (Non-MSU/Other), IDeA Network of Biomedical Research Excellence (INBRE)

Julius Scott: Computer Science (Great Falls College – Montana State University)
Mentor: Chris Mee – Computer Technology
Ares Space Grant CNC Plasma Table Abstract

The purpose of the CNC Plasma table project was to take a discontinued plasma table that is malfunctioning and find ways to update the table. The first step of the project was to gather as much information and data from the table as well as it's manufacturer, Precision Cutting Systems. The next phase is to do testing to make sure the equipment on the table is functional, while also testing for future possible scenarios that could occur during use. The final phase which we are currently working on is updating the hardware by installing a new computer with a more user-friendly operating system and system applications. It this project, it is very important that control the plasma arm is functional; if it is not, then the next step is to seek out replacements. For software, we are looking to add apps that are similar to what most industry standard tables are using, Linux based designing applications. Future work is going to include finalizing the computer application and operating system design including compatibility troubleshooting.

Acknowledgements: Montana Space Grant Consortium (MSGC), IDeA Network of Biomedical Research Excellence (INBRE)

Aaron Sharp: Biology Medical Laboratory Science (Montana State University – Billings)
Mentor: Kurt Toenjes
Small molecule Gram-Positive Bacterial Inhibition.

With the advent of antimicrobial molecules in the mid nineteenth century countless people were saved from life threatening infections. With decades of use, antimicrobials put enormous selective pressure on targeted pathogens resulting in resistances forming in many common microbes. These resistant strains of pathogens result in over two million illnesses, 23,000 deaths every year, and billions of dollars in medical expenses. This represents a need to research new molecules that have antimicrobial properties to combat the rise of resistance and prevent undue suffering to those afflicted. A small molecule is under investigation now that displays promising antimicrobial properties in preliminary studies against Candida species and many pathogenic gram-positive bacteria. The gram-positive bacteria that are inhibited by this small molecule at include Staphylococcus aureus, Streptococcus pneumonia, Listeria monocytogenes, Staphylococcus epidermidis, Streptococcus pyogenes, Bacillus cereus and Clostridium difficile. Research is currently focused on S. aureus and C. difficile with disk assays performed on both and plate assays performed on S. aureus to narrow down the minimum inhibitory concentration. C. difficile has a zone of inhibition of 9mm, while S. aureus has zone of inhibition at 10mm. The plate assay for S. aureus has shown a minimum inhibitory concentration to be between 150-100 uM of the small

molecule, though further studies are needed. Plans are being made to find the mechanism of action of the small molecule by using mutant strains of S. aureus.

Acknowledgements: IDeA Network of Biomedical Research Excellence (INBRE)

Tayler Songer: Biology (Montana State University – Billings)
Mentor: Matt Queen – Biological & Physical Sciences
Dechlorination of carbon tetrachloride by Cu(PDTC)Br in environmentally relevant conditions

Carbon tetrachloride is a known carcinogen that can cause cancer related illnesses when it is dechlorinated by Cytochrome P450, located in the human liver. Environmental reduction of carbon tetrachloride can produce lesser chlorinated intermediates, such as the trichloromethyl radical, which is harmful to living organisms. [Cu(PDTC)Br]- has shown to be able to dechlorinate carbon tetrachloride all the way to CO2 and chloride, which are environmentally safe compared to lesser chlorinated intermediates. This study investigates the dechlorination kinetics of carbon tetrachloride by [Cu(PDTC)Br]- in environmentally relevant conditions. We created simulated Hanford ground water samples featuring Fe3/2+ Ca2+, and Mg2+ SO4-2 salts. Data suggests that the rate of dechlorination of carbon tetrachloride by [Cu(PDTC)Br]2+ is unaffected in the presence of the aforementioned ions.

Acknowledgements: IDeA Network of Biomedical Research Excellence (INBRE)

Courtney Stinger: Life Sciences (Salish Kootenai College)
Mentor: Wendy Westbroek – Life Sciences
Workflow Development for Exosome Isolation of A549 Lung Cells

There is a disproportionate amount of pollution sources located on or near Tribal land, such as mines and toxic waste dumps. This contributes to heavy metal toxin contamination of Tribal natural resources, resulting in documented health disparities, such as cancer, in Native American communities. Cadmium (Cd) is an environmental heavy metal toxin and human carcinogen. Two sources of Cd exposure in Native American communities are mining and smelting activities and tobacco use. Studies have established a link between Cd-exposure and lung cancer in Native American and non-Native communities. The molecular mechanism of this relationship remains elusive. Exosomes are small vesicles secreted into the extracellular environment when endosomal multi-vesicular bodies fuse with the plasma membrane. Exosomes are of high interest to the cancer research field because of their involvement in release of pro-invasive factors and initiation of pre-metastatic niches. The impact of Cd-exposure on lung exosome signatures and effects on tumorigenesis have never been explored. We hypothesize that Cd exposure contributes to changes in lung exosome signatures.
We developed and applied a workflow for capturing exosomes from cultured A549 lung cells by differential centrifugation. This was followed by an in-depth morphological and antibody-based biochemical characterization of captured exosomes. The workflow outcome indicated reproducibility of exosome isolation. In future studies, we will compare protein signatures of exosomes from Cd-exposed and non-exposed A549 lung cells with LC-MS/MS. This work will lay the foundation for characterization and elucidation of exosome-related molecular pathways in lung cancer. Ultimately, this will facilitate the future development of novel therapeutic and diagnostic tools.

Acknowledgements: Chloe Bryson (Salish Kootenai College) – Life Sciences, IDeA Network of Biomedical Research Excellence (INBRE)

Cody Walters, David McGee: Cell Biology & Neuroscience (Montana State University – Billings)
Mentor: Lynn George, David Butler – Cell Biology & Neuroscience
Generation of a High Throughput Screening System for Small Molecules Capable of Rescuing Axonopathy

Familial Dysautonomia (FD) is a neurological disease with both developmental and degenerative aspects including axonopathy of peripheral nerves. FD results from a point mutation in the ELP1 gene, causing reduced levels of the corresponding protein that functions in assembling a highly conserved, six-subunit complex known as Elongator. Elongator catalyzes the chemical modification of transfer RNAs needed for the translation of codon-biased transcripts that preferentially use AA- or AG-ending codons. Like FD, axonopathies are a common feature of many other neurological diseases including amyotrophic lateral sclerosis (ALS), and Alzheimer's. Despite their prevalence in neurodegenerative diseases, the discovery of therapeutics for treating axonopathies has been impeded by the difficult and costly nature of culturing primary neurons. Therefore, an experimental model that can withstand the manipulation required for a high throughput small molecule screen is essential for drug discovery. *Candida albicans* shows a pronounced polarized growth phenotype that is distinct among other yeasts. To determine whether this phenotype is dependent on Elongator, as is polarized growth in neurons, we knocked out the *ELP1* gene in *C. albicans*. Importantly, this knockout exhibits severely compromised polarized growth. Our long-term goal is to use this knockout to develop a high throughput screen for small molecules that can rescue normal polarized growth. Molecules that rescue in our yeast model system, will then be tested *in vitro* for the ability to rescue axon elongation in Elp1 deficient neurons.

Acknowledgements: IDeA Network of Biomedical Research Excellence (INBRE)

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Solange Dubreuil: Ecology Mentor: Amy Apprill – Chemistry & Biochemistry *DNA-based sequencing approach to identify microbial community diversity from Cuban Coral Tissue*	pm	94
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Anders Enevoldsen: Microbiology & Immunology Mentor: Alice Running, Bernadette McCrory – Nursing, Mechanical & Industrial Engineering *Dust Mitigation System for Use in Sterile Human Foot Medical Care*	am	96
Arden Engel: Ecology Mentor: Ryan Thum – Plant Sciences & Plant Pathology *Microsatellites distinguish morphologically similar native and invasive water primroses (Ludwigia hexapetala and L. grandiflora)*	pm	96
Emily Entz: Chemistry & Biochemistry Mentor: Sharon Neufeldt – Chemistry & Biochemistry *Nickel-Catalyzed Stille Cross-Coupling of Phenolic Electrophiles*	am	97
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