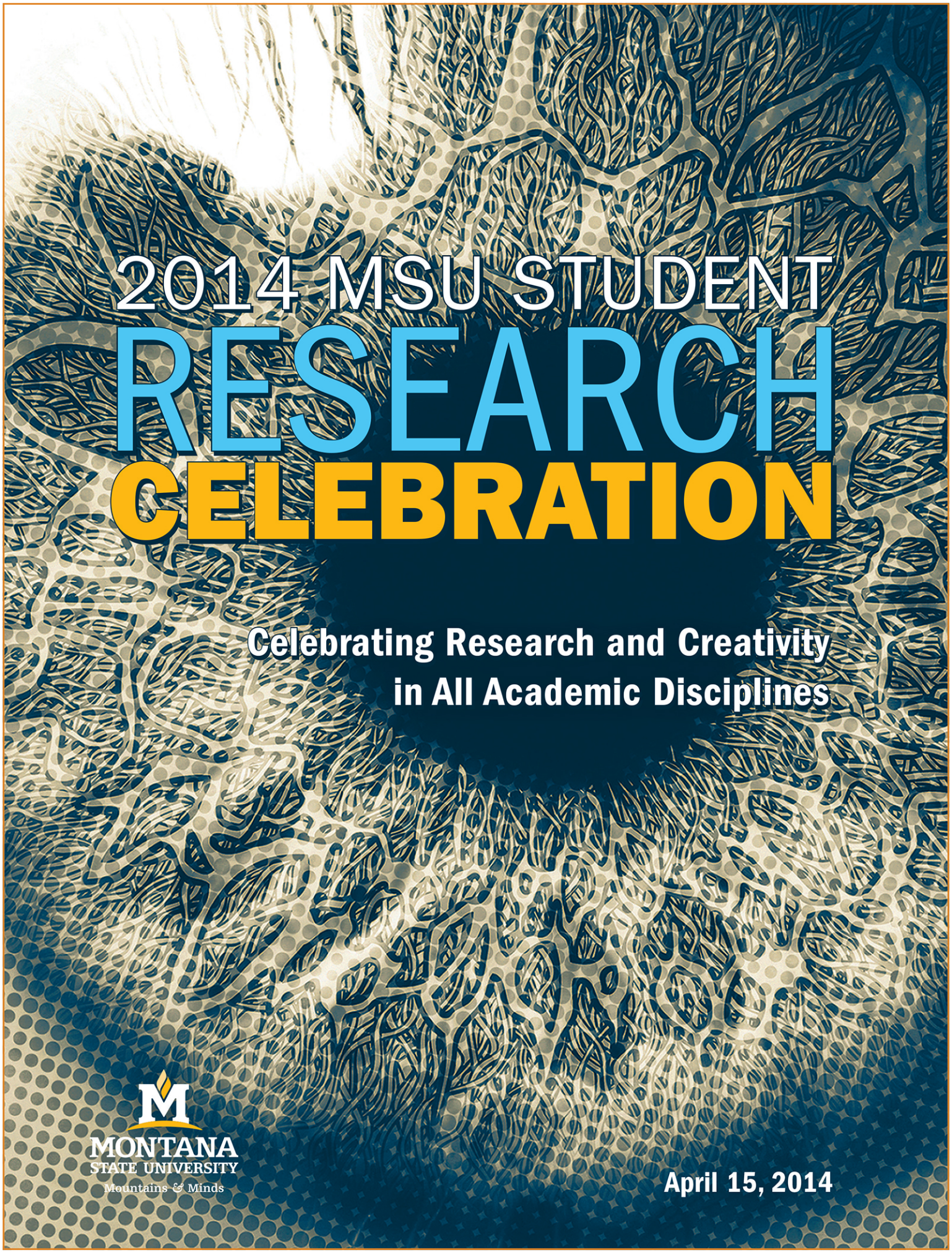
2014 MSU STUDENT
RESEARCH
CELEBRATION
Celebrating Research and Creativity
in All Academic Disciplines
MONTANA
STATE UNIVERSITY
Mountains & Minds
April 15, 2014

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

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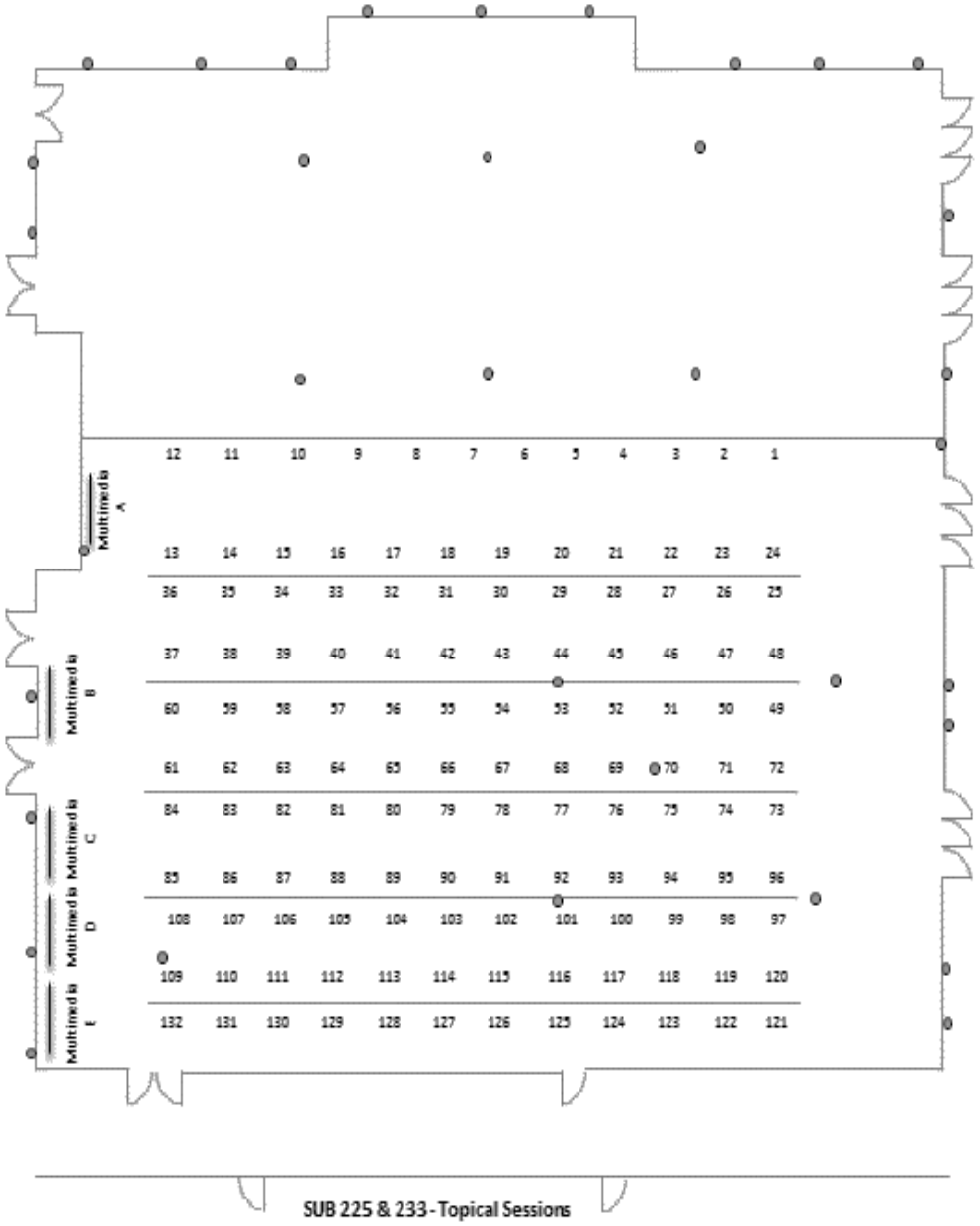

Topical Sessions—SUB Room 233

April 15, 2014

Smithsonian Internship Experiences—9:00 am – 10:30 am

Please join us as 7 MSU undergraduates discuss their experiences working at the Smithsonian National Museum of Natural History.

9:00 – Katherine Wright –*Systematic Entomology Laboratory*
9:15 – Riley Shearer – *Integrating Specimens from the Great Smokey Mountains National Park*
9:30 – Pannu Khin – *Systematic Entomology Laboratory*
9:40 – Matthew Kennedy – *Photographic Show: Unintended Journeys*
9:50 – Kathryn Pintar –*Systematic Entomology Internship*
10:00 – Benjamin Moon & Connor Murnion - *Insect Biodiversity in Your Backyard*
10:15 – Panel Style Q&A

McNair Scholars—11:00 am – 12:30 pm

The essence of our program is to successfully combine faculty mentoring, undergraduate research, and academic support services for students who are preparing themselves for success in graduate school and whose families have not traditionally participated in post-secondary education.

11:00 – Halley Heintz, Major Art History (Faculty Mentor – David Swingle, MA)
The Hybrid of Rural and Metropolitan Museum
11:15 – Michael Ruiz, Major Anthropology (Faculty Mentor – Dr. Jack Fisher)
A Test of The Effectiveness of Undiluted Bleach Method in Defleshing Human Remains
11:30 – Dani Morrison – Major Secondary Education (Faculty Mentor – Dr. Jioanna Carjuzaa)
Empowering Miracle Survivors: Native American Student Success Services at MSU
12:00 – Thomas Wurtz – Major Animal Science (Faculty Mentor – Dr. Glenn Duff)
Measuring Resting Metabolic Rates in Cattle of Varying Body Weights
12:15- Kendra Teague – Major Land Resources & Environmental Sciences (Faculty Mentor – Dr. Alison Harmon)
Indigenous Food Systems: Grains, Global Perspectives and Health Outcomes

Doing Sociology in Theory & Practice: Locating Hierarchies, Intersectionalities, and Spatialities—1:00 pm – 2:30 pm

In this session, MSU Sociology students will present their original and exciting sociological research in the areas of gender and work in two different settings, race and NFL draft positions, and nontraditional university student experiences.

1:00* – Lindsay Murdock –*The Female President: Is equality an effective top down strategy?*
1:20 – Molly Cech – *If You Happen to be a Woman... Gendered Norms of Competency in the Professional Kitchen*
1:40 – John Meyer – *Racing for Draft Positions: A Study of How Race Impacts NFL Quarterbacks' Draft Pick Positioning*
2:00 – Susan Andrus – *Okay with the Uncertainties: Balancing Family and School as a Nontraditional MSU Student*

**List represents order of presenters - times are approximate*

Topical Sessions—SUB Room 235

April 15, 2014

HUGHES UNDERGRADUATE BIOLOGY – 9:00 AM– 10:30 AM

Successful scientists in the 21st Century are using multi-faceted approaches to sharing science in general and their research in particular with diverse audiences. Hughes Scholars will present their experiences designing and delivering outreach projects to young learners across Gallatin County and in Wyoming.

9:00 – Josh Carter: Mechanical Engineering and Microbiology (Blake Wiedenheft)
Help Wanted: Virus Hunters

9:12 – James Sutton: Cell Biology & Neuroscience (Sheila Nielsen)
Exploring a World We Can't See

9:24 – Emma Hannigan: Chemistry (Mary Cloninger)
Demystifying Cancer through Mold

9:36 – Will McGuinness: Microbiology (Jovanka Voyich)
Backyard Discoveries: Hunting New Viruses

9:48 – Michael Burt: Biochemistry (Martin Teintze)
Science Club: Exploring the Unseen World of Microbes

10:00 – Madison Martin: Microbiology (Michelle Flenniken)
What's Killing the Honey Bees?

10:12 – Riley Shearer: Chemical Engineering, Biochemistry, and Economics (Trevor Douglas)
Geckos and Goo: Learning across Disciplines

MATH & STATISTICS INTERDISCIPLINARY RESEARCH—1:00 PM – 2:30 PM

In the mathematical sciences, we have a unique opportunity to use our expertise on research projects in several disciplines. In this session, we will give an overview of a few current projects that range from traffic to biofilms to ecology.

1:00* – Benjamin Jackson (Isaac Klapper, Robin Gerlach)
Biofilms and Mathematics: Examining Urea Metabolism in a Bacterial Community

1:15 – Alyssa Peck (Jim Robison-Cox)
Evaluating the Effectiveness of Occupant Protection Programs

1:45 – Tamra Heberling (Lisa Davis, Billie Kerans)
Modeling the Direct and Indirect Effect of a Non-Host on Parasite Transmission

2:00 – Terrill Patterson
Project title not available

2:15 – Dan Kanewske (Tianyu Zhang)
2D Modeling of Biofilm as a Visco-Elastic Fluid

**List represents order of presenters - times are approximate*

2014 Student Research Celebration
April 15, 2014

MORNING POSTER PRESENTATIONS

SUB Ballrooms B, C, and D
9:00 am - 12:30 pm

Student, Mentor, Project	Poster #	Abstract Page #
Chaparral Berry: Chemical & Biological Engineering Roberta Amendola, Paul Gannon -- Mechanical & Industrial Engineering, Chemical & Biological Engineering *Fundamental investigation of hydrogen transport in ferritic stainless steel for S.O.F.C interconnect applications*	1	60
Phyu Pannu Khin: Cell Biology & Neuroscience Christa Merzdorf, Daniel Van Antwerp, Jennifer Forecki -- Cell Biology & Neuroscience *Positioning the Midbrain-Hindbrain Boundary during Nervous System Development*	2	95
Connor Murnion: Cell Biology & Neuroscience Frances Lefcort -- Cell Biology & Neuroscience *Motor Innervation in a Familial Dysautonomia Mouse Model*	3	100
Riley Shearer: Chemistry & Biochemistry Trevor Douglas -- Chemistry & Biochemistry *Using Protein Cages as T1 enhanced contrast agents for Magnetic Resonance Imaging*	4	106
Linn Thrane: Physics Charles Kankelborg -- Physics *Inspection of Image Offset During First MOSES Flight in 2006*	5	110
Warren Colomb: Physics Randy Babbitt -- Physics *High Power Continuous Mid-Infrared Difference Frequency Generation*	6	85
Halley Heintz: Art David Swingle -- History & Philosophy *Museum of the Rockies: The Hybrid of a Rural and Metropolitan Museums*	7	51
Matthew Evans, Nicholas Peyton: History & Philosophy Robin Hardy -- History & Philosophy *The New North Africa*	8	87
Elizabeth Corey: Sociology & Anthropology John (Jack) Fisher -- Sociology & Anthropology *Osteoporosis & the Negative Effects of Elongated Human Life Spans: An Evolutionary Perspective*	9	85
Melissa Emery: Chemistry & Biochemistry Charles McLaughlin -- Chemistry & Biochemistry *Student Perceptions Toward the TEAL Approach to Enhance Chemistry Education*	10	87
Emma Hannigan: Chemistry & Biochemistry Mary Cloninger -- Chemistry & Biochemistry *Cancer Cell Aggregation Studies Using Carbohydrate Functionalized PAMAM Dendrimers*	11	92
Andy Marshall: Art Josh Deweese -- Art *Native Refractory*	12	51

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Michael Burt: Chemistry & Biochemistry Martin Teintze -- Chemistry & Biochemistry *Development of THAM-3PhG as a Novel Antibacterial Compound against Methicillin-Resistant Staphylococcus aureus*	13	84
Edward Gillig: Chemistry & Biochemistry Mary Cloninger -- Chemistry & Biochemistry *Uptake of Lactose-functionalized PAMAM Dendrimers*	14	90
Lindsey Jackson: Education Marilyn Lockhart -- Education *Technology Enabled Active Learning Classrooms at Montana State University*	15	30
Grant Gittus: Sociology & Anthropology Jack Fisher -- Sociology & Anthropology *Archaeological Analysis of the Coal Creek Spring Stone Artifact Scatter*	16	90
Logan Moriarty: Modern Languages & Literatures Pascale Hickman -- Modern Languages & Literatures *Moroccan French Phonetics: Beyond Le Français Standard*	17	99
Sydney Jaramillo: English Dave Swingle -- History & Philosophy *The Making of an Effective Visitor-Orientated Museum*	18	95
Brett Green: Physics John Neumeier -- Physics *Analysis of the BRAN Forward High Luminosity Detectors at the LHC*	19	91
James Sutton: Cell Biology & Neuroscience Sheila Nielsen -- Microbiology & Immunology *Differential Recognition of Candida albicans by Human Monocytes due to Microgravity*	20	110
Brian Spencer: Cell Biology & Neuroscience Steve Stowers -- Cell Biology & Neuroscience *Mapping the Thermoreceptive and Mechanoreceptive Neural Pathways in Drosophila*	21	108
Brigit Noon: Chemistry & Biochemistry Brian Bothner -- Chemistry & Biochemistry *Metabolite Diffusion of a Microfluidic H-Filter*	22	101
Luke Morton: Chemistry & Biochemistry Trevor Rainey -- Chemistry & Biochemistry *Elucidation of Palladium-catalyzed Enantioselective Reactions*	23	99
Jacob Remington: Chemistry & Biochemistry Bern Kohler -- Chemistry & Biochemistry *Further Probing the Structural Dynamics of Single Stranded DNA Labeled with the Fluorescence Probe 2-Aminopurine Using Time-Resolved Fluorescence Measurements*	24	104
Paul van Erp: Microbiology & Immunology Blake Wiedenheft -- Microbiology & Immunology *Mechanisms of CRISPR-RNA guided surveillance in Escherichia coli*	25	26
Jennifer Weeding: Mathematical Sciences Mark Greenwood -- Mathematical Sciences *An Exploration of the GSIMEX Approach to Modeling Variables with Correlated Measurement Errors in R*	26	43
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Patrick Donnelly: Computer Science John Sheppard -- Computer Science *Clustering Spectral Filters for Feature Extraction in Musical Instrument Identification*	30	32
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Katie Atkinson: Ecology Cathy Zabinski -- Land Resources & Environmental Sciences *Soil Organic Matter and Enzyme Activity*	40	81
Madison Martin: Microbiology & Immunology Michelle Flenniken, Brian Bothner -- Plant Sciences & Plant Pathology, Chemistry & Biochemistry *Evaluation of the Metabolic Signatures of Virus-Infection and Agrochemical-Stress in Honey Bees*	41	97
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Shane Leary: Mathematical Sciences Carly Urban -- Agricultural Economics & Economics *Effect of Win Percentage on Home Attendance of NFL Games*	46	96
Julia Platt: Mathematical Sciences Tomas Gedeon, Lisa Davis -- Mathematical Sciences *Mathematical simulation of traffic flow and torque for bio-polymerization processes*	47	104
Amy C. Graham: Microbiology & Immunology Joshua Obar -- Microbiology & Immunology *Activation of mast cells by influenza A virus stimulates virus-induced immunopathology*	48	25
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Sarah Witt: Health Promotion (Montana State University - Billings) Kathe Gabel, Shawn Hinz -- Health & Human Performance, Riverstone Health *Risk Factors that Predict Incidence of Drinking Alcohol during Gestation*	62	119
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2014 Student Research Celebration
April 15, 2014

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SUB Ballrooms B, C, and D
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2014 STUDENT RESEARCH CELEBRATION

GRADUATE ABSTRACTS

Sorted by Student Major

COLLEGE OF AGRICULTURE

Alayna Caffrey: Microbiology & Immunology
Mentor: Joshua Obar, Robert Cramer, Bridget Barker - Microbiology & Immunology
IL-1α is critical for leukocyte recruitment during pulmonary Aspergillus fumigatus infection

Aspergillus fumigatus is a mold that causes severe pulmonary infections. Currently, our knowledge of how *A. fumigatus* growth is controlled in the respiratory tract is limited. Alveolar macrophages and the airway epithelial cells constitute the first lines of defense against inhaled *A. fumigatus* conidia; subsequently, neutrophils and macrophages are sequentially recruited to the respiratory tract to control fungal growth and germination. How neutrophils and macrophages are recruited to the respiratory tract after *A. fumigatus* infection remains ill defined. *A. fumigatus* instillation induced biphasic expression of the inflammasome-dependent cytokines IL-1b and IL-18 during the first 48 hours, while IL-1a expression linearly grew over the same period. *Il1r1*-deficient mice are highly susceptible to pulmonary *A. fumigatus* infection. Enhanced susceptibility of *Il1r1*-deficient mice correlated with defects in leukocyte recruitment and anti-fungal activity. Interestingly, IL-1a rather than IL-1b was crucial for optimal leukocyte recruitment. IL-1a signaling enhanced the production of CXCL1, which was responsible for pulmonary leukocyte recruitment. In contrast, the inflammasome and IL-1b was only essential for optimal activation of anti-fungal activity of leukocytes. As such, *Pycard*-deficient mice were only mildly susceptible to *A. fumigatus* infection. Taken together, our data reveal central, non-redundant roles for IL-1a and IL-1b in controlling *A. fumigatus* infection in the lung.

Acknowledgements: Margaret Lehmann, Kelly Shepardson, Christopher Watschke, Kimberly Hilmer (Research Associates) - Microbiology & Immunology

Amy C. Graham: Microbiology & Immunology
Mentor: Joshua Obar - Microbiology & Immunology
Activation of mast cells by influenza A virus stimulates virus-induced immunopathology

Influenza A virus (IAV), a seasonal respiratory pathogen, results in severe lung pathology. Recent global analysis of lungs from mice infected with highly pathological IAV strains demonstrated enrichment of mast cells, but the role of mast cells during severe pulmonary viral infections has been under studied. We have recently shown that A/WSN/33 causes significant immunopathology in C57BL/6 mice and is mast cell-dependent. A/WSN/33(WSN) was able to directly activate mast cells to produce histamine, leukotrienes, inflammatory cytokines, and anti-viral chemokines. IAV-induced cytokine storm is thought to induce viral immunopathology, therefore we explored the importance of this response from mast cells. Mast cell cytokine production occurred in a RIG-I/MAVS-dependent fashion, but reconstitution of mast cell-deficient mice with RIG-I-/- mast cells generated lung pathology similar to wild type mast cells. Thus, it appears that mast cell degranulation rather than production of cytokines causes WSN-induced lung pathology. Mast cell degranulation occurs early in the viral entry cycle through a RIG-I/MAVS- and MyD88/Trif-independent mechanism. Using recombinant WSN strains, we found an association between the WSN hemaggultinin and neuraminidase proteins in the activation of mast cell degranulation and WSN-induced disease. We have identified a unique inflammatory cascade which could be therapeutically targeted to limit morbidity following infection with influenza virus.

Acknowledgements: Kimberly Hilmer, Julianne Zickovich (Research Associates) - Microbiology & Immunology

Delisha Meishery: Microbiology & Immunology
Mentor: Jovanka Voyich - Microbiology & Immunology
Differential regulation of staphylococcal virulence by the sensor kinase SaeS in response to neutrophil-derived stimuli

Bacteria have a highly conserved two-component system (TCS) for sensing and responding to different environmental conditions. The Gram-positive bacterium *Staphylococcus aureus* (*S. aureus*) is a leading cause of infection in the U.S. *S. aureus* uses the sae TCS to sense host signals and activate transcription of virulent factors essential to pathogenesis. The mechanism by which the sensor kinase recognizes the stimuli and activates the cognate response regulator to regulate transcription of virulent genes is unknown. In this study, we mutagenized the extracellular loop of the membrane histidine kinase SaeS, and discovered that one methionine residue (M31A) was essential for the ability of *S. aureus* to transcribe sae target genes including *hla*, *lukAB*/*lukGH* and *hlgA*. M31A had reduced levels of cytotoxicity in human neutrophils, comparable to Δ*saeS*. In addition, we found that the mutation of two aromatic anchor residue (F33A and W32A) affected the baseline signaling of SaeS in the absence of inducing signals, but had normal activation of virulent genes post exposure to human neutrophils. The transcription of virulent genes for W32A mutation was consistent with that of wild-type in response to human-α-defensin, but the mutation F33A did not properly transcribe the γ-toxin genes. These results suggest that the Sae system employs differential regulation of its virulence genes in response to the varied host derived signals. Currently, we are investigating the mechanism of differential virulence gene expression by the Sae system by observing the varied levels of phosphorylation of SaeS using Phos-tag™ technology.

Acknowledgements: Caralyn Flack, Oliwia Zurek (Doctoral Student), Kyler Pallister (Research Associate) - Microbiology & Immunology

Sam Tulganyam: Animal & Range Sciences
Mentor: Craig Carr - Animal & Range Sciences
Ecological impacts of bladed fire lines in the Northern mixed grass prairie

Bladed fire line construction is a fire suppression technique that limits fire spread by altering fuel continuity through vegetation removal and mineral soil exposure. Anecdotal evidence suggests bladed fires lines can cause long-term changes in soil and vegetation properties; however, relatively little research has been performed to corroborate these changes. In this study we compared soil and vegetation properties among burned, unburned, and bladed fire line conditions (treatments) at three locations in north-central Montana and three locations in southwest Montana. Vegetation cover, standing biomass, functional group abundance, soil bulk density, soil aggregate stability, and infiltration rates were quantified and comparisons made using one-way Analysis of Variance (ANOVA)(alpha equals 0.05 level). Perennial grass and perennial forb cover and standing biomass were lower on fire lines while annual grasses and annual forbs were higher on fire lines in comparison to the other treatment types. Soil bulk density was higher on fire lines than the other two treatments while soil aggregate stability was lower. Litter cover and standing biomass did not differ among treatment types. These data support the contention that bladed fire lines could cause long-term ecological change associated with altered hydrologic function, potential soil loss, and alteration in successional dynamics associated with substantial increase in dominance on non-native annual species.

Paul van Erp: Microbiology & Immunology
Mentor: Blake Wiedenheft - Microbiology & Immunology
Mechanisms of CRISPR-RNA guided surveillance in Escherichia coli

In *Escherichia coli* K12, foreign DNA is recognized by an RNA-guided surveillance complex called Cascade. Hybridization between the guide RNA and the DNA target triggers a conformational change in Cascade that recruits a trans-acting nuclease/helicase called Cas3. However the mechanisms of target recognition and Cas3 recruitment remain poorly understood. Using our recently determined x-ray structure of Cascade, we have identified residues likely to be involved in crRNA/DNA base pairing, R-loop stabilization and Cas3 recruitment.

Structure guided mutations of Cascade, the target DNA and Cas3 provide new insights into the functional relationship between Cascade and Cas3.

Acknowledgements: Ryan Jackson (Postdoctoral Researcher), Sarah Golden (Research Associate), Josh Carter (Undergraduate Student) - Microbiology & Immunology

Jasmine Westbrook: Animal & Range Sciences
Mentor: Craig Carr - Animal & Range Sciences

Integration of sheep and crop production: Effects on cover crop termination, wheat emergence, and sheep live weight gains

The integration of sheep grazing into crop rotation systems has been proposed as an alternative to conventional cover crop management techniques. This study assessed the use of sheep grazing to terminate a field pea (*Pisium sativum*) cover crop as part of a rotational winter wheat production system. Rambouillet yearlings grazed the cover crop for 32 days in either a rotational or continuous grazing system. The effects on cover crop termination, sheep live weight gain, and subsequent winter wheat emergence were quantified. Sheep grazing was compared to chemical application and mechanical tillage, the two most common conventional termination methods. Sheep grazing was the most effective termination method based upon cover (77% dead pea, 1% live pea, 22% bare ground), followed by tilled (60% dead pea, 5% live pea, 35% bare ground) and chemically treated (18% dead pea, 73% live pea, 9% bare ground) plots. Cover comparisons among treatments were significantly different ($p < 0.05$) except percent live pea cover between grazing and tillage. Average daily gains (ADG) did not differ between grazing treatments, with sheep exhibiting ADGs of 0.40 lbs day-1 and 0.34 lbs day-1 for rotational and continuous treatments, respectively ($p= 0.117$). Winter wheat seedling emergence post grazing was higher under the continuous grazing treatment ($p = 0.0172$), however, the practical significance of this difference will not be known until the wheat crop has been harvested and yield differences evaluated. Results indicate grazing as a viable method of cover crop termination that also minimizes herbicide and fossil fuel inputs.

COLLEGE OF ARTS & ARCHITECTURE

Steven Berkas, Madison Gabig, Trae Schwenneker: Architecture
Mentor: Maire O'Neill - Architecture
The Crouse Homestead

The Crouse Homestead Barn is located 12 miles north of Bozeman, MT in the Springhill community. It is significant not only for its connection to a pioneering family of Montana's agricultural industry, but also as an example of a transitional period in the development of architectural structure of large buildings. Its founder, Henry Crous(e), arrived in the Montana Territory in 1864, only two years after the first gold strike. After unsuccessful attempts at gold mining, he became a leader in the emerging agricultural community of Springhill, Montana. The Crouse barn was constructed between 1900 and 1910, and uses a hybrid system of heavy timber and light wood frame construction. This experimental design signifies the transitional process Montana builders were undergoing as journeymen carpenters, and as new milling technology became more widely available in the Gallatin Valley with the railroad's arrival in 1883. Experience with light wood frame construction at the time was limited in large buildings until it had been proven structurally sound. The Crouse Barn developed as a transitional hybrid between the traditional, sturdy heavy timber structure and light wood frame construction. Measured drawings and historical documentation involved hours of detailed fieldwork on the building site, in addition to archival research. The project was completed as part of an architectural graduate elective focused on studying the tools, techniques and technological forces that shaped the built environment representing the lives and work of ordinary people in the Rocky Mountain West. The generated work will be submitted for the Peterson Prize under the Historic American Buildings Survey (HABS), and will become a part of their permanent collection of measured drawings in the Library of Congress.

Benjamin Larson: Architecture
Mentor: Maire O'Neill - Architecture
Know Your Town

Bozeman is booming as thousands of people move here for the atmosphere, outdoors and job opportunities. With such large population change, Bozeman is adapting to accommodate everyone and their needs. As Bozeman grows and the town identity changes, the community should have a say in the design of the future. This project, titled *Know Your Town*, is two fold. First, it examines the growth around Bozeman with new housing demands and shares information about suburban sprawl and its effects and stresses on a community identity. Then, it examines the architect's role in designing a better future for Bozeman. In many ways, the architectural profession has lost its influence on the majority of the housing market. The average person feels they cannot afford an architect, and often do not listen to proposed design solutions. This schism between the design world and the general public has resulted in mass sprawl of cookie cutter houses that are unsustainable, poorly designed and generic. As a response to the growth of Bozeman, particularly the new subdivisons on the edges of town, this project explores new ways for designers and architects to interact with the individuals of Bozeman, promoting quality and sustainability in a combined effort to instigate meaningful change in development patterns. Branded as *KNOW YOUR TOWN*, a series of posters, surveys and built art installations share information about the growth of Bozeman, creating connections between what people value about living here and the choices they make on a daily basis. It also provides a feedback valve via social media for the community to broadcast their thoughts and suggestions, so that they can become a part of designing the future of Bozeman.

COLLEGE OF EDUCATION, HEALTH & HUMAN DEVELOPMENT

Sarah Devitt: Health & Human Development
Mentor: Dawn Tarabochia - Health & Human Development
The assessment of Professional Caregivers Perceptions and Attitudes of Sexual Health Issues and Behaviors associated with the Elderly Population and the Need for Educational Programs

This mixed methods descriptive study assesses the perceptions and attitudes of staff members working in a long term care facility regarding older adult sexuality. A revised Aging, Sexual Knowledge, and Attitude Scale created by White in 1982 was utilized in this study, specifically examining 18 questions for caregiver perceptions and 12 questions for caregiver attitudes. Three open-ended questions regarding educational resources for residents and staff members were also asked. Staff positions ranged from registered nurses to housekeeping workers. Men represented one-third of the sample population, while women represented two-thirds. The mean score on the attitude scale of all respondents was 31.6. This indicates an overall positive attitude, but just barely. Scores ranged from 12 to 84, whereas a lower score indicates a more positive attitude and higher score indicates a more negative attitude. This study found no correlation between gender, attitude, years working with older adults or comfort in talking with older adults about sexual health issues. Additionally, this study found no difference between men or women with regard to comfort level in talking with older adults or attitudes associated with sexual health education in long term care facilities. The qualitative data suggests that sexual health education is important to both long term care facility residents, but primarily for its staff members. Many staff members reported that they would like to have educational resources available to them to enhance their knowledge and awareness about sexuality in older adults.

Yanet Eudave Marin: Health & Human Development
Mentor: Suzanne Christopher, Bethany Letiecq - Health & Human Development
Coping and Depression among Frontier Migrants: Status and Gender Matter

Latino migration has shifted from traditional urban settlement areas in states such as California, Texas, and Arizona to rural areas in the United States. In these non-traditional rural and frontier settlement areas, there has been minimal research on the mental health of Mexican migrants. The purpose of this study was to examine the coping strategies and mental health outcomes of documented and undocumented Mexican migrant men and women in a new frontier settlement and to examine individual, stress-related factors and coping strategies as predictors of migrant depression. This study utilized secondary data gathered from a community-based participatory research (CBPR) project called “Salud y Comunidad: Latinos en Montana.” For this study, the results of 120 interviewer-assisted survey questionnaires focusing on mental health correlates and migrant coping were analyzed. Findings revealed that migrants utilized different coping strategies and experienced different mental health outcomes as a function of documentation status and gender. By status, undocumented Mexican migrants were significantly more likely to employ negative coping strategies than documented migrants, including denial, behavioral disengagement, and self-blame. By gender, women were significantly more likely to utilize positive coping strategies such as religious coping, and emotional support. For depression scores, undocumented migrants experienced significantly more depression symptoms as compared to documented individuals. This research suggests that documentation status matters for migrant mental health and coping, and holds important implications for intervention efforts in rural and frontier settlements.

Michael Fox: Health & Human Development
Mentor: Alison Harmon, Mary Miles, Carmen Byker - Health & Human Development
A Comparison of Freshly Harvested Organic Lettuce and Conventionally Grown Bagged Lettuce as Assessed by Blood Sugar Levels and Insulin Requirements of Type 1 and Type 2 Diabetic Subjects

It is well accepted that a plant-based diet benefits the glycemic control of diabetics. Although the specific mechanisms of action remain largely unknown, and correlating dietary intake with health outcomes presents challenges, there is convincing evidence that the consumption of fresh vegetables increases insulin sensitivity. Following a randomized crossover design, this study compared the effects that freshly harvested organic lettuce (treatment 'a') and conventionally grown bagged lettuce (treatment 'b') had on blood sugar levels and insulin requirements in six type 1 and type 2 diabetic subjects. Involving two days of participation, treatments were separated by one week. Diets were identical on all days except for the lunch interventions, composed of 10 ounces of selected lettuce. Subjects ate the same lunch meal on both days of a given treatment, bolusing meal time insulin as usual for the control meal and testing blood sugars at times 0, 30 and 60. In contrast, subjects did not bolus for the test meal and tested blood sugars six times over the two hours postprandial. Results indicated that treatment 'a' induced a 46.1% greater incremental Area Under the Curve after the test meal but surprisingly required 8.0% less insulin during the cumulative two day period.

Sarah Haack: Health & Human Development
Mentor: Carmen Byker - Health & Human Development
Psychosocial Factors and Dietary Habits Affecting Food and Beverage Choices of College Students: A Theory-Based Approach

Low fruit and vegetable intake and high soft drink consumption have been linked to obesity and chronic disease. The Health Belief Model and Diffusion of Innovations have been applied to health behavior, although not as a framework for understanding dietary habits in terms of Dietary Guidelines for Americans. The purpose of this study was to identify dietary and psychosocial factors associated with college students' eating habits. Fifty-eight college students were recruited and completed a 24-hour dietary recall and accompanying survey to assess dietary intake, knowledge and support of Dietary Guidelines for Americans, and self-efficacy. These scores were compared between those who consumed soft drinks and those who did not using a Mann Whitney non-parametric test. Associations between variables were tested using Spearman's non-parametric test. It was found that those consuming soft drinks had lower fruit intake, lower self-efficacy, and higher added sugar intake than those not consuming soft drinks. Additionally, fruit intake was positively correlated with support for Dietary Guidelines for Americans. In conclusion, self-efficacy was significantly associated with avoiding soft drinks, while barriers to change, benefits of change, and early or late adoption of Dietary Guidelines for Americans were associated with increased fruit consumption. Those consuming soft drinks, both full-calorie and no-calorie, consumed more added sugar that those who did not, suggesting alternative dietary sources of added sugars. Further studies are needed using a larger, more representative sample. Future interventions should emphasize social support in promoting a healthy diet and self-efficacy for discouraging negative health behaviors.

Acknowledgements: Courtney Pinard

Lindsey Jackson: Education
Mentor: Marilyn Lockhart - Education
Technology Enabled Active Learning Classrooms at Montana State University

Learner centered pedagogy is critical for student learning (Svinicki & McKeachie, 2014; Prince, 2004). Innovative technology in the classroom can enhance student capabilities to visualize information, view simulations and collaborate with peers and experts (Warger & Dobbin, 2009). This poster will present information on the process followed by Montana State University to create the University's pilot Technology Enhanced Active Learning (TEAL) classroom. The objective for building the classroom was to increase student academic success. The poster will provide an overview of the design of the room, which included five round tables of nine students at each table, computer connections for each team, flat screen monitors for each table, and an instructor work station located in

the middle of the room. The poster will also include discussion of the pedagogical implications of a TEAL classroom, information on instructor preparation and best practices. The innovative design of the room and curriculum contributed to the increased student engagement, student success, and the development of skills that can be used beyond individual classes. Details on the assessment of student success and feedback will also be included.

Timothy Reusch: Health & Human Development
Mentor: Alison Harmon - Health & Human Development
Sustainable Food Systems and the Role of Controlled Environment Production

The research poster will examine season extension opportunities and the role of controlled environment production. Currently, the United States does not produce the required amounts of fruit and vegetables to meet US Dietary Guideline recommendations for its citizens. Growing conditions, crop subsidies, crop insurance, and the current demand present challenges for a much needed increase in specialty crop production and consumption. However, due to technological advancements, plant breeding, and an increased awareness of the need for a more secure food system many realize the importance of controlled environment production systems. The poster will showcase the sustainability of inputs that are required for production along with potential limitations. The role of hydroponic food production in a controlled environment could play a pivotal in the overall sustainability of the United States food production system and public health.

Lidice Tobar: Health & Human Development
Mentor: Suzanne Christopher, Bethany Letiecq - Health & Human Development
Legal Status, Perceived Health, and Wellbeing among Migrants in a New Settlement

Mexican migrants are at risk for both obesity and depression, yet few studies have examined these outcomes and its predictors. Migrants in new settlements, face cultural and political resistance to their presence, and have to grapple with more health and well-being risks than those residing in traditional gateway cities. Literature is in its infancy regarding disparate rural health challenges for migrants. Aims: To examine (1) the stressors, resources and demands, perceptions of the situation, and health outcomes among documented and undocumented Mexican migrants in Montana, and (2) explore predictors of obesity and depression for this population. Methods: Community-based action research approach in partnership with Mexican migrants in Montana. We conducted interviewer-assisted surveys of physical and mental well-being with 120 migrants from Mexico. Results: 74.7% of migrants were in the overweight and obese categories as measured by their BMI and 29.2% reported elevated depression symptoms in the range for clinical concern, yet 62.5% of migrants rated their health as good and 18.3% as excellent. Individual stressors, resources and demands, and perceptions had a greater influence over depression than BMI. Significant predictors of depression: lack of legal status, lack of English proficiency, sending remittances, lack of resources to meet family basic needs, heightened level of isolation, and poor self-rated health. Significant predictors of BMI: legal status, lack of English proficiency, and level of worry about police. Discussion and Implications: Fear-driven health promotion programs are not recommended since that approach might exacerbate worry and fear. Further research is needed to explore the mismatch between SRH and health outcomes among Mexican migrants.

COLLEGE OF ENGINEERING

Spencer Bruce: Chemical & Biological Engineering
Mentor: Stephanie Wettstein - Chemical & Biological Engineering
Conversion of xylose to furfural in gamma-valerolactone using novel zeolite catalysts

Furfural derived from lignocellulosic biomass could be used as a valuable platform molecule in the production of renewable liquid fuels and chemicals. With increasing global emphasis on reducing our dependence on traditional petroleum-derived fuels and chemicals, producing value-added chemicals from biomass has the potential to have a major impact. Novel zeolite catalysts were used to convert xylose to furfural using gamma-valerolactone (GVL) as the solvent. One major benefit of using GVL as a solvent is that it is a renewable chemical produced from cellulosic biomass, which makes for an exceptionally "green" overall process. Additionally, it has been shown that GVL can solubilize biomass, leading to more efficient separations. Xylose, a sugar molecule found in the hemicellulose fraction of biomass, was used as the model compound in a GVL/H_2O solvent system. The solid acid catalysts used for the reaction are much easier to separate from the system than the typically used homogeneous catalysts, such as sulfuric acid. Preliminary data shows a zeolite-catalyzed xylose to furfural conversion as high as, and in some cases higher than, that seen from more commonly used catalysts. Replacement of corrosive and harmful chemicals like sulfuric acid with the less noxious zeolites accomplishes another significant step in the "greening" of this process.

Katie Davis: Center for Biofilm Engineering
Mentor: Matthew Fields, Al Cunningham, Robin Gerlach - Microbiology & Immunology, Center for Biofilm Engineering, Chemical & Biological Engineering
Biogenic Coal Bed Methane Enhancement: Methods for Field-relevant Experiments

The largest fossil fuel resource in the United States is coal, and most of this coal is deep in the subsurface making it costly and potentially dangerous to extract. However, in many of these deep coal seams, methane, the main component of natural gas, has been discovered and successfully harvested. Coal bed methane (CBM) accounts for approximately 7.5% of the natural gas produced in the U.S. each year. Combustion of natural gas produces substantially less CO_2 and toxic emissions (e.g. heavy metals) than combustion of coal or oil thereby making it a cleaner energy source. CBM can have both abiotic and biotic origins. The biotic production of CBM by methanogenic microbes is of particular interest for present and future natural gas sources as it has the potential to enable the harvesting of energy from coal seams without the environmental impacts of mining and burning coal. Previous MSU research has shown that there is potential for enhancing the microbial processes that produce CBM. This project investigated the design of laboratory experiments to investigate methanogenesis enhancement while maintaining "field-relevant" conditions.

Acknowledgements: Logan Hodgskiss (Masters Student) - Civil Engineering

Patrick Donnelly: Computer Science
Mentor: John Sheppard - Computer Science
Clustering Spectral Filters for Feature Extraction in Musical Instrument Identification

We propose a technique of training models for feature extraction using prior expectation of regions of importance in an instrument's timbre. Over a dataset of training examples, we extract significant spectral peaks, calculate their ratio to fundamental frequency, and use k-means clustering to identify a set of windows of spectral prominence for each instrument. These windows are used to extract amplitude values from training data to use as features in classification tasks. We test this approach on two databases of 17 instruments, cross evaluate between datasets, and compare with MFCC features.

Nathan Fortier: Computer Science
Mentor: John Sheppard - Computer Science
Abductive Inference in Bayesian Networks using Distributed Overlapping Swarm Intelligence

We propose several approximation algorithms for the problems of full and partial ab-ductive inference in Bayesian belief networks. Full abductive inference is the problem of finding the k most probable state assignments to all non-evidence variables in the network while partial abductive inference is the problem of finding the k most probable state assignments for a subset of the non-evidence variables in the network, called the explanation set. We developed several multi-swarm algorithms based on the Overlapping Swarm Intelligence framework to find approximate solutions to these problems. For full abductive inference a swarm is associated with each node in the network. For partial abductive inference, a swarm is associated with each node in the explanation set and each node in the Markov blankets of the explanation set variables. Each swarm learns the value assignments for the variables in the Markov blanket associated with that swarm’s node. Swarms learning state assignments for the same variable compete for inclusion in the final solution.

Acknowledgements: Shane Strasser (Doctoral Student) - Computer Science

Ahmed Imtiaz: Mechanical & Industrial Engineering
Mentor: Laura Stanley - Mechanical & Industrial Engineering
Hazard Perception Differences between Experienced and Less Experienced Drivers While Driving in Real World Hazards

Hazard perception skill, or the ability to anticipate traffic situations, is an important aspect of safe driving behavior. It was evident from the literature that such important skill develops in the drivers as they grow with driving experience. Several studies indicated that such skill differ significantly between the novice and experienced drivers, even after the novice drivers being trained and having a year of driving experience. Hence, the question arises: when do the less experienced drivers start exhibiting essential hazard perception skill as well as their experienced counterparts? No literature was found that addressed this question, which has motivated the researcher to conduct a naturalistic real world driving study employing eye tracking technologies, which in turn might address the issue. Thus, the aim of this research is to study the differences in road scanning patterns between the less experienced (1-2 years of experience) and experienced drivers (2-5 years of driving experience). Total 10 participants, 5 for each group, will be recruited for the study and will be asked to drive through the two predetermined scenarios, namely hidden crosswalk and curved stop ahead, consisting of real, pre-selected location on Bozeman roads. A time window will be extracted from the recorded eye movement videos that start from the first moment the hazard situation is perceptible to the moment when the hazard has been passed. During that period, eye fixation duration and gaze frequency data on the regions of interest will be collected using MAPPS software. Necessary statistical analyses will be then performed to compare the recorded fixation duration and gaze frequencies of less experienced and experienced driver groups to find any significant difference.

Sarah Mailhiot: Mechanical & Industrial Engineering
Mentor: Joseph Seymour, Ronald June - Chemical & Biological Engineering, Mechanical & Industrial Engineering
Determination of Diffusion Coefficients in Human Arthritic Cartilage

Cartilage is the soft tissue that covers the end of articulating joints in the body. Cartilage functions to provide a low friction surface and support very high contact pressures. Cartilage normally shows no sign of wear during the typical lifetime of a healthy human. Since the cartilage is not directly connected to the vasculature and contains relatively few cells, the tissue does not heal well after injury. Osteoarthritis is a disease associated with the deterioration and degradation of cartilage. This disease is one of the leading causes of disability in the United States. The current state of the art treatment for this disease is joint replacement which is both expensive and high-risk in many patients. Therefore, to understand osteoarthritis, it is important to understand the functional material behavior of cartilage so that improved treatments can be developed that are safer, less expensive, and more accessible to a wide variety of patients. Nuclear magnetic resonance is a tool that allows for the measurement of the diffusion of hydrogen nuclei. This information is important to understanding molecular

motion in the tissue. Specifically information can be obtained about diffusion coefficients for varying hydrogen populations in the tissue and this can be used to understand the pore structure of the sample. The tissue was obtained from an arthritic human hip and the cartilage was isolated and separated into top and bottom sections. Using data obtained from a pulse gradient stimulated echo (PGSE) experiment and analyzed using a Stejskal-Tanner plot, diffusion coefficients were obtained for free water, water in the pore structure, and hydrogen molecules associated with the biomolecules found in the cartilage.

Acknowledgements: Nathan Williamson, (Masters Student), Elmira Nybo (Doctoral Student), Ella Wardwell (Undergraduate Student) - Chemical & Biological Engineering, Mechanical & Industrial Engineering

Flynn Murray: Civil Engineering
Mentor: Michael Berry, Sarah Codd - Civil Engineering, Mechanical & Industrial Engineering
Feasibility of Reclaimed Asphalt Pavement as Aggregate in Portland Cement Concrete Pavements

A Phase I research effort performed at Montana State University, funded by the Montana Department of Transportation (MDT), investigated the feasibility of using reclaimed asphalt pavement (RAP) as an aggregate in concrete. The research resulted in two mix designs that were optimized in this Phase II effort to create the most economical and environmentally friendly paving material through modifications of the paste content and the RAP replacement rates. The mechanical and durability tests of the Phase I research demonstrated that the strengths and the workability of the specimens decreased as the replacement rates of RAP increased and high paste content was needed to retain adequate concrete properties. In order to satisfy MDT specifications and keep paste content low, this current research effort continued to optimize mix designs and evaluated the use of a water-reducing admixture (glenium) in the RAP mix designs, an attempt not previously performed in Phase I. Findings of this study demonstrated that adding glenium admixture proved advantageous in increasing the workability of the mix while keeping the paste content low. Conclusions of the study suggested that the 6-sacks per yard of concrete mix with 50% coarse RAP and 25% fine RAP replacement rates would be the most economical recommendation for the MDT. Although the 6.5-sack mix with replacement rates as high as 62.5% coarse RAP and 31.25% fine RAP would not be fully analyzed until after the completion of this paper, it is also a feasible alternative paving material that will promise both economical and environmental benefits for paving applications.

Acknowledgements: Adeline Tran

Liessman Sturlaugson: Computer Science
Mentor: John Sheppard - Computer Science
Hazard Analysis with Continuous Time Bayesian Networks for Space Flight Operations

Space flight has many inherent risks, and flight crews and ground control must often make decisions that involve a calculated trade-off between these risks. For example, the choice to pursue a secondary mission objective may slightly increase the risk of losing the vehicle. If a critical component on the vehicle is known to be degraded, this risk could increase substantially. The decision whether to continue pursuing the mission objective requires quantifying competing risks--the loss of the mission objective and the loss of the vehicle. Calculating the trade-off of risk between different decisions and effectively communicating the risk to the decision-makers poses a challenging problem. To address this, we present work on a real-time computer-based environment to aid in risk-informed decision-making. In this work we assume that each available decision during a mission is pre-defined and can be enumerated as a set of contingency plans and that each risk has been identified and can be enumerated as a set of hazards. Our hazard analysis proceeds in four steps. First, the current health state of the vehicle is estimated using Qualtech Systems Inc.'s Testability, Engineering, and Maintenance System (TEAMS) diagnostic model. Second, this information is passed to a set of continuous time Bayesian network (CTBN) models, each of which encode the affect of a contingency plan on the various hazards. Third, the CTBN model for each contingency plan is evaluated given the current health state from the TEAMS model. Finally, the hazards and their associated probabilities under each contingency plan are presented to decision-makers using a variety of visualizations. This allows them to compare contingency plans and make decisions based on an acceptable trade-off between risks.

Kaysha Young, Jessica Mueller: Mechanical & Industrial Engineering
Mentor: Laura Stanley - Mechanical & Industrial Engineering
Characterizing Stopping Behavior at Intersections: Differences Between Experienced and Novice Drivers

As driver behaviors have been studied in recent years, interventions have been proposed to decrease traffic fatalities and injuries. One intervention with a divided following involves training drivers - and the most targeted group for training involves novice young drivers. Their inexperience and lack of driving experience has a noted effect resulting in a disproportionate number of crashes among their age group. This study looks at the difference between novice young drivers and experienced drivers, focusing on stopping behavior at intersections. Drivers from three distinct groups (novice young drivers, experienced young drivers, and experienced drivers) participated in a study consisting of an on-road driving session the same on-road route in an advanced driving simulator. The driving interval studied here includes two consecutive stop-signed intersections. The following metrics will be compared between driver groups and driving environment, using multivariate MANOVA statistical techniques: stopping compliance, stopping distance, time stopped, average approach speed and deceleration, average departure speed and acceleration. The difference between simulated and on-road stopping behaviors will aid in validating programs aimed at safely training young drivers in simulators, and improve simulated artificial ambient traffic driving behaviors to provoke a more realistic driving environment.

COLLEGE OF LETTERS & SCIENCE

Ana Baselga Mateo: Physics
Mentor: Randall Babbitt - Physics
Displacement measuring interferometer for comparison to calibrated FMCW ladar system

The high resolution frequency modulated continuous wave (FMCW) ladar system developed by Spectrum Lab and Bridger Photonics Inc. could be potentially used for length metrology purposes. However, its development is at an early stage and comparisons with other length metrology methods would help to determine its actual efficiency. An ultra-low phase noise and narrow bandwidth laser centered at 1536nm is used to build a displacement tracking interferometer for comparisons. Lock-in detection based on phase modulation is used to reduce sensitivity to amplitude noise. The data is processed to obtain an accurate displacement measurement with resolution higher than $\lambda/4$. After calibrating the ladar, its ranging capability is determined by comparison with these results along different wavelength regions.

Acknowledgements: Zeb Barber (Research Scientist) - Spectrum Lab

Ashley Beckstead: Chemistry & Biochemistry
Mentor: Bern Kohler - Chemistry & Biochemistry
Monitoring the Photo-induced Electron Transfer Capability of 8-oxo-7,8-dihydro-2'-deoxyguanosine Using Ultrafast Time-Resolved IR Spectroscopy

Recently the oxidative product of guanosine, 8-oxo-7,8-dihydro-2'-deoxyguanosine (8-oxod-Guo, O), has been studied for its ability to repair cyclopyrimidine dimers (CPD) in single and double stranded DNA. It has been proposed that the repair mechanism occurs via electron transfer to the CPD, in a manner reminiscent of the flavin in photolyase. This study investigates the electron transfer mechanism of 8-oxo-dGuo by probing the vibrational states of a dinucleoside monophosphate containing 8-oxo-dGuo at the 5'-position and 2'-deoxyadenosine (A) at the 3'-position using time-resolved infrared pump-probe spectroscopy (TRIR). The compound was initially excited by UV photons at two selective wavelengths, and the transients were monitored by mid-IR wavelengths in the double-bond stretching region. Excited state lifetimes were measured using global fitting analysis, and combined with high-level ab initio calculations, the results indicate a charge transfer (CT) state formed by electron transfer from the O to the A. The decay of the excited state occurs on two time scales, the longer of which is on the order of tens of picoseconds and has been assigned to charge recombination. It is this rapid charge recombination that has been attributed to the compound's ability to avoid photoreaction, safely bringing the excited state molecule to its low-energy ground state.

Acknowledgements: Yuyuan Zhang (Postdoctoral Researcher), Jordan Dood (Undergraduate Student) - Chemistry & Biochemistry

Michael Coryell: Microbiology & Immunology
Mentor: Seth Walk, Timothy McDermott - Microbiology & Immunology, Land Resources & Environmental Sciences
Do gut endosymbiotic microbes mediate arsenic uptake by the host?

Arsenic is a naturally occurring metalloid element which forms a number of toxic compounds and has no known human health benefits. More than 150 million people in countries around the world are exposed to drinking water containing levels of inorganic arsenic (iAs) that exceed the safety guideline set by the World Health Organization (10 μg/L). In the environment, arsenic chemistry and cycling are mediated by microbial activity. It is also known that many microbes found in the human gastrointestinal (GI) tract have the ability to code for arsenic-transforming enzymes. These observations have lead to the hypothesis that arsenic uptake and toxicity in humans is mediated by arsenic-active enzymes coded for by commensal microorganisms in the human GI tract. This study aims to test this hypothesis preliminarily by using a model mouse lineage with the endogenous Arsenic(III) Methyltransferase gene knocked out (As3mt). The GI microbial load of one group of mice is drastically reduced using antibiotics while

another group has a conventional lab mouse microbiome. Both groups are fed iAs in their drinking water for ten days and samples of urine and feces were collected daily. Using HPLC-ICP-Mass Spectrometry we will be able to track the levels of various arsenical species excreted by the mice. Using high throughput DNA sequencing we will also track the composition of the mouse distal gut microbial communities. We hope that these data will help us to better understand how the GI microbiome affects the speciation and uptake of arsenic in these model organisms.

Rebecca Danforth: Physical Chemistry
Mentor: Bern Kohler - Chemistry & Biochemistry
Electron Dynamics of Aqueous Iron(III) at Varying pH

Electron transfer dynamics in aquo-iron complexes at varying pH's has been studied using transient absorption spectroscopy. As the pH is increased from 0 to 3, the speciation of iron compounds in solution change resulting in difference in the signal. These changes are the result of different electron transfer processes happening on the iron(III) center. At pH 0 hexaaquo Iron (III) predominates, while at higher pH values monohydroxy Iron (III) becomes a participant in the solutions. The solutions were studied using a 266 nm pump and 250 nm and 300 nm probe, which probes a strong absorption band associated with hexaaquo Iron (III) species. The transients clearly show the disappearance of signal before the time scale reaches 300 ps. This characteristic is believed to be the result of geminant recombination of a hydroxyl radical with the Iron (III) center.

Katie Garrison: Psychology
Mentor: Ian Handley - Psychology
The effect of initial mindset and mode of thought on decision quality: Unconscious and analytical processes at play

Recent psychological literature suggests that people can process complex information unconsciously to form reasonable judgments. In many experiments, participants receive complex information, then report their judgments using that information either immediately, after a 3min distraction that prevents conscious thinking about the information (i.e., fosters unconscious thought), or after 3min of conscious thinking. Typically, results reveal an "unconscious-thought effect" such that people report the best judgments in unconscious-thought conditions compared to the other conditions. Yet, some researchers argue that this effect does not result from unconscious thinking per se, but from emotional and intuitive processes which are generally good at making global-level assessments. The reported experiment tested whether unconscious thinking is merely emotional, or may also be compatible with analytic processes. In the current experiment, participants were manipulated into either an emotional or analytic mode of thought, then received complex information while given the opportunity to think unconsciously or consciously. The results of this experiment suggest that unconscious thinking is not redundant with emotional processes, and is compatible with emotional or analytical thinking styles. In fact, participants formed the best judgments when they thought unconsciously and were in an analytic mindset.

Tamra Heberling: Mathematical Sciences
Mentor: Lisa Davis, Billie Kerans - Mathematical Sciences, Ecology
Modeling the Direct and Indirect Effect of a Non-Host on Parasite Transmission

We present a mathematical model of the Host/Parasite system describing the Myxobolus Cerebralis parasite and the *Tubifex tubifex* worms that cause whirling disease in trout. A Non-Host worm is incorporated which competes with the Host producing a negative effect but also eliminates the parasite spores causing a positive, indirect effect. We will present a bifurcation diagram that shows with the addition of the Non-Host, the coexistence equilibrium is stable for a larger range of parameter values. Limit cycles are also seen when the equilibrium loses stability at a Hopf bifurcation.

Acknowledgements: Ryan Lamb (Doctoral Student) - Ecology

Benjamin Jackson: Mathematical Sciences
Mentor: Isaac Klapper, Robin Gerlach - Mathematical Sciences, Chemical & Biological Engineering
Biofilms and Mathematics: Examining Urea Metabolism in a Bacterial Community

Microbially induced calcite precipitation (MICP) is a potentially useful mechanism in the formation of biocement, which has applications in soil stabilization, carbon sequestration, and concrete remediation. MICP can occur via ureolysis, a process in which bacteria break down urea through a series of chemical reactions which raise the pH of the system, allowing for solid calcium carbonate formation when calcium ions are present. MICP takes place in complex systems which often contain communities of bacteria adhering to surfaces -- biofilms -- in which the rates of ureolysis are not well known. We seek to characterize these rates in a biofilm system by collecting data from tube reactor experiments conducted at Montana State University's Center for Biofilm Engineering and applying the data to a mathematical model. The model uses a differential equation to describe transport and reaction of urea in the tube system, and a classic one-dimensional biofilm model to describe the breakdown of urea in the biofilm. Ideally, we would use data from the tube reactor experiments to find appropriate ureolysis rates for the model. However, it has been difficult to find consistent rates using measured biofilm height profiles and urea concentrations from the experiments. We present an alternative approach using synthetic data sets for model testing, in which we use statistical methods to estimate the rate of urea degradation in biofilm. Our results demonstrate the feasibility of this method for real data and provide a guide for ongoing and future lab work.

Acknowledgements: James Connolly (Doctoral Student), Al Parker (Research Engineer) - Center for Biofilm Engineering

Daniel Kanewske: Mathematical Sciences
Mentor: Tianyu Zhang - Mathematical Sciences
2D Modeling of Biofilm as a Visco-Elastic Fluid

I am modeling the visco-elastic (Viscous means thickness and elastic means stretchy) flow of biofilms (biofilms are bacterial colonies suspended in mucus) using a modified Navier-Stokes equation. The Navier-Stokes equation is a PDE governing viscous fluid flow to which we have added an elastic stress term. My talk will focus on demonstrating viscoelastic fluid flow with a brief discussion of the physical interpretations of the mathematical components of the modified Navier-Stokes PDE.

L.J. Krumenacker: Earth Sciences
Mentor: Dave Varricchio - Earth Sciences
Taphonomy of the Cretaceous Wayan Formation of Idaho

The mid-Cretaceous (roughly 99-95 million year old) Wayan Formation of eastern Idaho has produced a diverse but fragmentary vertebrate fossil assemblage. Dinosaurs found include ankylosaurs, the small burrowing ornithopod *Oryctodromeus*, and larger iguanodontid and hadrosauroid ornithopods. Theropods are diverse and include a probable oviraptorid, a small tyrannosaurid, dromaeosaurs, a larger possible fish-eating theropod, a neovenatorid, and unidentified forms. Other vertebrates include fragmentary remains from large and small crocodylians, fish, turtles, and mammals. While the fauna is moderately diverse, the vast majority of vertebrates are known only from isolated teeth, fragmentary skeletal elements, or eggshell and eggs. *Oryctodromeus* is by far the best represented taxon, with numerous partial to near complete skeletons having been found in sediments representing drier floodplain soils. These remains range from partial fully articulated skeletons to associated skeletons with articulated vertebrae and feet. Excluding eggs from a large oviraptorid, the majority of other vertebrates are found as isolated elements in river channel deposits. The abundance of relatively complete remains of *Oryctodromeus*, as well as the degree of articulation and lack of modification to the bones, demonstrates quick burial and/or little exposure to destructive post-mortem processes. These observations suggest that as was observed the holotype and paratype specimens, burial in burrows may be a common preservational mode for *Oryctodromeus*. The much greater incompleteness of other taxa known from the Wayan suggests conditions on the drier adjacent floodplains were less conducive to fossil preservation, with burial in river channels being the main preservational pathway for most taxa.

Katharine Kujawa: Psychology
Mentor: Mike Babcock, Frances Lefcort - Psychology, Cell Biology & Neuroscience
Familial dysautonomia: An evaluation of anxiety using the elevated plus maze

Familial Dysautonomia (FD) is a Hereditary Sensory and Autonomic Neuropathy (Type III) marked by a mutation within the Ikbkap gene encoding the IKAP protein. This mutation is prevalent in 99% of the clinical FD population. Symptoms include emotional liability, cardiovascular instability, vomiting crises and decreased pain and temperature sensation. One clinical symptom associated with FD is increased anxiety in response to stressful situations (Axelrod, 2006). The Lefcort lab has generated a novel mouse model of FD in which Ikbkap is selectively deleted from CNS neurons. The present study evaluated the expression of anxiety behaviors in this mouse model. A significant difference between conditions in time spent in the open arms of the elevated plus maze was observed; FD mice spent significantly more time in the open arms relative to control mice. Secondary behaviors showed significantly greater instances of unprotected head-dipping and fewer protected head-dipping in FD mice. Tertiary behaviors showed FD mice spending more time immobile, slower speed, and smaller distance traveled. These data suggest that the FD mice presented as less anxious, an observation that seemingly differs from the clinical population. Additional research to characterize the behavioral phenotype of these mice is under investigation.

Lacey Murphy: Microbiology & Immunology
Mentor: Deborah Keil, Jamie DeWitt (East Carolina University), Brenda Buck (University of Nevada Las Vegas) – Microbiology & Immunology, Toxicology & Pharmacology, Geosciences
Immunotoxicity Profile Following Exposure to Silt Deposit Dust Samples from Nellis Dunes Recreational Area, Clark County, Nevada

The Nellis Dunes Recreation Area (NDRA) is a popular region for off-road vehicle driving that attracts over 300,000 commercial and personal riders each year. Trace metals that could potentially affect human health have been measured in soil and airborne dust samples. Map unit CBN7 is composed of aggregated silt deposits commonly found in badlands without rock or vegetative cover. Dust samples from CBN7 with a median grain size of 4.37µm were analyzed via inductively coupled plasma mass spectrometry (ICP-MS) and contained: 293.63 ppm Mn, 248.23 ppm Sr, 49.49 ppm Cr, 26.20 ppm Pb, and 23.51 ppm of As. B673CF1 female mice were exposed via oropharyngeal aspiration at doses of 0.01, 0.1, 1, 10, and 100 mg geological sample/kg/day at four intervals, each a week apart. No dose-responsive changes were observed in body or organ weights. Serum total bilirubin was dose-responsively increased beginning at 0.1 mg/kg/day. Serum creatinine levels were increased at 10 and 100 mg/kg/day whereas blood urea nitrogen was dose-responsively decreased beginning at 0.1 mg/kg/day. Blood neutrophil and lymphocyte numbers were increased at 10 and 100 mg/kg/day. Splenic CD8+ and CD4+/CD8+ T-cells were decreased; however, this was not clearly dose-responsive. No significant changes were detected in splenic B220 or thymic CD4/CD8. IgM antibody production was dose-responsively suppressed beginning at 0.1 mg/kg/day with an ED50 of 0.30 mg/kg/day. The LOAEL was 0.1 mg/kg/day whereas the NOAEL was 0.01 mg/kg/day as demonstrated by antigen-specific IgM production. Further studies will assess the potential health risks associated with recreation at this site.

Acknowledgements: Mallory Spencer (Masters Student), Marna Jensen (Undergraduate Student), Winnie David (University of Nevada Las Vegas), Mehana Chow (Research Assistant - University of Nevada Las Vegas) – Microbiology & Immunology, Harry Reid Center

Nicolas Najdovski: Ecology
Mentor: Benjamin Poulter - Ecology
A modeling approach to estimate carbon emissions from D.R.C. deforestation

With a surface of 1.8 millions squared kilometers, the Congo basin dense forest plays a significant role in the regulation of global climate by its potential carbon dioxide emissions and carbon storage. However, modifications in environmental conditions as well as deforestation and forest degradation have the potential to modify this balance leading to higher or lower biomass storage. Here, we quantified the relative effects of deforestation and

21st century climate change on carbon emissions in Congo Basin over the near future (2035). Carbon dioxide emissions are estimated using a series of moderate resolution (10 km) vegetation maps merged with spatially explicit deforestation projections and developed to work with a prognostic carbon cycle model. The inversion of the deforestation model allowed hindcast land-use patterns back to 1800 by using land cover change rates based on the HYDE database. Simulations were made over the Democratic Republic of Congo (DRC) using the ORCHIDEE dynamic global vegetation model with climate forcing from the CMIP5 Representative Concentration Pathway 8.5 scenario for HadGEM2. Four simulations were conducted in order to separately assess the impact of deforestation and climate changes: a reference simulation with land cover fixed at 2005 and stable climate, two simulations with climate change and with/without land use and land cover changes (LULCC), and finally, a fourth simulation with LULCC under a stable climate. Because of the relatively high resolution of the model simulations, the spatial patterns of human-driven carbon losses can be tracked in the context of climate change, providing information for mitigation and vulnerability activities.

Acknowledgements: Ines Moreau, Astrid Verhegghen, Jean-Paul Kibambe Lumbaba, Fabienne Maignan - Universite catholique de Louvain (Belgium), Laboratoire des sciences du climat et de l'environnement (France)

Mariana Olsen: Psychology
Mentor: Sara Waller - History & Philosophy
Dog-Tired: Breed Differences in Inhibitory Control and Ego Depletion

A great deal of psychological literature has been dedicated to inhibitory control and ego depletion in humans. Over the last several years, such research has extended its reach to other species including birds, primates and, more recently, the domestic dog. Such studies have found evidence for ego depletion in dogs, as well as context-specific inhibitory control. However, the effect breed might assert on these capabilities remains largely a mystery. One would expect that, in selection for desired traits, some breeds would possess greater capacity for inhibitory control than others, namely working breeds (e.g., shepherds, retrievers, hunting dogs). It may also be possible that such dogs might be less susceptible to ego depletion. The current study aims to elucidate the role breed might play in level of inhibitory control and susceptibility to ego depletion. Approximately 16 purebred dogs will serve as subjects, split evenly between working and nonworking breed types. Each dog will engage in a detour-reaching task after spending five minutes in a depleting or control condition. We have three predictions: first, that working breeds will demonstrate better performance on the detour-reaching task overall in the form of fewer trials needed to reach criterion; second, dogs in the depletion condition will require more trials to reach criterion than dogs in the control condition; and third, that the depletion condition will have a greater effect on nonworking than working breeds, such that depleted nonworking breeds will require more trials to reach criterion than working breeds.

Shaun Owenby: Psychology
Mentor: Ian Handley - Psychology
Changing Certain and Uncertain Attitudes: The Opposite Effects of General Action and Inaction Goals

Several factors can shape how individuals process and react to persuasive information. Recent research indicates that individuals in whom a general action (vs. inaction) goal has been triggered, activate their attitude about a given topic more quickly, process persuasive information less, and therefore report less (vs. more) attitude change. This is particularly true while individuals hold a certain (i.e., clear) attitude along with the goal to act, given that attitudes facilitate behavior. However, if the individual holds an uncertain attitude, the individual is unsure how to act. An action goal should therefore increase processing of information to decrease attitude uncertainty, resulting in greater attitude change. The reported experiment tested these predictions, finding that salience of attitude uncertainty moderated the effect of action and inaction goals on attitude change. Specifically, an action goal (a goal to act) resulted in more attitude change for individuals when their initial attitude uncertainty was made salient, whereas an inaction goal (a goal to not act) resulted in greater attitude change when attitude uncertainty

was not made salient. Thus, action and inaction goals can influence the extent to which people think effortfully about information, but their effect depends on additional factors—in this case, perceived certainty about the topic. These findings, along with direction for future research will be discussed in the context of attitude and persuasion research.

Alyssa Peck: Mathematical Sciences
Mentor: Jim Robison-Cox - Mathematical Sciences
Evaluating the Effectiveness of Occupant Protection Programs

Vehicle occupant protection, and especially seat restraint use, is widely accepted as critical to public health. Recently, transportation agencies have confronted stagnation in seat belt compliance rates with a suite of programs designed to increase use. It is of interest to these agencies to evaluate the effectiveness of their programs across jurisdictions, but the required analytical methods are typically beyond their scope. This project attempted to bridge that gap by working in collaboration with Montana Department of Transportation to analyze a set of metrics corresponding to occupant protection program efficacy. Information was leveraged from existing, but previously unpaired data streams (state-level program activity maps and budgets, and nationally standardized seatbelt survey data) to estimate the impacts of occupant protection programs in Montana on seat belt compliance rates. Data were assembled in a GIS, and analyzed via a logistic regression model with mixed effects. The findings provide quantitative estimates of specific programs' contribution to seat restraint use with critical insights for future resource allocation.

Acknowledgements: Kezia Manlove (Statistical Consultant), Laura Stanley (Assistant Professor-Mechanical & Industrial Engineering Department), Western Transportation Institute

Hannah Schweitzer: Microbiology & Immunology
Mentor: Matthew Fields - Microbiology & Immunology
Investigation of coal-associated microbial community from a diffusive microbial sampler (DMS)

The Powder River Basin(PRB), located in southeastern Montana and northeast Wyoming, is the largest coal mining region in the United States but the majority of the coal in this region is too deep to be conventionally mined. Within the deep coal beds microbial ecosystems produce methane which can be used for electrical generation, heat and transportation fuel and compared to other hydrocarbon fuels, methane produces less carbon dioxide per unit of heat released. How this microbial community produces methane within coal beds is poorly understood. To begin to investigate this process the microbial ecology from four PRB coal seams was sampled with a diffusive microbial sampler (DMS). Native core samples from each of the four seams was used in the DMS. The native core samples were sequenced with Illumina MiSeq® sequencing to compare the in situ community from the cores with the community obtained from DMS. These results will provide novel insights into the microbial ecosystems producing methane within PRB coal beds and potentially lead to new techniques for harvesting this energy resource.

Acknowledgements: Elliott Barnhart (Doctoral Student) - Microbiology & Immunology

Mallory Spencer: Microbiology & Immunology
Mentor: Deborah Keil, Jamie DeWitt (East Carolina Univesity), Brenda Buck (Unviersity of Nevada Las Vegas) – Microbiology & Immunology, Toxicology & Pharmachology, Geosciences
Immunotoxicity Profile Following Exposure to Geological Dust Samples Collected from Nellis Dunes Recreational Area Map Unit CBN2

Nellis Dunes Recreational Area (NDRA) is a highly popular ORV area near Las Vegas, NV. Soil and airborne dust in this area are rich in naturally occurring arsenic. This presentation focuses on data from CBN2, which is a yellow silt and clay unit mostly barren of vegetation. Dust samples with a median grain size of 4.5 µm were analyzed for total elemental composition via inductivity coupled plasma mass spectrometry. The following concentrations were found: As:136.82 ppm; Cr:38.74 ppm; Pb:22.71 ppm; Mn: 386.28 ppm; and Sr:424.89 ppm. B6C3F1 female mice were exposed to dust via oropharyngeal aspiration at doses of 0.01, 0.1, 1, 10, and 100 mg geological sample/kg

body weight/day and a PBS control at four intervals, each seven days apart. After the exposure period, immunotoxicological assays were performed on secondary lymphoid tissues and blood was evaluated for clinical chemistry parameters and markers of oxidative stress. All comparisons were made to the control group. Across all doses, thymic CD4/CD8 subpopulations were decreased. Serum creatinine was dose responsively increased beginning at 1.0 mg/kg/day whereas blood urea nitrogen decreased at 10 and 100 mg/kg/day. No changes were seen in SOD, ROS, total glutathione, and total antioxidant capacity oxidative stress markers. Antigen specific IgM antibody production was dose responsively suppressed beginning at 0.1 mg/kg/day with an ED50 of 0.03 mg/kg/day. A LOAEL of 0.1 mg/kg/day and a NOAEL of 0.01 mg/kg/day were determined from IgM antibody production. These, and additional data, will support an assessment of the potential health risk to people who recreate at the Nellis Dunes site.

Acknowledgements: Lacey Murphy (Masters Student), Marna Jensen (Undergraduate Student), Rebecca Chow (University of Nevada Las Vegas), Winnie David (University of Nevada Las Vegas) - Microbiology & Immunology, Harry Reid Center

Charles Stark: Chemistry & Biochemistry
Mentor: Bern Kohler, Trevor Douglas - Chemistry & Biochemistry
Electron tansfer and localization processes in ruthenium bipyridyl complexes linked via click chemistry

Tris(2,2'-bipyridyl)ruthenium(II) ([Ru(bpy)3]2+) is a well-studied photosensitizer known for its long-lived triplet metal-to-ligand chargetransfer (3MLCT) excited states (τ = 0.88 ms). It is currently accepted that electron density in the 3MLCT state is localized on a single bipyridine ligand no more than a few ps after photoexcitation. Due to the long lifetime of the 3MLCT state, this electron can hop from ligand to ligand in a process known as interligand electron transfer (ILET). Precisely how ILET occurs in [Ru(bpy)3]2+ and in mixed-ligand ruthenium(II) complexes is obscure due to overlapping dynamics from intersystem crossing, vibrational relaxation, and vibrational cooling. For example, intersystem crossing (1MLCT → 3MLCT) has been determined to be an ultrashort process, which is complete within ~100 fs. Vibrational relaxation, on the other hand, has been shown to occur on time scales of ~10 ps at rates that are surprisingly independent of the solvent. In this study, we are concerned with how rapidly an excited state can hop from one ligand to another in heteroleptic complexes with the formula [Ru(bpy)n(phen)3-n]2+, where n = 0, 1, 2 or 3, bpy stands for 2,2'-bipyridine, and phen is 1,10-phenanthroline. Understanding how often an excited electron can visit a particular ligand is important for selectively directing excitation energy toward an acceptor attached to a functionalized ligand.

Acknowledgements: Wolfgang Schreier, Janice Lucon, Ethan Edwards (Doctoral Student) - Chemistry & Biochemistry

Alan Weaver, Jr: Chemistry & Biochemistry
Mentor: Martin Teintze, Jovanka Voyich - Chemistry & Biochemistry, Microbiology & Immunology
Elucidating the Mechansim of Action of a Novel Antibacterial Agent: Trishexylaminomelamine-tris-phenylguanide

The rise in bacterial resistance to what were once effective antibiotics is becoming an increasingly difficult challenge to overcome. This research focuses on the development and characterization of a novel guanide compound known as Trishexylaminomelamine-tris-phenylguanide (THAM-3ΦG), which has chemical similarities to a current antibacterial, chlorhexidine, and has shown similar antibacterial activity against *Staphyloccus aureus* (including MRSA). Initial studies showed THAM-3ΦG to be effective at the same concentration as CHX (2 mg/L), while also showing similar kill rates in vitro. THAM-3ΦG has a higher selectivity index and less toxicity towards mammalian cells as compared to CHX. Furthermore, preliminary in vivo studies have shown THAM-3ΦG to be capable of reducing bacterial loads in mice. The chemical similarities between CHX and THAM-3ΦG led to the hypothesis that the mechanism of action may be a shared characteristic of these compounds. Since CHX is believed to be a membrane disruptor, preliminary studies investigated the potential for cellular leakage of both compounds. Cellular leakage was detected with both compounds at sub-lethal doses, suggesting membrane disruption as a possible mechanism of action for THAM-3ΦG. Current studies look to isolate a resistant mutant to THAM-3ΦG in order to further elucidate the mechanism of action and understand the mechanisms involved in antibacterial resistance. Alongside these studies we look to use NMR metabolomics to investigate changes within

the bacteria following treatment with THAM-3ΦG and CHX, which would aid in understanding the mechanism of action of these compounds.

Acknowledgements: Ryan Bachofer (Undergraduate Student), Joyce Shephard (Past Graduate Student), Royce Wilkinson (Postdoctoral Researcher) - Chemistry & Biochemistry

Jennifer Weeding: Mathematical Sciences
Mentor: Mark Greenwood - Mathematical Sciences
An Exploration of the GSIMEX Approach to Modeling Variables with Correlated Measurement Errors in R

Measurement error in regression models can lead to bias in parameter estimates, a loss of power, and mask important features of the data. Measurement errors are commonly ignored due to the lack of software available to implement the methods and the extra information needed to correct for measurement error is not available to the researcher. The SIMEX (Simulation Extrapolation) approach of Cook and Stefanski (1994) is a simulation-based method of inference that accounts for additive measurement errors. Ronning and Roseman (2008) made this approach more general by allowing for the correlation of measurement errors in their approach, GSIMEX. However, this method is currently unavailable in software packages. An implementation of the method in R is discussed. A simulation study is used to explore this approach and results are compared across different correction methods.

Benjamin White: Microbiology & Immunology
Mentor: Michael Franklin, Garth James, Phil Stewart - Microbiology & Immunology, Center for Biofilm Engineering
The Development of Chronic Wound Exudate Media

Chronic wounds are a healthcare problem worldwide. The negative effect of infection on wound healing has been known for decades and the control of infection is recognized as an important aspect in wound management. Research has indicated that many chronic infections are due to the development of biofilms (1,2,3) including native valve endocarditis, otitis media, chronic bacterial prostatitis, infection in cystic fibrosis patients, and periodontitis (2,4). Biofilms are rarely seen in acute wounds; however, they appear to be common in wounds that persist (5). Treatments that target biofilms may aid in the healing of the compromised tissue (5). In order to develop better antibiotic treatment methods for chronic infections it is important to grow biofilms in conditions that mimic the wound environment. By compiling data on the composition of chronic wounds we have developed a defined media that closely resembles the exudate of a persistent wound. Three species of bacteria have been identified as organisms of interest, drug-resistant *Acinetobacter baumannii*, *Pseudomonas aeruginosa*, and drug-resistant *Staphylococcus aureus*. We have confirmed growth of *A. baumannii*, *P. aeruginosa*, and *S. aureus* in the defined chronic wound exudate media (CWE) and are now ready to begin growing the organisms in biofilm models.

2014 STUDENT RESEARCH CELEBRATION

UNDERGRADUATE ABSTRACTS

Sorted by Student Major

COLLEGE OF AGRICULTURE

Russell Callahan: Land Resources & Environmental Sciences
Mentor: Tony Hartshorn - Land Resources & Environmental Sciences
Can Zirconium Serve as an Indicator of Post-Fire Soil Burn Severity?

Fire severity can be defined using the ratio of mid (~2.2 um) to near (~0.8 um) infrared reflectance values from satellite imagery. We were curious if post-fire soils data could be used for groundtruth. We relied on well-established patterns between soil zirconium (Zr), soil organic matter (SOM), and loss on ignition (LOI). The Zr element is associated with weathering-resistant zircons. Addition of SOM to soils typically dilutes soil Zr, while SOM losses via LOI can increase soil Zr. Results from long-term experimental burn plots in South Africa indicated that triennial burns increased soil Zr by 160% whereas annual burns increased soil Zr by 141% compared to unburned soils . To test our approach, soils were sampled from burned and unburned plots at the Red Bluff Ranch in Norris, Montana, which burned between June 25 and July 2 of 2012, as part of the Beartrap 2 Fire. We simulated differing fire severities on unburned samples from Red Bluff Ranch using a muffle furnace (durations: 5, 15, 30, 45, or 60 minutes; temperatures: 50, 100, 200, 300, 400, or 500^{o}C). Our results showed little LOI (<0.12%) below 200^{o}C, but an increase in LOI (0.2 to 3.0%) with increasing durations for temperatures >200^{o}C. LOI values peaked at 5.1% for the 60 minute duration at 500^{o}C. By ratioing our simulated LOI to maximum LOI, and comparing these ratios to expected vs. observed Zr levels, we document the promise of this novel post-fire burn severity index derived from ground-based, not satellite-based, data.

Patrick Cole: Plant Sciences & Plant Pathology
Mentor: Li Huang - Plant Sciences & Plant Pathology
Investigating the role of beta-l,3-1,4-glucanase in the resistance of Triticum aestivum to Puccinia infection

Plant endo beta-glucanases have be shown to play different roles in plant-pathogen/pest interactions. Some beta-glucanases have exhibited antifungal activity in the model plant system *Nictotiana tabacum* (Sela-Buurlage et. al, 1993), but research also revealed a group of beta-glucanases played a favorite role for pathogenic nematode infestation (Karczmarek et al.m 2008) . In wheat, the beta-l,3-1,4-glucanase enzyme has been shown to involve in resistance to necrotrophic pathogen *Fusarium graminearum* (Lapitan, personal communication), but the role in resistance to biotrophs are unknown. Here we are using virus-induced gene silencing to knock down the beta-l,3-1,4-glucanase gene in several wheat (*Triticum aestivum*) cultivars that with or without rust resistance genes, and then inoculate the plants with two biotrophic Puccinia species that cause leaf rust *(P. triticina)* or stem rust (*P. graminis* f. sp. *tritici*) to investigate the function of beta-l,3-1,4-glucanase in wheat defense response to biotrophs. Currently we have constructed a silencing vector using barley stripe mosaic virus gamma genome with a fragment of wheat beta-l,3-1,4-glucanase gene insert to act as a template for silencing endogenous beta-l,3-1,4-glucanase. The silenced plants will be infected by *P. triticina* or *P. graminis* dependent on the type of rust resistance gene used, we will be comparing the infection types and pathogenesis of the fungus across the silenced plants and the controls to determine if the beta-l,3-1,4-glucanase plays any role in wheat resistant to rust pathogens.

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Zachariah Conley: Animal & Range Sciences
Mentor: Clayton Marlow - Animal & Range Sciences
The Effects of Russian Olive and Black Cottonwood On Fish Growth

The purpose of this study is to find out if an invasive species, Russian olive (*Eleagnus angustifolia*), and a native species, Black cottonwood (*Populus trichocarpa*), serve as a viable protein source and promote growth for fisheries. A comparison will be made to understand which of the two species is preferred by fathead minnows (*Pimephales promelas*). Russian olive is comprised of ~22% protein while Black cottonwood is ~14% protein. Three pelletized diets will be formulated: first a plant based control, second a Russian olive with 90% inclusion rate and 10% fillers/vitamins, third a Black cottonwood with 90% inclusion rate and 10% fillers/vitamins. The study is taking place at the Bozeman fish technology center. A system of twelve tanks each with 7 minnows, are arranged with a flow of 2 gallons per minute at 67^{o}F. The initial average tank body weight is 12g with an average individual fish weight of 1.7g. 5 random fish were measured to find an initial average length of 5.6 cm. Amount of daily feed will be based on 5% of the average tank body weight, .6 grams per tank per day. Four tanks will receive the control diet; another four tanks the Russian olive diet and the last group of four tanks the Black cottonwood diet. The feeding trials will last approximately 30 days, in which average tank body weight, average individual weight and average length will be recorded to compare with the initial numbers. If each diet is readily consumed, it is speculated that the Russian olive diet will promote the greatest rate of growth, due to the higher protein content.

Tara Donohoe: Land Resources & Environmental Sciences
Mentor: William Dyer - Plant Sciences & Plant Pathology
Physiological Analysis of Oxidative Stress Response in Multiple Herbicide Resistant Avena fatua Biotypes

Avena fatua (wild oat) biotypes with resistance to five different mechanisms of herbicide action are being investigated in the Dyer laboratory. These biotypes cannot be controlled by any of the selective herbicides used in small grain cropping systems. My goal is to investigate the physiological and biochemical mechanisms responsible for the multiple herbicide resistance (MHR) phenotypes. Specifically, I used enzymatic assays and Western immunoblotting to quantify superoxide dismutase (SOD), glutathione peroxidase (GPx), and glutathione S-transferase (GST) enzyme activities in MHR and susceptible (HS) plants. Preliminary results show no significant differences in specific activities of any of these enzymes using generic substrates, either before or after herbicide treatment. However, immunodetection assays show that two GST isoforms are constitutively upregulated in MHR plants before herbicide treatment. Potential role(s) of enhanced GST activity in MHR will be discussed.

Bailey Engle: Animal & Range Sciences
Mentor: Jennifer Thomson, Jane Ann Boles - Animal & Range Sciences
Gene Expression of Skeletal Muscle of Red Face Hereford Steers

The objective of this study was to evaluate the relationship between quality grade and genetic growth patterns on meat tenderness. The research sought to elucidate the effect of stage of growth on tenderness. Evaluation of loin samples from 16 different Hereford steers with different growth patterns were collected and allowed to age for 1, 3, 7, 14, and 21 days postmortem and frozen. Tenderness was measured on cooked steaks after each postmortem aging time. Tenderness was evaluated using Warner-Bratzler shear. Muscle samples were taken after death and RNA was extracted from these samples to evaluate which genes were being turned on in the muscle at time of harvest. After harvest, carcasses were quality graded by an experienced grader. Grading of carcasses resulted in six carcasses grading Choice and five carcasses each for Select and Standard. Standard carcasses were significantly lighter, less fat with smaller loin muscle area than the Select and Choice carcasses, suggesting the steers yielding Standard carcasses were not at the same growth phase as the steers yielding Choice or Select carcasses. Shear force measurements unexpectedly indicated that there was no difference in the tenderness of steaks from Choice and Standard carcasses, while steaks from Select carcasses were significantly less tender. Meat quality and tenderness are two of the most important traits for beef production, and ongoing research will be required in order to gain a better understanding of the genetic and molecular basis of these traits, and how selection and growth interact in these economically significant characteristics.

Melissa Herrygers: Animal & Range Sciences
Mentor: James Berardinelli, Robert Garrott - Animal & Range Sciences, Ecology
Pregnancy Rate and Metabolites in Bighorn Sheep (Ovis canadensis) at the End of Breeding Season and in Mountain Goats (Oreamnos americanus) Before the Breeding Season and the First Trimester of Pregnancy

Objectives were to evaluate pregnancy rates (PR), and energy-related metabolites in bighorn ewes at the end of the breeding season and mountain goat does before breeding season and 1st trimester of pregnancy. Bighorn samples were from herds in Jackson (JWY), Mt. Everts (ME), NE Yellowstone (NEY), Taylor Hilgard (TH), and Tom Miner (TM). Capture events occurred mid-Dec. (end of breeding season) for TH, ME, and TM herds and mid-Jan. (1st trimester of pregnancy) for JWY and NEY herds. Mountain goat samples were from herds at Palisades (PAL) and NE Yellowstone (NEY). Samples were collected from July to Aug. (before breeding season) and mid-Jan. (1st trimester of pregnancy). Capture methods differed among locations. Samples were assayed for progesterone (P4), pregnancy specific protein B (PSPBs), glucose, and NEFA. Cyclicity was defined as > 1.5 ng/mL of P4 and pregnancy classified as a positive PSPBs test. Percentages of ewes cycling at the end of breeding season differed ($P < 0.05$) among herds. PR at the end of the breeding season and 1st trimester of pregnancy differed ($P < 0.05$) among herds. Herds sampled at the end of the breeding season had lower ($P < 0.05$) PR than the herds sampled in the 1st trimester of pregnancy. Glucose, but not NEFA, was greater ($P < 0.05$) in non-pregnant (NP) ewes than pregnant (P) ewes. Glucose in P ewes may have differed because a majority of P ewes were captured by ground darting and net guns, which decreases stress. Mountain goats were all non-cycling before breeding season (PAL). PR during 1st trimester (NEY) was 100%. NEFA and glucose concentrations did not differ ($P > 0.05$) between P and NP does. NEFA and glucose concentrations did not differ ($P > 0.05$) between herds because both were collected by net gun.

Acknowledgements: Carson Butler (Doctoral Student) - Ecology

Drew Narduzzi: Animal & Range Sciences
Mentor: Clayton Marlow - Animal & Range Sciences
Russian olive (Elaeagnus angustifolia L.) as a food source in Montana stream ecosystems

The introduced plant, Russian olive (*Elaeagnus angustifolia*), is displacing native plains cottonwood (*Populus deltoides*) in riparian areas throughout eastern Montana. To determine how this change might affect prairie stream food webs, I analyzed the fat, protein, and energy content of leaves from each species and reviewed scientific literature. Russian olive leaves had higher concentrations of protein and energy than plains cottonwood and similar concentration of fat. The additional protein and energy from Russian olive leaf litter provide no apparent benefits to native prairie stream food webs. However, I identified some possible negative impacts mostly related to surplus nitrogen, and I have suggested these as topics for future research.

Sarah Olivo: Animal & Range Sciences
Mentor: Shannon Moreaux - Animal & Range Sciences
Identification and Management of Anthelmintic-Resistant Intestinal Parasites in Equines

Drug-resistant intestinal parasites were suspected in a herd of horses owned by Montana State University. This study was conducted to identify the species of parasites present in the herd, test the parasite population for presence of drug resistance, and determine which horses were carrying the highest parasite burdens. Over a period of 8 weeks, three fecal samples were collected from each of the 32 horses in the herd. Parasite eggs in each fecal sample were counted using Modified McMaster slides to identify which horses shed the highest numbers of parasite eggs. Parasite species were identified by examining eggs under a microscope. Of the 32 animals in the herd, 12 horses with the highest numbers of parasite eggs present were then treated with oral Ivermectin to kill the parasites. Fecal samples obtained 7 days after treatment contained 0 parasite eggs, meaning no adult parasites survived treatment to produce more eggs. Data is still being collected to determine if any immature larval stages of the parasites could have survived treatment. Reappearance of any parasite eggs within 6 weeks of treatment may suggest Ivermectin-resistant parasites are present.

Katie Olson: Microbiology & Immunology
Mentor: Jovanka Voyich, Shannon Moreaux - Microbiology & Immunology, Animal & Range Sciences
Characterization of Virulence Factors and Antibiotic Resistance levels of Staphylococcus aureus and other Staphylococcal species in Equine Populations

Staphylococcus aureus (*S. aureus*) is a Gram-positive, non-spore forming, and non-motile bacterium that is part of human and animal normal microbiota. The focus of the current study was to characterize *Staphylococcus* virulence factors as well as antibiotic resistance from equine isolates and compare these results to human isolates. We investigated 26 individual horses two separate times for the presence of *Staphylococcus*. To do this nasal swabs were taken from both left and right nostrils of the subjects and bacteria was isolated from the microbiota and confirmed using RAPIDEC Staph® (Biomerieux) . Our data suggest 7 individual horses were colonized with *Staphylococcus aureus*. Using PCR we investigated the presence of toxin and antibiotic resistance genes including: mecA, sbi, tsst-1, lukS-PV, lukF-PV, hla, hlga, and blaZ. PCR results indicate all isolates have blaZ (gene that confers penicillin resistance), a high prevalence of alpha toxin (hla), and the sbi gene that encodes an immunomodulatory protein important in complement evasion. Several isolates appear to contain mecA, the gene responsible for methicillin-resistance, but through MIC analysis, only two samples show enough resistance to be considered MRSA. Through measuring hemolytic activity it was found that several strains did not have hemolytic activity which was surprising as several strains expressed hla. Collectively, these studies indicate that *Staphylococcus* is a common inhabitant of equine nasal passages and that these isolates contain antibiotic resistance and virulence factors common with strains colonized on humans. Recent investigation has been directed towards using 16S sequencing to determine the species of *Staphylococcus* present in samples.

Acknowledgements: Brent Van Schaumburg (Undergradaute Student) - Microbiology & Immunology

Jeff Patriarche: Land Resources & Environmental Sciences
Mentor: Lisa Rew, Tim Seipel, Stephanie Ewing - Land Resources & Environmental Sciences
The role of soil salinity and mineral toxicity as drivers of plant species composition in south Phillips County, Montana

Vegetation composition of central and eastern Montana lies between the mixed-grass prairie and the sagebrush steppe ecotones. It is commonly held that plant composition in this area is strongly influenced by soil and parent material. I assessed the relationship between plant composition and soil salinity and mineral content within the core of the American Prairie Reserve (APR), Phillips County, Montana. A 1km x 1km grid was established from which 59 grid-points were sampled in the summer of 2013. At each 10 m x 10 m grid-point presence of all plant species, and local habitat type were recorded, along with consolidated soil samples (four * 5-15 cm). Soil samples were then analyzed for electrical conductivity (EC), as a proxy for soil salinity concentrations. Full elemental analysis was performed on 29 of the 59 soil samples. The responses of plant species richness and beta-diversity patterns to EC and elemental content were analyzed using linear regression and analysis of variance.
Three habitat types were observed: sagebrush, greasewood and disturbed vegetation. Electrical conductivity varied by habitat type. Sagebrush steppe had lower salt concentrations when compared to a greasewood habitat type. However, EC was not a major predictor of plant species richness across habitat types, though specific plant species were significantly associated with soil salinity. Furthermore, the elemental analysis revealed differences between the types of salt associated with different layers of the marine shales, which in turn influenced the distribution of habitat types, but none of these significantly effected plant richness. While visually soil salinity and parent material appear to effect plant composition in the APR, we could not find any consistent quantitative evidence of this.

Nathaniel Powell-Palm: Land Resources & Environmental Sciences
Mentor: Cathy Zabinski - Land Resources & Environmental Sciences
Grazing versus Haying: Harvest methods' affects on Gallatin Valley grassland productivity

With millions of acres in hay and pasture production, Montana's grasslands are a major contributor to the state's agriculture industry. Commodities that rely on these grasslands, primarily cattle and sheep, are becoming increasingly valuable. Establishing production methods that increase forage yields is essential if producers are to keep up with demand. In order to produce greater forage yields without increasing the application of synthetically derived fertilizers, producers may need to reconsider the role of grazing livestock in hay production. In this study, we examined the effect of grazing cattle on grassland productivity. Specifically, we determined whether grazing a field rather than mechanically cutting it for hay had any effect on soil nutrient availability and fall crop regrowth. Our initial results indicate that fields that were grazed experience a boost in available soil nutrients as well as post harvest plant regrowth over those fields that are mechanically harvested for hay. According to the initial results, by incorporating grazing into a forage production system, the producer may realize greater overall plant yield.

Chad Smith: Agricultural Economics & Economics
Mentor: Anton Bekkerman - Agricultural Economics & Economics
Economic analysis of the newly emerging wine markets in the northwest United States

Over the past few decades wine consumption in the United States continues to increase. To meet this increased demand for wine, the United States had had associated increases in production of wine and wine grapes. The focus of this study is on the economic analysis of the emerging wine markets in the northwest United States, including an evaluation of developing wine markets in Montana. There are economic challenges and barriers to entry that need to be considered. This market requires large amounts of upfront capital and involves a reasonable amount of risk. In addition, there are few data available for this market, which will increase the difficulty of developing production and sales forecasts. The study compares the demographic and industry characteristics of these newly emerging markets and looks into the economic feasibility of starting a winery and or vineyard in the northwest region. Based on the findings of the study there is room for entry into the wine production market in the northwest United States.

Kendra Teague: Land Resources & Environmental Sciences
Mentor: Alison Harmon - Health & Human Development
Indigenous Food Systems: Grains, Global Perspectives and Health Outcomes

Current health outcomes for Indigenous peoples are related to transitions in agriculture, culture and diet. Agriculture has transitioned from biodiverse landraces to industrial scale monocultural production systems, in some cases using genetically modified seeds and other synthetic inputs like pesticides and fertilizers. Cultural transitions include attempts to eradicate Indigenous life ways and pressure to assimilate. Dietary transitions have included movements away from whole foods towards refined and convenience foods, often provided in the form of food assistance. Re-emergence of Indigenous foodways in the context of modern European influenced foodways is necessary for restoring health among Indigenous populations. The purpose of this work is to offer a conceptual model of the agriculture, culture and dietary transitions to a modern food system and the resulting health outcome for Indigenous peoples. The model includes the re-emergence of Indigenous foodways in a modern context and the potential for creating new positive outcomes for all peoples.

Smith Wells: Animal & Range Sciences
Mentor: Clayton Marlow - Animal & Range Sciences
Russian Olive (Elaeagnus angustifolia) Leaf Litter as a Food Source in Montana Prairie Stream Ecosystems

The purpose of this study was to compare the effects of the invasive plant Russian olive (*Elaeagnus angustifolia*) and its native counterpart, plains cottonwood (*Populus deltoides*), on the primary food chain of Montana prairie streams. Equal numbers of stoneflies (*Plecoptera*) and caddisflies (*Trichoptera*), benthic macro-invertebrate genera that shred and scrape detritus material into fine particulate organic material, were placed in five aquatic tanks with varying amounts of Russian olive and plains cottonwood leaf material. Tanks contained three cages each with either 100% Russian olive, 100% plains cottonwood, or a mixture of both species. Leaf dry weight and visual observations of macro-invertebrate preference were recorded on 10/28, 11/5, and 12/12/2013. Paired t-test data analysis from 10/28 to 12/12 indicated changes in leaf dry weight of both species were significant ($p < .05$) across all tanks and leaf cages. Tank 1 with 100% Russian olive and tank 5 with 100% plains cottonwood material had one-tailed p-values of 0.0003893 and .0000000264 respectively, indicating that both species had significant changes in dry weight. Percentage of material disappearance was similar between tank 1 and tank 5 with 74.03% and 80.67% material disappearance respectively. A two-tailed paired t-test indicates these percentages are not significantly different ($p=0.087$). Visual observations concluded that macro-invertebrates prefer larger leaves such as cottonwood for habitation but this showed no effect on disappearance rates. Results indicate no significant difference in macro-invertebrate utilization of these native and invasive species. Until other studies indicate otherwise, this study shows extreme measures to eradicate Russian olive may be unnecessary.

Sophie Zhu: Pre-Veterinary Medicine
Mentor: Matthew Fields - Microbiology & Immunology
Effects of light intensity variation on lipid accumulation and carbon fixation of Pheaodactylum tricornutum

Global economies have long relied on the usage of fossil fuels such as methane, coal, and petroleum. However, depletion of fossil fuel supplies within the past hundred years has necessitated the prevalence and efficiency of green, or renewable energy sources. Biodieselproduction from oils/lipids that are extracted from living organisms are especially promising due to the fact that they can be directly consumed by existing vehicles without transformation of the engine and that they fix a great deal of inorganic carbon in the process. First generation biofuels such as ethanol come directly from food crops and compete with food supply, which is why second generation biofuels such as algal bio-oil are a better option in the long-term. Under controlled conditions great success has been achieved in regards to algal lipid accumulation, but in order for algal biofuel to become more widely used more research is needed on the cultivation of algal in natural/variable conditions in order to maximize biomass and bio-oil production. In this study the underlying objective is to investigate the extent that light intensity has on inorganic carbon fixation, and ultimately lipid accumulation in the bio-oil accumulating diatom, *Pheaodactylum tricornutum*.

COLLEGE OF ARTS & ARCHITECTURE

Benjamin Babcock: Art
Mentor: Josh DeWeese - Art
Celadon: A Search for Indigenous Answers and Local Solutions

Celadon is a blue/green glaze prized for it's subtlety and simple, striking beauty. During the Goryeo Dynasty in Korea (918-1392), the production of celadon wares reached new heights, thanks to technological advances and new adaptations of regionally available materials. This fall, I traveled to the Jeolla region of South Korea, an area well known for the production of celadon wares. Over 200 Goryeo dynasty kilns exist in the hills near Gangjin, along with a ceramic research center and museum. Living and studying at a school in Gangjin, I produced a small body of work utilizing the available iron rich clay and celadon type glaze. During this stay, I visited historical kiln sites, had conversations with celadon researchers, and searched for interesting clays. I learned that the native materials needed for a basic celadon glaze consist of: 40 percent indigenous feldspar, 30 percent clean pine ash, and 30 percent iron rich earthenware clay. The iron content of the clay body itself plays a much larger role in determining the hue of the glaze than I had previously considered. The temperature and atmosphere within the kilns that these wares were produced in also greatly impacts the final outcome. To understand the glaze, one must consider the entire process and historically available technologies. I plan on collaborating with members of the earth science department to gain a clearer understanding of the feldspathic material utilized in these recipes, as I was fortunate enough to return with a small sample. Earthenware clay and wood ash exist in abundance locally, and I believe the key to a Celadon type glaze comprised of native Montana materials involves the isolation of a similar feldspar, an iron rich clay body, and a cooler, heavily reduced kiln atmosphere.

Paul Bennett: Music
Mentor: Bolte Jason - Music
Classical Downtempo Hybrid Composition

My project has two main objectives. The first objective is to record and assemble a percussive sample kit to be used in the second objective, which will be an original composition that seamlessly combines the aesthetic of downtempo electronic music with the rhythmic and harmonic freedom found in early twentieth century classical music. Although the work is still in progress at this stage, the first objective has certainly been met. I have succeeded in recording a variety of samples that I have used as the rhythmic and percussive spine of the composition. Because they are all percussive sounds derived from unique objects, the resultant tracks were very unique and successful. The harmonic framework for my composition has been established. The harmonic progression moves quite slowly so that the tonal center of the work is more difficult to pinpoint. Although there is still much work to be done, the results are looking very promising.

Lindsey Brunken: Film & Photography
Mentor: Tom Watson - Film & Photography
The Hunt : A Short Film

What happens when the path of a hunter crosses the path of the hunted? A short film about a boy, his father, and a felon which explores masculinity and morality in the depths of the Montana wilderness.

Ethan Cayko: Music
Mentor: Jeremiah Slovarp - Music
Sounds and Scenes of Spain/Morocco Tour

In the spring of 2013 I traveled to Spain and Morocco with the MSU Cello Ensemble to perform as well as assist Prof. Jeremiah Slovarp in making professional recordings of each of the ensemble's performances. I also recorded impulse responses of the various venues in which the ensemble played. These recordings are used in digitally recreating the unique reverberation of a given room or space. This is done by recording a hard transient such as

clapping to blocks of wood together, capturing the reverb tail, and the frequencies accentuated and attenuated by the room's size and structure. This is all done in a recording typically lasting no more than three or four seconds. I created these effects from five different venues in Spain and Morocco. With these effects I can make a recording of nearly any sound and then apply to it the sonic characteristics of one of the venues in Spain or Morocco. In addition to the impulse responses, I took descriptive photographs of each of the spaces I recorded. This project helped me to better understand the parts of Music Technology I would not experience in a classroom setting. By putting my learned skills to practice I finally have declarative knowledge of these various recording techniques and how to properly create an impulse response effect. Beyond that I was able to meld the two worlds of Music Technology and Photography in a way that was both a learning experience and a creative endeavor.

Halley Heintz: Art
Mentor: David Swingle - History & Philosophy
Museum of the Rockies: The Hybrid of a Rural and Metropolitan Museums

Museum of the Rockies (MOR) contains the characteristics of a rural and metropolitan museum. Unlike other $4.1 million dollar non-profit museums, it has more volunteers than staff members. My research captures the views of volunteers, staff members and supporters experiences of MOR and compares their experiences to staff members of other museums like The Bair Family Museum and the Smithsonian. Comparing these museums may suggest what will be needed to gain and retain the Millennial generation.

Logan Henke: Music
Mentor: Linda Antas - Music
Signal Processing: Creating Art with Science

My presentation will focus on the use of signal processing techniques that transform acoustic sounds into new and potentially unrecognizable forms. These techniques are the core of both acousmatic music and Foley effects in film. I will present examples alone and in the context of an original piece of my own. Viewers will be able to listen to the source sounds and compare to the processed version, and will be able to listen to the final version of the work as well. My presentation will also include visual examples (sonograms) of sounds before and after their alterations. Many of the sounds you will hear in my presentation were created using everyday objects. I will have examples of audio manipulation to demonstrate in real time. I will also discuss how the context and mood of the piece causes interesting psychological reactions and false conclusions as to the source of the sound. This is aided by the use of signal processing on the sounds involved.

Andy Marshall: Art
Mentor: Josh Deweese - Art
Native Refractory

The purpose of this research is to determine the viability of creating a castable refractory from native Montana mineral deposits as well as to explore the potential of various refractory formulas and construction methods. Refractory is a combination of materials able to withstand temperatures in excess of 2300^{o} Fahrenheit while remaining chemically stable. The artistic traditions of ceramics, glass blowing, and blacksmithing all require the use of refractory, as do numerous industrial applications. The world production of refractory is estimated to be 46 million tons by 2017 and its current production and transport methods create an extremely large carbon footprint. This research utilizes rock materials dug from four sites in Montana that were independently processed and combined with other materials into sample refractory bricks. These were then dehydrated and heated in excess of 2300^{o} Fahrenheit before being analyzed for their refractory, reflective, thermally conductive, and insulating properties as well as structural integrity. The preliminary results indicate that three out of the four sample rock materials are capable of producing a viable castable refractory and doing so with a smaller carbon footprint than that created by commercially produced refractory. The findings of this research may benefit the producers as well as the consumers of refractory throughout the world.

Chalice Stevens: Music
Mentor: Jeremiah Slovarp - Music
Andalusian Music : From Islamic Spain to Modern Morocco

In the Summer of 2013, I travelled to Spain and Morocco with my research mentor, Jeremiah Slovarp and the MSU Cello Ensemble. This journey informed me as a scholar, musician, and composer. While in Morocco I recorded the music of Berber natives, and throughout the summer, collected pre-recorded examples of Andalusian classical music. My research is on medieval Spanish, and modern Moroccan culture, with a focus on the origins and evolution of Andalusian classical music. This music flourished during the period when Muslim dynasties ruled Hispania. For nearly eight-hundred years, Islam and Judaism co-existed with Christianity, in a unique blending of cultural and religious tolerance not found anywhere else in the medieval world. This music, birthed in medieval Spain, traveled with Muslim refugees of the Reconquista to present-day Morocco and the surrounding Maghreb countries, where it has been passed down as an oral tradition. As an added, creative component to my research, I wrote a composition for the cello ensemble, two percussionists, and solo violin, that reflects my personal impression of the unique character of Andalusian music. This piece will be presented to the School of Music in Reynolds Recital Hall this fall, along with my final research report detailing the rich history of Andalusian music. I will explain the inspiration for my composition and cite specific examples of my use of musical elements present in Andalusian music.

Cara Thuringer: Film & Photography
Mentor: Alexis Pike - Film & Photography
Midwest Best

The memories that I have of my grandmother are fleeting. I was ten years old when she passed away. I barely knew anything about her, but she seemed to know everything that I would grow to become. Fast forward nine years and I clutch in my hand an envelope of dusty and scratched Kodak Safety Film, the first of many envelopes and boxes that would immerse me in the world that belonged to my grandma. With the help of other family members, I rephotographed the settings of her world. What I discovered was that the midwest is a drastically different place. Once thriving lake resorts have been squeezed out by multimillion dollar lakefront mansions. The houses that my grandmother grew up in and the ones she raised her own children are, for the most part, gone. In the intervening decades between my grandma and I, the landscape of the midwest has completely transformed. These changes inspired me to revitalize the landscape my grandma experienced by reprinting her original negatives using the Van Dyke Brown process. I chose the Van Dyke Brown process for its rich tones and vintage aesthetic. I carefully scanned each negative individually using an Epson Perfection V700 negative scanner. The scans were uploaded to Adobe Photoshop CS5, where the scratches and dust were removed digitally from the image. I then applied tonal corrections and a contrast curve based on paper calibrations using Mark Nelson's Precision Digital Negatives Software. Digital negatives were printed out on an Epson Stylus Pro 3880 inkjet printer. The image was then contact printed to a sheet of hand coated paper. Each print was then developed in an archival developer and fixer then hung to air dry.

Kalina Vander Poel: Environmental Design
Mentor: Pravin Bhiwapurkar - Architecture
Connecting Art & Science in Fused Glass

This project applied the principles of material science to the art medium of fused glass. By understanding the material properties of fused glass, the beauty of artistic glass and the performative qualities of energy efficient glass will hopefully be combined within a single piece of fused glass. Functional pieces of art are created that manipulate specific environmental conditions and lighting within a habitable space.

Troy Vanderlinde: Art
Mentor: Rollin Beamish - Art
Squaring the Circle

My research project concerns the field of contemporary sculpture, and in part, investigates public access to contemporary art. This project is intended to advance my previous investigation of issues relevant to the field of contemporary art and society at large. The project has entailed the construction of a self-contained mobile living unit. The work will be installed in non-traditional urban locations, with the artist (myself) living within. This public installation will occur continuously over a period of days, and will encourage both viewing and interaction by the public. Digital video and audio recording will be employed during installation, and this comprehensive documentation will be used to disseminate my research, expand the work's audience, and further evolve this work.

Cassondra Wilson: Film & Photography
Mentor: Theo Lipfert - Film & Photography
The F-Word: A Short Documentary Film on Fertility

In my presentation, I will show clips from my film with an exhibition on Fertility Awareness Methods. I will explore pros and cons of using the Fertility Awareness Method as well as a proposal of how Fertility Awareness could be taught in schools, exhibited in doctor's offices, and even advertised in magazines. Current technologies are working towards making charting easier, more effective, and more available for women of all backgrounds. In my research presentation, I will show fertility awareness can grow to benefit the women who have interest in using this method.

COLLEGE OF BUSINESS

Michelle Cassens: Business
Mentor: Gerard J. Carvalho, Harry Benham - Business
Student Opinion on Bring your Own Device at the Jake Jabs College of Business and Entrepreneurship

This study examines students' perceptions of the impact of bringing their own computing devices to school on a daily basis. Bring your own device (BYOD) is a world-wide trend that is having a significant impact on both the education and the business environment. The study examines student use of mobile computing technology in the classroom and its impact on quality of learning, in-class engagement, and involvement in the Montana State University (MSU) academic community.

David Owen: Business
Mentor: Carly Urban - Agricultural Economics & Economics
How Medicinal Cannabis Enrollment Effects Public Welfare Programs: A Study of Montana State

Drug use among welfare recipients has long been identified as an important correlation that low income individuals face. However what if the drug use was a legal act? This paper considers the rising enrollment of medical marijuana programs and the effects it has created on public welfare systems. In Montana, both public welfare systems and medical marijuana laws are currently in place. To understand the effects on welfare systems I focus on one variable in particular and that is the change in enrollment for Food Stamp benefits per 6 month intervals. My data concludes that the increasing rate of food stamp participants creates a correlation that is strong among medical marijuana enrollment holding many other deciding welfare variables constant.

Taylor Travers, Timothy McInerney, Jeff Whitney, Emily Lindquist, Lexi Palagi: Business
Mentor: Omar Shehryar - Business
Satisfaction Based on User Experience at Montana State University

We are conducting a student satisfaction survey. We have already conducted a focus group to identify key themes. The survey data will be gathered after spring break. Results based on a random sample of MSU students will inform us on three distinct aspects of an MSU student's life; Academic, Personal and Social. Comparisons of attitudinal and behavioral dimensions among class levels will also be provided.

COLLEGE OF EDUCATION, HEALTH & HUMAN DEVELOPMENT

Megan Baker: Health & Human Development
Mentor: Renee Harris – Area Health Education Center
Successful Interventions in Pediatric Obesity: A Comparative Study

Pediatric obesity is now termed a public health epidemic, with 35% of American children and adolescents overweight or obese. Pediatric obesity increases one's risk of becoming obese as adults as well as developing Type II diabetes, cardiovascular problems, high blood pressure and high cholesterol. Results from three programs which target pediatric obesity were collected primarily via the internet and peer-reviewed journal articles. Programs were chosen based on their success in overall reduction of BMI and/or waist circumference as well as an increase in fitness, coordination and/or nutrition and health related knowledge. All programs saw a varying degree of reduction in BMI and/or waist-circumference and aimed to increase participation in physical activity as well as nutrition related knowledge. The length of the program was directly proportional to weight loss. Additionally, parent involvement was found to be crucial in success post-treatment. Pediatric obesity interventions that aim to promote lifestyle modifications have been the most effective in terms of weight management in overweight and obese children. The goal of pediatric obesity programs should be to give their participants the knowledge, skills and self-efficacy to live healthier and longer lives.

Rachel Bochy: Health & Human Development
Mentor: Carmen Byker, Chrisopher Seitz, Health & Human Development
Using PhotoVoice to Understand Food Access and Experiences Among Seniors in Gallatin County

PhotoVoice is a research method that involves giving cameras to people to take photographs that illustrate issues that concern them or to communicate their view of a particular issue. The purpose of this project was to add to the scientific research base about food availability and senior populations. This study was also for the purpose of giving seniors an opportunity to tell their food stories in a research setting. Data was gathered from the photographs and interviews of ten seniors living in Gallatin Valley, Montana.

Kelly Borden, Kaysha Young (Graduate Student): Health & Human Development, Mechanical & Industrial Engineering
Mentor: Laura Stanley, Carolyn Plumb - Mechanical & Industrial Engineering
A Peer-to-Peer Traffic Safety Campaign

The purpose of this project was to implement a peer-to-peer driver's safety program designed for high school students. This project builds upon an effective peer-to-peer outreach effort in Texas entitled Teens in the Driver Seat (TDS), the nation's first peer-to-peer driving safety program run by teens for teens. This program is based on the idea that teens will pay more attention to ideas that are presented by their peers than to those that come from adults. The peer-to-peer traffic safety campaign program empowers high school students to create methods of outreach to their peers. The implementation of this project followed that of the TDS high school program developed by the Texas Transportation Institute, and was assessed using a case-control experimental design across two urban and two rural Montana high schools that included approximately 2,700 students. Results did show some early success in improving teens' awareness of the most dangerous risk factors for teen drivers. These results were more prominent in the rural group than the urban group. However, self-reported driving behaviors did not reflect this change (except for increase in seat belt usage). Urban teens reported being influenced most by their peers, closely followed by a parent, whereas rural teens reported being nearly equally influenced by their peers and a parent. Other key findings included different types of peer-to-peer media are effective in different sizes of schools.

Acknowledgements: Erica Pimely (Undergraduate Co-Author) - Mechanical & Industrial Engineering

Stephanie Johnson: Health & Human Development
Mentor: Laura Larsson - Nursing
Exploring Treatment Barriers to Postpartum Anemia in Rural WIC Users

Postpartum anemia affects one in four postpartum women in the United States. The effects of postpartum anemia can include decreased physical work capacity, decreased immune function, altered neurotransmitter function, cellular and oxidative processes, and thyroid hormone function. The stressful environment created by having a newborn baby exacerbates these symptoms. The prompt and proper treatment for these mothers has beneficial implications for their baby, family, and community. Many women in rural Native American communities are at risk for developing postpartum anemia and WIC has reported a high incidence of postpartum anemia in their clientele in these areas. For the health and welfare of the WIC participants in rural Native American communities, solutions to these treatment barriers were explored. Interviews were conducted with health care providers on the reservation to explore solutions to postpartum anemia treatment barriers on the Reservation. Early results suggest that community endeavors and patient compliance are treatment barriers to postpartum anemia. A brown bag luncheon with community stakeholders is an avenue being explored to bring this issue to the attention of the allied health care community to craft practical solutions.

Stephanie Johnson: Health & Human Development
Mentor: Alison Harmon, Melody Anacker, Laura Larsson - Health & Human Development, Nursing
Exploring Food Security Issues at MSU Through Food Group Choices

We are all familiar with the jokes about students surviving on ramen throughout college. Students are not known for having the best eating habits. There is no data on whether or not MSU has a food security issue and if students are just getting by with nutrient void foods. A few other universities have surveyed their population and found that many students are food insecure. If there is a food security issue on campus, we need to implement assistance or education programs to help students during college. College is where many individuals develop habits and behaviors for life. If we were able to get people started on the right foot, they may have a better chance for overall wellness in the future. Around 375 MSU students have been surveyed over the past three years in a row at MSU Food Day. They have taken a half page Likert scale survey about going without food, food groups they purchase, nutrition assistance program use, and demographic information. The data was analyzed using SPSS to see if certain demographic groups are having more issues than others and if there is an issue with food security at MSU. The results indicate that food insecurity is a real issue on campus. Almost 40% of students are food insecure or at-risk of becoming food insecure. This is an issue that should be addressed by student organizations, the university, and the community to promote better student outcomes and wellbeing.

Lai Yee Phoon: Health & Human Development
Mentor: Mary Miles - Health & Human Development
Oxidative Stress and Insulin Sensitivity on Exercise and Sugar-sweetened Beverages

Proper nutrition and physical activity help to reduce the rate of metabolic diseases. A single bout of moderate exercise improves insulin sensitivity and reduces the oxidative stress in our body. Alternatively, glucose ingestion increases oxidative stress and reactive oxygen and nitrogen species (ROS/RNS) in cells and may be a cause for diabetes. ROS/RNS are produced by cellular disturbances in glucose and lipid metabolism. High levels of ROS/RNS will increase the inflammation of insulin resistance, thus decreasing the insulin sensitivity. The objective in this experiment is to explore the effect of sugar-sweetened beverages and high carbohydrate meals on oxidative stress. Specifically, how does drinking sugar sweetened beverages or eating a high carbohydrate meal influence oxidative stress and insulin sensitivity after exercise? The amount of ROS/RNS on exercise with no sugar-sweetened beverage and with sugar sweetened beverages or different types of exercise followed by a high carbohydrate meal will be studied. Lower levels of ROS/RNS indicate healthier and more desired metabolism. The expected outcome for the experiment is the higher the blood glucose values the greater the levels of ROS/RNS will be regardless of the experimental condition.

Arielle Richard: Health & Human Development
Mentor: John Seifert - Health & Human Development
The Kinematics of Slope Style Skiing: Dominant vs. Non-Dominant Rotations in Professional, Advanced, and Intermediate Level Athletes

Skiing is a sport that encompasses a broad range of disciplines. Slope-style skiing consists of "terrain-park" and "urban" features in which athletes perform spins and flips off of jumps and grind rails on their skis. Most all resorts have professionally built "freestyle terrain-parks" designated for these free ski athletes. These features range in difficulty levels from beginner to advanced, and complications arise when athletes attempt tricks that are too advanced for the skill levels. In terms of going off of jumps, riders perform tricks such as 180^{o}, 360^{o}, 540^{o}, 720^{o}, 900^{o} rotations. Athletes often times go inverted and "off-axis" in many of these tricks, performing backflips, flat-spins, double spins, and even triple spins. This sport is growing rapidly with children as young as 11 years old entering the competition scene at a professional level, and it has recently been accepted into the Winter 2014 Olympics. Because of this, it is crucial that researchers begin investigating and exploring the kinematics, kinetics, and other factors that are required to successfully execute and safely land these tricks. An exploration of some of the most basic factors involved in executing a 360^{o} rotation in an athlete' s dominant and non-dominant directions of rotation will yield useful data for freestyle coaches, teams, and athletes because it will provide a foundation for identifying each athlete's strengths and weaknesses, and will allow coaches and/or athletes to begin implementing drills and techniques to build the athlete's skills. These skills are necessary for all slope style skiers to master before further progression can occur.

Caroline Rowe: Health & Human Development
Mentor: Renee Harris, Erin Bills - Montana Office of Rural Health
Outcomes and Implications of the Child Ready Montana Program in the critical access hospitals in Roundup and Lewistown, Montana

Currently Montana does not house a pediatric hospital and only employs 148 pediatricians: 73% of which are concentrated in five major areas. With geography that features significant rurality and sparse population concentration, treating pediatric emergency care (PEC) patients becomes difficult and often times impossible. Montana also boasts a significant American Indian population, making culturally appropriate care vital. In 2010 the Department of Public Health and Human Services released six state health initiatives to improve public health and wellness in Montana. Two of those objectives include: promote the health of mothers, infants and children; and strengthen the public health and healthcare system. One manner in which the Montana Office of Rural Health (MORH) and Area Health Education Center (AHEC) are working towards these goals is through the Child Ready Montana grant; the paramount intent of which is to develop an accountable, culturally competent, and accessible system of care for pediatric patients, resulting in providing the right care at the right time in the right place. This paper documents research conducted at site assessments of both the Lewistown and Roundup critical access hospitals, including the performance of a pediatric mock "code" simulation, in conjunction with previous research of PEC throughout the state of Montana through the Child Ready MT program. The findings led to a profile of the individual facilities' (a) degree of successful PEC performance; (b) level of PEC preparedness and competence; (c) PEC equipment capacity; (d) PEC training and certifications present, and finally (e) level of cultural competency present within the facility.

COLLEGE OF ENGINEERING

Jon Adams, Alex Shchepetkin: Computer Science
Mentor: Clem Izurieta - Computer Science
A Database System to enhance Leadership Institute Capabilities

The purpose of this project is to design and implement a database for the Leadership Institute at Montana State University. The database facilitates a relational approach to storing and querying student and faculty assets. The database uses MySQL and follows all standards set forth by Montana State University which can be accessed via the Leadership Institute's web page. Specific technologies used during the implementation phase include PHP embedded in HTML along with MySQLi commands to support security concerns. The new functionality afforded to users includes access and querying capacity to database text files, events, and hyperlinks to TED_Talks and YouTube videos selected by Leadership personnel. A separate secure login allows Leadership personnel access to specialized and administrative capabilities. The project benefits all students on campus as it provides much needed functionality for a pervasive MSU service.

Quinn Andrews: Chemical & Biological Engineering
Mentor: Paul Gannon - Chemical & Biological Engineering
Investigation on Effects and Prevention of Hot Corrosion

The focus of this USP research is on the investigation and prevention of hot corrosion. The process of hot corrosion is an accelerated form of corrosion that occurs due to the presence of salt in contact with metals at high temperatures. This environment is found in combustion reactions, jet engines, and steam boilers, with much research being dedicated towards the preservation and increased lifetime of gas turbines. These salts, often found in the fuel and in the air, melt under combustion temperatures and form a molten liquid on the surface of the metal that damages and dissolves the protective oxide layers on the metal. The alkali metal salts formed during hot corrosion, most commonly Na_2SO_4, are ionic conductors and act as electrolytes that dissolve the protective oxide layers on metals. Without the protective oxide layer, sulfidation and oxidation of the metal occur at a heightened rate, causing accelerated corrosion. The research in progress is testing a variety of coatings that can be applied to metal's surfaces to greatly hinder the invasion of these molten salts and the corrosion of the metal. Currently coatings of silicon, chromium and aluminum are being tested and the results that have been gathered show high effectiveness. The intent of the research is to gain a fundamental understanding of the mechanism of hot corrosion and the interactions between metals and salts under these conditions. The project will be continued through the rest of the semester and possible the summer term in order to test more coatings and improve upon current findings and results.

Adam Bartz, Alison Figueira: Computer Science
Mentor: Clemente Izurieta - Computer Science
Japanese-On-The-Go: A Japanese Kanji Image Translation App for the Android

The Japanese language is an intricate language of over 2,000 imported Chinese characters. It also contains two different written syllabaries, one for foreign loan words and the other for Japanese native words. Due to the rise in international travel and the ongoing spread of globalization, the need for translation software to bridge language barriers is ever increasing. The time it takes to translate using a dictionary or to learn a language is becoming more inconvenient in a lifestyle that is moving at par with the speed of technology. Due to this increasing need, the goal of this project is to produce an application (App) that provides a simple and effective way of translating and identifying Japanese characters in everyday situations. This App will use pictures of Japanese characters taken from an Android device and translate them into English. It will also provide some Japanese character information for users that are interested in learning the language without compromising the simple design of the App. The primary goals of Japanese-On-The-Go are accuracy, efficiency, and simplicity. The App uses the wwwJDIC internet database for information about the characters and it uses the Tesseract engine to help with the image recognition.

Tyler Bellville, Spencer Dahl: Chemical & Biological Engineering
Mentor: Ryan Anderson - Chemical & Biological Engineering
Heat Transfer through Encapsulated Phase Change Material

The heat transfer coefficients of fluids are valuable to know, because they can help design more efficient systems, such as heat exchangers, automobile radiators, and air conditioning units. The magnitude of the heat transfer coefficient of a fluid dictates the heat transfer capability of that fluid and its applicability to real world systems. This project was concerned with building a heat transfer loop, validating it with water, and testing phase change material's heat transfer coefficients in comparison with water. A successful loop was built with a flow development section and a heating section connected to a power supply. The system was validated with water at flow rates of 0.15, 0.25, and 0.50 gallons per minute at power supply values of 200, 300, and 500 Watts. The experimental values for the heat transfer coefficients were compared to theoretical values derived from the Reynolds, Prandtl, and Nusselt numbers of these flow conditions at several points throughout the heating section. Only initial testing has been performed on the phase change materials, but the data for 37D material seems to be producing a higher heat transfer coefficient and similar results are expected for the 43D material as well. Further testing will be performed on different concentrations of the phase change materials and for mixtures of phase change materials.

Andrew Bender: Mechanical & Industrial Engineering
Mentor: Sarah Codd - Mechanical & Industrial Engineering
Variables Affecting the Growth of Biofilm in Porous Media

In-situ bioremediation is a commonly used subsurface process to remove contaminants from groundwater, yet monitoring growth of the thick biofilm characteristic of this process is incredibly difficult. Previous work at MSU has shown that magnetic resonance (MR) techniques can detect copious amounts of the extracellular polymeric substances (EPS) characterizing biofilm. The MSU College of Engineering MR research group is investigating using a low-field MR spectrometer that can be inserted into a large sand bioreactor and nondestructively monitor the extent of the biofilm growth process over space and time. The ability to consistently grow copious EPS in porous media is crucial in the success of the research. This research project investigated the variables that affect thick biofilm growth of *Bacillus mojavensis* in porous media and developed a repeatable method for copious EPS production for use in a large sand bioreactor. Iterative benchtop experiments with small syringe sand columns were used to test the biofilm growth variables. Although EPS production was abundant under continuous flow of fresh nutrient, recycle experiments were necessary in order to scale up from the syringe columns to the large bioreactor. Realistic biofilm growth parameters were found using a nutrient with 36 grams per liter of BHI that was pumped through the bioreactor at a specific discharge of 0.05 centimeters per minute, recirculating one system pore volume of fresh nutrient for 24-hour periods. Future work aims to create biofilm growth parameters for a different organism that will be used in an upcoming field test.

Acknowledgements: Catherine Kirkland (Doctoral Student) - Environmental Engineering

Emily Bermel: Chemical & Biological Engineering
Mentor: Christine Foreman - Chemical & Biological Engineering
The Effects of Ultraviolet Light on Biofilm Formation and Pigment Production of Janthinobacterium sp. Strain CG23_2

Organisms found in Antarctica have been shown to possess a variety of mechanisms to persist under low temperatures, freeze thaw events, and UV radiation. An adaptation that bacteria have developed to cope with a variety of environmental stressors is biofilm formation. Although stress responses are receiving increased attention, still relatively little is known about the responses of Antarctic bacterial isolates to UV stress. Organisms from supraglacial streams may offer insights to the requirements for the growth of microbes that are adapted to high levels of solar radiation, as they are continuously exposed during the Austral summers. The microorganism studied was isolated from the Cotton Glacier supraglacial stream in Antarctica. This organism is *Janthinobacterium* sp. strain CG23_2, a pigmented, gram negative bacterium. It was grown in a CDC bioreactor, and the sunlight simulation was accomplished using a broad spectrum white light, UVA, and UVB. The samples were exposed to

continuous UV radiation during the entire duration of the reactor run, while a dark reactor was used as a control. Samples were collected every 24 hours during the run of the reactor for both biofilm and planktonic analysis. Confocal laser scanning microscopy (CLSM) was used to image biofilm formation and cell localization throughout the course of the reactor runs. Oxidative stress response was analyzed by a combination of maleimide probes and proteomic analysis. Results suggest that increased biofilm formation and pigment abundance per cell is a reaction to UV stress. Moreover, CLSM showed that there are differences in biofilm structure throughout the course of the experiment. In conclusion, the pigmented *Janthinobacterium* sp. strain CG23_2 has many different responses to cope with UV stress.

Acknowledgements: Heidi Smith, Michelle Tigges (Doctoral Students) - Land Resources & Environmental Sciences, Chemistry & Biochemistry

Ashley Berninghaus: Chemical & Biological Engineering
Mentor: Robin Gerlach - Chemical & Biological Engineering

Growth of Two Alkaliphilic Microalgal Isolates in Recycled Harvest Water Supplemented with Anaerobic Digestate

In order for large-scale algae production facilities to be feasible, adequate supplies of water and nutrients must be available and able to sustain algal growth. Municipal wastewater, agricultural wastewater, and water produced as a byproduct of oil and gas extraction have been proposed as possible sources of low-quality and/or nutrient-rich water that could be used in the production of algal biomass. In this study, two alkaliphilic microalgal isolates were separately grown in non-sterile municipal wastewater until medium nitrogen depletion. The algae were then removed through centrifugation, and the water, supplemented with nutrients, was reused for subsequent growth. Nutrient additions included: anaerobic digestate, anaerobic digestate plus iron, and laboratory-grade $NaNO_3$. Growth characteristics and nutrient removal efficiencies were determined for three generations of growth in recycled harvest water. The two strains were able to effectively utilize supplemented nutrients in recycled harvest water for each generation of growth. No inhibitory effects of recycled harvest water were shown for either strain. The addition of iron resulted in a significant increase in chlorophyll content of *Scenedesmus* sp. WC-1, but the addition did not affect the chlorophyll content of *Chlorella* sp. SLA-04. This study suggests harvest water remaining after algal growth can be reused and nutrients can be recycled through anaerobic digestion to support subsequent growth.

Acknowledgements: Luke Halverson (Gradaute Student) - Chemical & Biological Engineering

Chaparral Berry: Chemical & Biological Engineering
Mentor: Roberta Amendola, Paul Gannon - Mechanical & Industrial Engineering, Chemical & Biological Engineering

Fundamental investigation of hydrogen transport in ferritic stainless steel for S.O.F.C interconnect applications

Ferritic stainless steel (FSS) is widely used for interconnects in planar solid oxide fuel cell (SOFC) stacks. Interconnects separate and connect individual cells into a stack .This design demands the interconnect to be simultaneously subjected to high temperature ($800^{o}C$) moist oxidizing (air) conditions on the cathode side and moist reducing conditions (H_2) on the anode side, creating a "dual atmosphere exposure." It is generally accepted that, at high temperature, hydrogen transport through the steel promotes accelerated and/or anomalous corrosion. It is hypothesized that effective hydrogen transport through steels can be dominated by hydrogen-soluble, interconnected grain boundaries precipitates, or by presence of surface layers. This investigation focuses on evaluating these hypotheses via parametric studies of steel compositions (and microstructures), sample thickness and hydrogen partial pressures, within customized dual atmosphere exposures (in terms of temperature and time), to elucidate and model mechanisms governing hydrogen transport in steels. Resulting observations, along with speculated mechanisms, will be presented and discussed in the context of facilitating engineering of steels and protective coatings to develop durable interconnects for long-term high-performance SOFC systems.

Acknowledgements: Chris Zimny (Graduate Student) - Mechanical & Industrial Engineering

Alissa Bleem: Chemical & Biological Engineering
Mentor: Ross Carlson - Chemical & Biological Engineering
A survey of acetic acid substrate and product inhibition kinetics for Escherichia coli K-12 MG1655 wild-type and select gene deletion mutants

Acetate is a ubiquitous byproduct of bacterial metabolism; its secretion is linked to competitive physiological functioning but it inhibits growth and reduces substrate yields. A better understanding of acetic acid inhibition is important to fundamental biology and the design of efficient industrial bioprocesses. The present study utilized a combination of experiments and computational modeling to quantitatively define the role of acetic acid as both a substrate and inhibitory byproduct. Wild-type *Escherichia coli* K-12 as well as a glucose-positive/acetate-negative *E. coli* mutant and an acetate-positive/glucose negative *E. coli* mutant were used to uncouple the effects of acetate on cellular behavior. Steady-state chemostat and batch reactor experiments measured culture specific growth rates as a function of acetate concentration and pH in the presence of excess glucose. These data were used with a symbolic regression approach to generate novel mathematical, acetate-based growth and inhibition terms as well as develop a response surface for these variables. In the presence of acetate, small changes in pH resulted in substantial changes in cellular inhibition quantified as specific growth rate. Additionally, synthetic consortia studies utilizing a combination of glucose-positive/acetate-negative and acetate-positive/glucose-negative strains demonstrated the emergent property of enhanced biomass productivity relative to monocultures. The computational model and accompanying experimental procedures establish fundamental quantification of acetate inhibition and provide a metabolic engineering paradigm which can be easily adapted to bioprocesses to improve system efficiency.

Orrin Boese: Chemical & Biological Engineering
Mentor: Wataru Nakagawa - Electrical & Computer Engineering
An Optical Characterization System for the Evaluation of Grating Coupling Efficiency and the Index of Refraction of Nano-structured Polymer Materials

An optical characterization system was developed to evaluate the grating coupling capabilities of nano-structured polymer waveguides and to measure the refractive index of polymer thin films. A single system was built which integrates both of these functions without causing transitions that require major variations in the core design of the system. Refractive index was by measured by a prism method using physical relationships and MATLAB techniques to identify the critical angle for total internal reflection. The characterization system was given fine control over the incident angle by using a Z-type 2-mirror assembly. Polymeric grating coupler devices were fabricated in-house both to test the system and to evaluate the grating coupling and waveguiding capabilities of the devices.

Eric Bogenschutz: Chemical & Biological Engineering
Mentor: William Inskeep - Land Resources & Environmental Sciences
Mechanisms of Oxidative Stress Response in the Thermoacidophilic Crenarchaeon Metallosphaera yellowstonensis

Reactive oxygen species (ROS) are a group of free radical oxygen-based compounds found in all environments and organisms. Though ROS occur naturally, terminal oxidase complexes and enzyme-facilitated pathways form intracellular ROS, thus organisms have evolved specific enzymes to prevent these powerful oxidants from damaging cellular components (e.g., DNA). The most well-known reaction that produces ROS is the Fenton reaction, in which Fe(II) is oxidized by H_2O_2 to Fe(III) and produces the hydroxyl radical, $OH^{\cdot}$. Many lithotrophic *Archaea* and *Bacteria* are able to use Fe(II) as an energy source, including novel crenarchaeota found in the geothermal springs of Yellowstone National Park (YNP), WY, USA. *Metallosphaera yellowstonensis* is an autotrophic, Fe(II)-oxidizing crenarchaeon found in numerous thermoacidic, iron oxide habitats in YNP. The goal of this project is to investigate the effects ROS have on the transcription and regulation of enzymes that guard against the detrimental effects of ROS. Specifically the degradation of H_2O_2 by the enzyme 1-cys peroxiredoxin (1-cysPrx), shared by all three domains of life, will be used as the primary transcriptional target. Transcription levels and degradation of H_2O_2 in *M. yellowstonensis* will also be compared to another crenarchaeon *Sulfolobus islandicus.*

Initial experiments spiking *S. islandicus* with 20 µM H_2O_2 show an increase in the expression of 1-cysPrx with a peak at 60 minutes post H_2O_2 addition. We believe when this experiment is repeated on *M. yellowstonensis* the rate of H_2O_2 degradation will increase and a peak in 1-cysPrx expression will be seen closer to the initial addition of H_2O_2.

Acknowledgements: Jacob Beam (Doctoral Student) - Land Resources & Environmental Sciences

Michael Bonde: Mechanical & Industrial Engineering
Mentor: Ron June - Mechanical & Industrial Engineering
Mouse Knee Pressure Distribution Sensing

Osteoarthritis (OA) is a degenerative joint disease involving deterioration of the articular cartilage that lines the surfaces of bones in joints such as the knee and the hip. The June laboratory is studying cartilage mechanobiology to understand how axial loading may affect osteoarthritic cartilage. Mouse models of osteoarthritis are often used to study the disease because of similarities to human models. While the link between altered mechanics and cartilage degeneration has been established in human joints, the small size of the mouse joint has prevented studies examining the mechanical contact pressure within the mouse joint. The objective of this project was to determine the spatial distribution of contact pressure within the mouse knee joint when stabilized and destabilized. This was done along with other June Lab projects such as flow cell re- manufacture.

Logan Boucher: Chemical & Biological Engineering
Mentor: Macur Rich - Center for Biofilm Engineering
Lipid and Proteomic Analysis of a Lignocellulosic Degrading Fungi

A mixture of extremophilic fungi have been shown to be highly efficient for converting lignocellulosic feedstocks to oils (lipids) that can be transformed to biodiesel. Montana State University and Sustainable Bioproducts LLC are working together to further optimize the fungal mixture for maximum conversion to oil. Understanding the lipid profiles produced by the fungal mixture, especially the high-value oils, is an important step toward commercialization of the process. Furthermore, understanding of the enzymes and enzyme systems responsible for degradation of lignocellulose will provide important information that can be used to optimize conversion rates. Lipids were extracted using various techniques, transesterified, and analyzed using gas chromatography-mass spectroscopy (GC-MS) and gas chromatography-flame ionization detection (GC-FID). The combination of these GC methods enabled a thorough characterization of lipid profiles, which included high-value lipids such as vaccenic acid. Protein profiles were identified by precipitation of secreted proteins and purification followed by shotgun sequencing with the MS-MAXIS instrument at the MSU Mass Spectrometry, Proteomics, and Metabolomics Facility. Proteomic data were analyzed using an OPEM-MS pipeline that I have been developing with Drs. Rich Macur, Mark Kozubal, and members of the proteomics facility. This pipeline allowed for label free quantification and identification of proteomic data and enabled us to determine that the fungal mixture relies on a unique suite of enzymes to degrade lignocellulose. When fully developed the pipeline will be a valuable tool for proteomics work at MSU.

Ryan Brandt, Karen Igo: Computer Science
Mentor: Clem Izurieta - Computer Science
A mobile and web enabled application to help with organization and academic excellence

The “Academic Excellence” software application is designed to help students achieve academic excellence with the aid of technology. This application provides a simple interface that facilitates coursework organization, time management and performance tracking. While grading software applications exist in the market today, they do not fully integrate with typical features such as calendar, clock, reminders, and web technologies. It includes functional features which track assignments attributes (e.g., due date, point worth), calculates grade progression and forecasts pass/fail using a simple linear regression. Other features include integration across multiple platforms, an all inclusive, sortable assignment list (for quick access), an integrated calendar and alarms, priority recommendations for the student, a secure server interface and data synchronization over all devices.

Grace Caldwell, McLain Leonard, Lik Ming Aw (Graduate Student): Mechanical & Industrial Engineering, Chemical & Biological Engineering
Mentor: Roberta Amendola, Paul Gannon - Mechanical & Industrial Engineering, Chemical & Biological Engineering
Synthesis of Cr_2AlC MAX-phase protective coating on nickel-based super alloys in low temperature hot corrosion via magnetron sputtering

Jet propulsion engine systems are crucial for the execution of NASA missions. The components of these systems are frequently subjected to extreme conditions. Turbine blades can be exposed to temperatures up to 1700^{o} C, pressures up to 10 MPa, and supersonic gas velocities. Material selection is crucial for ensuring the durability of the system. Nickel-based super alloys are often used to construct turbine blades because they are relatively inexpensive, lightweight, and mechanically durable. A critical limitation of jet propulsion systems is susceptibility to "hot corrosion," an accelerated form of corrosion resulting from high temperature exposure, reaction of airborne salt contaminants and oxidized sulfur impurities, that leads to the formation of a detrimental molten salt on the surface of engine components. Low temperature hot corrosion (LTHC) takes place between temperatures of 600-800^{o}C. Protective thin-film coatings may be effective in preventing hot corrosion from rapidly degrading nickel-based super alloys. Mn+1AXn (MAX) phase coatings (Cr_2AlC, in particular), which combine advantages of both metals and ceramics, have been proposed as a potential solution due to favorable coefficients of thermal expansion (CTE) and oxidation resistance. This research project aimed to utilize low-pressure magnetron sputtering to stoichiometrically deposit ~1 µm Cr_2AlC on Ni 201. Coated Ni 201 samples were then exposed to a SO_2/air mixture at 700^{o} C with and without NaCl salt deposits. Surface characterization and cross-sectional analysis were conducted using FE-SEM and XPS.

Connor Dack: Electrical & Computer Engineering
Mentor: Brock LaMeres - Electrical & Computer Engineering
Designing and Benchmarking Space Imagining Algorithms through the use of the Montana High Performance Computing Cluster

This research covers the design of an image compression algorithm that is optimized for the use on a Field Programmable Gate Array (FPGA). The algorithm uses the input of a bit map created by the camera that is attached to the stack of circuit boards which also house the FPGA and the power supply. The bit map is converted into an array of red, green, and blue codes that create the JPG image. The conversion of the bit map was completed through a series of loops and calculations within the algorithm. The algorithm was then tested on the Montana High Performance Computing Cluster at Montana Tech in Butte, Montana. The results will be used as the baseline for testing the algorithm on the FPGA. The final application of both the FPGA and the image compression algorithm will be space imaging.

Matt Danczyk: Mechanical & Industrial Engineering
Mentor: Sarah Codd - Mechanical & Industrial Engineering
Experimental Two-Phase Flow Through A Porous Medium

Demonstrations of numerical simulations and a mean field calculation show that immiscible two-phase flow in a porous medium behaves effectively as a Bingham viscoplastic fluid. The new theory claims the correct relation between change in pressure, across the porous medium, and the capillary number (Ca) scales as a power law with two distinct flow regimes. Previously done experimental work on two-phase flow through a porous medium in a low Ca system confirms the lower scaling regime that the theoretical work predicted. To experimentally verify simulations of the two distinct flow regimes, and expand upon previous experimental work, a more comprehensive range of pressure drops scaled as a power law with the Ca must be tested. To do this a high pressure bead pack was constructed to reach the high Ca regime while still having the resolution for the lower flow regime. A conclusion has not been reached yet as to whether or not theoretical calculations correctly model two-phase flow through a porous medium.

Acknowledgements: Joshua Bray (Postdoctoral Researcher) - Magnetic Resonance Lab

Ryan Downey: Electrical & Computer Engineering
Mentor: David Dickensheets - Electrical & Computer Engineering
The Carrion Interferometer

The ability to determine precise information regarding the topography of an object is of special interest to optical engineers designing mirrors and lenses. Michelson interferometers are typically used to accomplish this task, however, circumstances sometimes arise that require an expansion of measurement techniques. The Carrion interferometer was built in order to simultaneously measure the shape of both sides of a dual-sided pneumatic MEMS deformable mirror and to overcome issues of usability and functionality present in an original single view interferometer design. This was accomplished through the use of LabVIEW, MATLAB, and optical components purchased from THOR Labs. The Carrion interferometer operates using a single laser whose beam path is divided in two for imaging. These beams are diffused, further divided into two equal paths that are reflected off the system's imaging object and reference mirrors, and captured by two CMOS cameras for computer processing of the resulting interferograms. During testing, the imaging object is stepped forward in order to obtain quantitative height and shape information via a technique known as phase shifting. Through the use of this setup, both height and Zirnike mode data can easily be obtained for both sides of an object being investigated. The Carrion interferometer has proven an essential aid in simultaneously obtaining data for both sides of the dual sided pneumatic MEMS mirror.

Acknowledgements: Scott Allen (Undergradaute Student) - Electrical & Computer Engineering

Gerrit Egnew: Chemical & Biological Engineering
Mentor: Brian Bothner - Chemistry & Biochemistry
Thermal Characterization of VP1 N-terminal Domain in Parvovirus Capsids

Viruses exhibit many properties critical to biomedicine, nanomaterials, and pharmaceuticals. To these ends, the viscoelastic properties under thermal and pH-dependent conditions of virus capsids must be understood. Investigation of the P-22 bacteriophage as a model system is useful because it is a good model system: the virus has various structural forms which relate to the maturation process which all icosahedral virus capsids undergo. Thus, the study of P-22 clarifies the forces responsible for virus particle maturation, a critical step in engineering capsids. P-22 is being studied as a platform for nanomaterials and as a vector for gene therapy and drug delivery. QCM-D provides unique information about the viscoelasticity of capsids. This research utilizes QCM-D to understand viscoelasticity changes during pH change. The effect of proteases on viscoelasticity is also a focus. The information gained in this research will impact the development of viruses as active nanomaterials and in biomedicine.

Nathan Fritz: Mechanical & Industrial Engineering
Mentor: Dave Miller, Doug Cairns, Daniel Samborsky - Mechanical & Industrial Engineering, Chemical & Biological Engineering
An Investigation of the Effects of Bond Line Thickness on the Strength of Scarf Joints

Composite materials are being used with increasing frequency in industries from the aerospace industry to the automobile industry; anywhere a strong, lightweight material is desirable. As composite materials such as carbon fiber and fiberglass laminates become more common, finding an effective way of repairing damaged composites is gaining importance. One such method involves the use of scarf joints. To repair a part, damaged material is cut out at an angle and replaced by new material bonded to this angled surface. However, currently these joints require a very thin layer of adhesive joining the repair material to the damaged part. The process would be much more versatile if it could be shown that the thickness of this adhesive could be increased without an unacceptable decrease in strength. Carbon fiber unidirectional samples were joined with a 5 degree scarf and bond line thicknesses of 0.01 to 0.05 inches. Resulting ultimate strengths ranged from 3.39 ksi for the 0.01 inch bond lines to 2.76 ksi for the 0.05 inch bond lines. Crack initiation occurred from 2.78 ksi for 0.01 inch bond lines to 1.98 ksi for the 0.05 inch bond lines. In general, stress and strain to crack initiation decreased with increasing bond line

thickness by about 45 and 35 percent, respectively. However, since the repaired strength is around one percent the strength of an undamaged composite, this may be an acceptable drop for improved manufacturability.

Acknowledgements: Tammy Ritchey (Graduate Student) - Mechanical and Industrial Engineering

Edgar Gamero: Chemical & Biological Engineering
Mentor: Rich Macur - Center for Biofilm Engineering
Lipid production from fungal mixture ENV1

This research served to further develop our understanding of uses of a fungal mixture (ENV1) that efficiently converts a variety of wastes and organic compounds to oils (lipids) for the production of biodiesel. A variety of carbon substrates were tested to evaluate growth and oil production by ENV1. Growth of ENV1 was evaluated in 250 mL baffled shaker flasks in 100 mL of Mandel's basal media under aerobic conditions. Naphthenic acid, a toxic contaminant common in the oil extraction industry, was added at 2% (vol/vol) and significant, although slow, growth was observed. The ability of ENV1 to use methanol as a substrate was also tested. Results showed that ENV1 efficiently converts methanol into lipids. This finding has significant implications for biodiesel production from lipids since waste methanol is produced in the lipid to biodiesel conversion (trans esterification) process. Another by-product of trans esterification is glycerol, and ENV1 was shown to efficiently grow on this substrate and convert it to lipids. Cyanobacterial biomass also served as a good feedstock for oil production. These results reveal that ENV1 can convert a wide variety of materials to lipids for biodiesel, and thus, furthered our understanding of potential commercial applications for this unique fungal mixture.

Emma Garcia: Chemical & Biological Engineering
Mentor: Michelle Flenniken - Plant Sciences & Plant Pathology
Honey Bee Host Response to Virus and Agrochemical Stress

Recent losses of US honey bee colonies are associated with increased pathogen incidence and abundance, though a specific etiologic agent remains elusive. One hypothesis is that a combination of pathogenic and environmental factors contribute to honey bee colony losses. To investigate the effect of agrochemical exposure on the severity of virus infection, and to examine the potential of viruses to serve as biomarkers for honey bee health, bees were exposed to these two stresses in a controlled laboratory setting. Honey bees were infected with a model virus, *Sindbis* virus tagged with green fluorescent protein (SINV-GFP), and exposed to five different agrochemicals in field relevant doses via their diet: one fungicide composed of boscalid and pyraclostrobin used to control almond pathogens, two neonicotinoid insecticides, one pyrethroid insecticide, and fungicide used to control microsporial infections in bees. Three days post infection, the relative abundance and distribution (i.e., head, thorax, and abdomen) of virus in individual bees was determined by Western blot and quantitative PCR (qPCR). Surprisingly, results to date indicate that bees exposed to neonicotinoids had less severe virus infections compared to controls, although the degree of variability in virus genome copy number between bees was high. The virus copy number in bees exposed to the fungicide and the pyrethroid insecticide also varied in individual bees, but was on average lower than the amount of virus detected in bees that were not exposed to agrochemicals. Overall our results suggest that copy number of this model virus may not reflect the sublethal affects of agrochemicals on bee health and/or that the amount of agrochemicals ingested by the bees in these studies was not sufficient to lead to an increase in viral titer. Additional studies are needed to more fully understand the potential relationship between agrochemical exposure and pathogen abundance in honey bees.

Joshua Gosney: Chemical & Biological Engineering
Mentor: Jeffrey Heys - Chemical & Biological Engineering
FEM of Microbubbles in biological flows

The NIH estimates that 80% of all persistent infections involve bacterial biofilms. The approach studied here examines the potential of targeted microbubbles, with specific antibodies covalently linked to their surfaces for use as an ultrasound contrast agent and drug delivery vehicle. Microbubbles have been researched for the detection and treatment of carcinomas and atherosclerotic plaque, but until now virtually no research has been

conducted on their use for detection or treatment of biofilm infection. Additionally this project will provide the first flexible model for determining the forces on microbubble conjugates in the vascular system. Previous work conducted by the author include investigating the usability of analytical force equations have indicated some promise, but more comparison and analysis is required to determine the usefulness of those equations. Non-Newtonian viscosity and time dependent flow parameters were fitted to the model, and were determined to be relatively insignificant. There were two objectives to the current work. The first is to finish the comparison of the Stokes drag law and the numerical results, and possible using the numerical results to create a modified empirical equation that may be useful for research scientists throughout a range of Reynolds numbers. The second objective of this research is validate both the FEM model and the correlation by comparing their predictions of microbubble attachment to experimental measurements.

James Gray: Chemical & Biological Engineering
Mentor: Ross Carlson - Chemical & Biological Engineering
Synthetic Escherichia coli Consortia and Emergent Properties

Naturally occurring microorganisms almost exclusively grow as a consortium. These interactions are expected to result in emergent properties including enhanced stability and nutrient usage efficiency. However, natural consortia are typically very complex, comprised of hundreds or thousands of interacting microbes making their study very difficult. To address this complexity, *Escherichia coli* strains were constructed to mimic naturally occurring functional guilds with a division of labor that permits noncompetitive use of electron donors and electron acceptors. The project tests our hypotheses of increased robustness and nutrient usage in artificial consortia through colony biofilm and batch culturing. Although previous research on engineered consortia has reported on the simultaneous conversion of differing electron acceptors, it has not addressed beneficial nutritional exchanges of noncompetitive consortia. Future applications of working consortia include enhanced biofuel production, fermented food products, wastewater treatment, and specialty chemicals.

Acknowledgements: Stephen Davis (Undergradaute Student) - Chemical & Biological Engineering

Lana Hoagland: Electrical & Computer Engineering
Mentor: Phillip Himmer - Electrical & Computer Engineering
Nanopositioning of a Optical Translation Stage

This project involved developing a computer controlled piezoelectric stage. This stage is part of a phase shift interferometer system, capable of nanometer precision surface profilometry measurements to be used by the Montana Microfabrication Facilities(MMF) for thin film characterization. Due to the sensitivity of the optical measurements being made by the interferometer, the phase shift stage is required to have precise translation with uniform motion, translating every point of the optical stage assembly equally within a few nanometers. This device will use three independent piezoelectric elements to control the positioning of the interferometers reference flat. Due to the independent nature of the piezoelectric elements, each element will have a different sensitivity to the applied voltage. Consequently, each piezoelectric element must be capable of independent voltage adjustments, gain, and offset to ensure each element actuates the same amount. A computer interface will control the voltage sources to provide ease of use and a higher precision.

Acknowledgements: Sarah Mondl (Undergraduate Student) - Electrical & Computer Engineering

Wyatt Holmes: Mechanical & Industrial Engineering
Mentor: Joseph Shaw - Electrical & Computer Engineering
Micro Wind Turbine Power for Infrared Cloud Imager Instrumentation

The Optical Remote Sensor Laboratory (ORSL) operates a variety of atmospheric sensing instruments in a wide range of environments including the Arctic. One such instrument is the Infrared Cloud Imager (ICI) which is used to collect cloud cover data day and night. At remote Arctic installations alternate power sources must be used to achieve continuous operation. Wind is the most feasible method for obtaining remote power in the arctic winter. This project explored using a small wind power system. A model was created using MATLAB to determine required

generator size. It simulated power output based off of wind data from Barrow, Alaska and Ampair 100 and 300 watt turbine power curves. The 100 watt turbine proved acceptable and entered the testing phase. For indoor tests of power versus temperature, a CIM AM802 12 Volt motor and Jaguar motor controller were selected. The Space Science and Engineering Lab has a small cold chamber that was determined as suitable to run these tests. Mechanical setup was performed in preparation for outdoor field testing at the ZERT weather station. The wind turbine will be mounted on an 8 foot tall tripod secured with three guy wires. The tripod is located approximately 30 feet north-east of the ORSL anemometer, to provide wind speed for comparison. A Campbell Scientific CR1000 data logger will be used for data collection in both tests. CR Basic was used to code the data collection routine, obtaining wind speed, turbine revolution speed, power output, and amperage measurements. Amperage and power will be obtained using a power resistor setup that was designed for this task. To measure generator RPM, a circuit was developed around an Omtron Photodiode proximity sensor. Wind data will be available from the anemometer at the adjacent station.

Chaitanya Johar: Mechanical & Industrial Engineering
Mentor: Mark Anderson - Agricultural Economics & Economics
Examining Economics Students' Psychology Using Recycling Preferences as a Test Mode

A fundamental trait assigned to economists is that of possessing and exuding the rationality to weigh marginal benefits against the marginal costs of a specified action. Due to the existence of such a characteristic, economists are expected to only execute an action should the anticipated benefits outweigh the costs. While economists are not to be confused with accountants, such a pragmatic trait often does dissociate into monetary terms. When in full command of a decision, economists may be expected to choose to trade off social benefit for self private gain. This hypothesis may spring due to an innate feature amongst the population that chooses to study economics or it could spark through the time spent in studying economics. The purpose and motivation of this study rests on determining whether economists place preference to individual good over that of society. Should such a hypothesis be proven to be true (through data accumulation and statistical analysis), the root causes will be studied. The mode used to study differences in the populations is that of recycling because recycling is a widely understood phenomenon that positively affects society. This study juxtaposes the perception of economics students to recycling with that of other majors.

Katherine Kent: Chemical & Biological Engineering
Mentor: Jennifer Brown - Chemical & Biological Engineering
Rheological Characterizations of Polymer-Particle Dispersions with Silicon Dioxide Nanoparticles

Locust bean gum (LBG), and combination locust bean gum/xanthan gum (LX) solutions of 1% by weight were mixed with and without silicon dioxide (SiO_2) nanoparticles, d_p=10-20 nm, at varying weight percentages and then rheologically characterized using linear and non-linear rheology. LBG and xanthan gum (XG) are biopolymers with a wide range of applications and are of interest due to their use in the food industry and potential in drug delivery systems and pharmaceuticals. When combined with SiO_2 these polymer-particle dispersions have been shown to exhibit unique rheological properties not seen in the polymer solutions alone. A variety of steady state flow tests, frequency sweeps, and temperature sweeps were completed to elucidate the viscoelastic qualities of these biopolymers. A new rheological method was learned in order to obtain more accurate information on how temperature affects these polymer systems; this involved the use of mineral oil placed around the geometry to mitigate dehydration artifacts seen in previous data. In solutions of locust bean gum, the introduction of mineral oil in solutions containing nanoparticles resulted in a more realistic increase in viscoelasticity as the temperature was raised. Also, an increase in viscosity and viscoelasticity was seen with higher concentration of silicon dioxide nanoparticles as evidenced by steady state flow tests and an increase in storage and loss moduli.

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Kostyantyn Kravchenko: Electrical & Computer Engineering
Mentor: Wataru Nakagawa - Electrical & Computer Engineering
Optical Sensing Using Surface Electromagnetic Waves

The Surface Plasmon-Polariton (SPP) is a type of Surface Electromagnetic Wave that can be observed at a conductor/dielectric boundary under certain optical conditions. The SPP effect is already being used in the Nano-Optics lab to successfully measure the refractive indices of several materials. The purpose of this project is to improve the stability and sensitivity of the existing laboratory setup. This achievement would extend the list of materials we could measure, which would benefit multiple MSU departments and students interested in optics.

Samuel Kuhlin: Mechanical & Industrial Engineering
Mentor: Erick Johnson - Mechanical & Industrial Engineering
Design and Optimization of a Vertical Axis Water Turbine

The area of hydrokinetic energy is a consistently expanding field of engineering. There is evidence to suggest that while widely known horizontal axis water turbines are applicable in hydrokinetic areas, they are not as optimal as their vertical axis counterparts. This evidence supports vertical axis water turbines in regards to both mechanical strength and overall power output. The focus of this project was to explore these two design considerations by means of computational fluid dynamic (CFD) software, in an effort to develop an optimal turbine design that could impact the hydrokinetic energy community. This research was primarily performed through an open-source turbine simulation program developed by Sandia National Laboratories called CACTUS. The program was utilized to inspect hundreds of separate design scenarios with unique power curves to determine an optimal turbine design for conditions that could be reproduced here at MSU in the civil engineering flume. These scenarios included multiple parameters which accounted for both alterations in rotor geometry as well as flow conditions. The design that resulted from the low-order CACTUS program was then imported to STAR-CCM+, a separate high-fidelity, commercial CFD program, to verify the results and further analyze more complex parameters such as stress distribution. This final design will soon be manufactured via 3-D printing techniques on campus to create a standalone rotor that can be tested in the civil engineering flume via a mounting and instrumentation device being separately designed and fabricated by a mechanical engineering capstone group. The results of this experiment will be compared to the CFD data from this project to effectively lay the groundwork for future hydrokinetic research projects at MSU.

Jesse Lee: Electrical & Computer Engineering
Mentor: Wataru Nakagawa - Electrical & Computer Engineering
Development of Phase and Polarization Resolved Measurement System for use in Optical Nanostructure Characterization

Silicon nanostructures with engineered optical properties are useful for compact, highly integrated systems, and have potential in the fields of medical imaging and microscopy. The Nano Optics group at Montana State University is currently fabricating Nanostructures for use in small profile applications, and need an informative characterization system when optimizing fabrication processes. We've developed a system for reading these devices that takes phase resolved measurements as a function of wavelength. This system was based on both a previous system designed to read Polarizing Beam Splitters as a function of wavelength, and the Mach-Zehnder Interferometer. We report on the final system, as well as the results of characterizing a Reflective Quarter Waveplate.

Neil Liotta, Kirkwood Donavin (Graduate Student), Jake Ebersole, Colin Gaiser, Alexander Paterson: Chemical & Biological Engineering, Economics, Sociology, Business
Mentor: Sarah Janzen - Agricultural Economics & Economics
Assessment of Health, Educational, Agricultural, and Psychosocial Outcomes from Engineers Without Borders' Water and Sanitation Projects in Khwisero, Kenya

Since 2005, the Montana State University chapter of Engineers Without Borders (EWB) has implemented eight deep water wells, 11 composting latrines, one biogas latrine, a rainwater catchment system and a water distribution pipeline for primary schools in the District of Khwisero, in western Kenya. They do so because it is well documented that the rural poor in developing countries spend a significant portion of their daily lives collecting water and that the leading cause of childhood mortality throughout the developing world is due to waterborne pathogens. However, aid organizations have a poor track record of projects with good intentions falling to ruin or not providing the intended positive effect. The goal of this research project is to analyze the health, educational, agricultural and psychological well-being of communities in Kenya to discern the outcomes of EWB interventions. The evaluation will analyze biological and economic indicators of households who benefit from an EWB project, relative to those who do not. A household survey and an appropriate sampling strategy have been developed. Additionally, past data sets from EWB have been analyzed in order to establish a baseline. Fieldwork this summer will involve the implementation of the surveys by native Kenyan enumerators, followed by data entry and evaluation during the following winter. The results of this research will provide direct feedback as to the efficacy of EWB's intentions. It will also guide future EWB projects and produce publishable research to contribute to the field of development economics.

Gavin Lommatsch: Electrical & Computer Engineering
Mentor: Joseph Shaw - Electrical & Computer Engineering
Infrared Cloud Imager Data Analysis for Optical Satellite Communication

As technology develops, satellites become more and more complex, gathering greater amounts of data at an increased rate. Due to this increase, radio communication is unable to provide the required data transfer speeds. Therefore, satellites have begun to be equipped with optical communication channels which allow for much higher data transfer rates. However, clouds can disrupt the optical signal anywhere from attenuating the optical signal to completely breaking any communication link. The Infrared Cloud Imager (ICI) can be used to measure cloud coverage and cloud optical properties at optical communication sites. One such ICI unit has been deployed at the Table Mountain Facility run by the NASA Jet Propulsion Laboratory. The data recorded from 2010 to 2013 by this ICI unit has been analyzed through a series of MATLAB processing algorithms to provide measurements of cloud spatial patterns as a function of time, cloud optical characteristics, seasonal variability, as well as other forms of statistical analyses.

Michelle Meagher: Chemical & Biological Engineering
Mentor: Brent Peyton - Chemical & Biological Engineering
Analysis of Selenium Reducing Microbial Communities in Mine Waste Rock

The dynamics of microbial community structure in mining environments have important implications in selenium discharge into watersheds surrounding mine facilities. In this study, the abundance and biodiversity of bacterial populations in mine waste rock was examined to assess their potential involvement in the sequestration of certain constituents of interest, specifically selenate, nitrate, iron and sulfate. Of particular interest was detecting selenium-reducing microorganisms. 16S- based rRNA community analysis of samples recovered from eight tailing columns was done to determine changes in bacterial population composition and relative abundance as a result of varying parameters and column stratification. The columns were filled with either mature or fresh tailing material samples, or sand as a control material, and fed with water impacted by mining activities and known to contain elevated selenium concentrations. Following initial operation, selenium removal in the columns was increased by carbon addition in the form of ethanol or silage tea. The genetic material extracted from various depths of each column was amplified using polymerase chain reaction (PCR), and analyzed by high throughput sequencing. Analyses of refined sequences showed microbial communities shifting as a result of varying operational and

construction parameters. Abundant bacterial populations with the metabolic capability to reduce selenium were found, occurring in association with carbon supplementation treatments. This information provides insight on how native bacterial populations in mine tailings might be utilized in the sequestration and stabilization of selenium.

Joshua Meyer, Benjamin Adams: Computer Science
Mentor: Clemente Izurieta - Computer Science
An Application to Facilitate Communication Between Physical Therapy Agencies and Their Clients

Many people throughout their lives require the services of physical therapists. After services are rendered, some of the information communicated in the therapy sessions may not be easily recalled, and paper based notes cannot be updated without recurring visits. This can be costly for both therapists and clients. A new tool is necessary to better facilitate the communication between clients and therapists. A growing abundance of technology within homes and businesses allows for the development of a modern communication tool. The proposed application is designed with the intent of providing high usability. By using an open source resource management system, MediaWiki (www.mediawiki.org), custom API software, and a visually pleasing user interface, all users will experience marked improvements over the status quo. The application will be available on numerous platforms with a focus on smartphones and tablet devices. Development of distribution channels and a centralized information database will provide users with an easy and helpful way to manage the information they need. The commercial ready application will give users greater satisfaction by offering additional control and easier access to relevant information.

Scott Miller: Electrical & Computer Engineering
Mentor: Randy Larimer, Berk Knighton - Electrical & Computer Engineering, Chemistry & Biochemistry
Control and monitoring of a near-space balloon payload using the Iridium satellite network

A presentation on a MSGC BOREALIS student project to track high-altitude balloon payloads using an Iridium network satellite modem to send and receive data from a payload at up to 90,000 ft. Ground station software was created to facilitate two-way communication with a webserver and database system set up to receive and store data. This information was then plotted on a Google Maps overlay and updated dynamically allowing anyone to view the location of the balloon via a website on the internet. The presentation will detail challenges, methods, and results of the project. An ancillary project utilizing ultrasonic sound waves to measure temperature during a high-altitude balloon flight will also be presented. Temperature measurement at altitude is a challenging task with several environmental factors influencing the measurement. The measurement device utilizes a microprocessor and ultrasonic transducer to measure the speed of sound. This measurement is then used to calculate ambient temperature. Project goals, challenges, methods, results, and future work will be detailed.

Sarah Mondl: Electrical & Computer Engineering
Mentor: David Dickensheets, Phil Himmer - Electrical & Computer Engineering, Electrical & Computer Engineering
Phase Unwrapping in Image Processing

Phase wrapping is a large problem in systems with any sort of frequency variation,as a distorted phase front can cause the appearance of features that are not there, or obscure features that are. This occurs even when the spread of frequencies being used is very small, and errors in the image produced by phase wrapping are cumulative. Because of this any phase wrapping can be extremely detrimental to the image quality and each image can have thousands of wraps making an unprocessed image unusable, and sometimes even unrecognizable. The MatLab program developed takes five images collected by a phase-shifting interferometer, and processes them to remove phase wrapping, and constructs a three dimensional model of the surface being imaged. This enables very precise measurement of thin films, surface morphology, and wafer curvature.

Acknowledgements: Lana Hoagland (Undergraduate Student) - Electrical & Computer Engineering

Sarah Mondl, Lana Hoagland: Electrical & Computer Engineering
Mentor: David Dickensheets, Phil Himmer - Electrical & Computer Engineering, Electrical & Computer Engineering
Optical Analysis of Aluminum Nitride Thin Films

This project is an optically based system that measures various aspects of Aluminum Nitride thin film characteristics. The design of this system is based on the principles of a Fizeau Interferometer and measures surface contours by using an optical flat and a laser to create interference fringes that are then imaged and used to create a model of the surface being measured. As the wavelength of the laser is known, the fringes can be used to create a highly accurate three dimension model of the substrate of interest. This model can then be used to characterize a thin film by measuring the surface curvature, surface morphology, and film thickness. This is useful in film stress measurements, wafer analysis for MEMS devices, and film characterization.

Nathan Murphy: Chemical & Biological Engineering
Mentor: Brent Peyton - Chemical & Biological Engineering
Long Term Cryopreservation of Algal Cultures

Culturing algae in laboratory conditions requires consistent transfers in liquid media to keep the algae in a growth phase and in a condition that allows them to be studied. Not only is it time consuming, it may also lead to possible contamination. A proper method for cryopreservation has the potential to more effectively maintain axenic algal cultures, as well as avoid genetic drift that may occur over successive transfers. One goal of this project was to determine a staining technique to obtain live/dead counts for green algae and diatom cultures, to more accurately determine a percent viability. The primary focus of this project was to vary several parameters in the University of Texas cryopreservation method to determine an optimal methodology resulting in the highest percent viability for the cultures. The chilling time and concentration of methanol were varied from this procedure to determine an optimum. Cultures were stored in cryopreservation for one year before being revived. The results of showed a preference of a six hour chilling time in a five percent methanol solution. In addition, as a cryo-medium, glycerol and DMSO were also tested as a substitute for methanol. Once an optimal method was determined, the growth rate of cultures was observed before and after cryopreservation to determine effects of cryopreservation on the rate of cell growth.

Nichole Murray: Mechanical & Industrial Engineering
Mentor: Berk Knighton - Chemistry & Biochemistry
The Daring Story of Taking High Altitude Balloons To New Horizons

Researching at the edge of space is an area that intrigues human minds. Two types of high altitude balloons can accomplish this: the traditional, latex sounding balloon which expands until it bursts, and the fixed volume zero pressure balloon, which expands to the capacity of the fixed volume and then vents out excess helium. The zero pressure balloon and its payload become neutrally buoyant and float at a nearly constant altitude until the flight is terminated. My project was to create a valve system to vent helium that would allow us to transform the traditional latex balloons into the rare and coveted zero pressure balloons. Several initial valve systems were created and tested. These valves worked well on smaller prototype balloons but lacked the capacity to vent our standard balloons. A modified valve with greater conductance was constructed and demonstrated the capability of venting sufficient helium to keep the balloon from bursting. When this valve and its control system is completed it will open countless doors for more scientific research at high altitudes, allowing experiments sent up on the balloons to float about 90,000 feet for extended periods of time, collecting more data and allowing for improved research results.

Acknowledgements: Tim Basta (Undergradaute Student) - Mechanical & Industrial Engineering

Nate Norberg, Brian Maher: Computer Science
Mentor: Clemente Izurieta - Computer Science
A Web-based Equipment Administration System for Music Technology

The Music Technology department at Montana State University has seen significant growth since its inception eight years ago. To help with the administration of its increasing equipment base, we developed a web-based checkout system. The existing system is paper based and inhibits the efficient administration and inventory of said equipment, creating potential scheduling conflicts and confusion. This web solution is a significant step forward that not only satisfies needed functionality, but it is also scalable by design and will allow for needed changes in future versions.

Taylor Oeschger: Chemical & Biological Engineering
Mentor: Joseph Seymour - Chemical & Biological Engineering
Growth and Isolation of Bacterial Alginate from Pseudomonas aeruginosa

The two strains of *Pseudomonas aeruginosa*, FRD1 and its mutant strain FRD1153, produce an extracellular polysaccharide alginate. Alginate is known to form a physical gel in the presence of divalent cations, such as Ca+2 or Cu+2. The formation of the gel from the bacterial alginates produced by the *Pseudomonas aeruginosa* is aided by the increased concentration of divalent cations, notably Ca+2 , that have been found in the pulmonary fluids of Cystic Fibrosis patients. This results in chronic infections of *Pseudomonas aeruginosa* that can be difficult to cure due to the protective gel layer. Nuclear Magnetic Resonance can be used to study the gelation of alginate produced by the *Pseudomonas aeruginosa* strains in order to characterize them and compare them to each other and to previously characterized algal alginates. In order to properly study these bacterial alginates they must be grown from the bacteria, separated, and purified using centrifuging, precipitations, and dialysis. This works details the procedure used to isolate the bacterial alginate to be used for further study.

Acknowledgements: Varsha Rao (Undergraduate Student) - Chemical & Biological Engineering

Chinomso Onuoha: Chemical & Biological Engineering
Mentor: Paul Gannon, Zach Gill - Chemical & Biological Engineering
High Temperature Corrosion of Chromium, Silicon and Aluminum on Nickel Base Metal

Hot corrosion is an accelerated oxidation of a metal at a high temperature induced by a thin film of a fused salt. This salt is commonly Sodium Sulfate (Na_2SO_4). Due to the ionic conductivity of the Sodium sulfate, hot corrosion can also be considered an electrochemical process. During the course of corrosion, sodium sulfate decomposes giving rise to acidic or basic fluxing of the protective oxide of the metal. Samples of Nickel coated with Aluminum, Chromium and Silicon were subjected to a high temperature of 900^{o}C in the presence of Sodium Sulfate salt. Changes in composition of the eutectic mixture above the metal samples were observed and estimated using the Field Emission Microscope (FEM) and the X-ray Difractometer. The change in mass for each sample was measured over time, and a graph of mass gain was plotted against time. Other similar samples without salt were heated to 900^{o}C over the same amount of time. These samples were used as a standard to check the extent of alteration and to better understand the science of high temperature corrosion in the salted ones.

John Pankratz, Will van Gelder: Chemical & Biological Engineering, Earth Sciences
Mentor: Jennifer Brown, Mark Skidmore - Chemical & Biological Engineering, Earth Sciences
Brinicle Formation in the Laboratory

Ice stalactites, or brinicles have been observed forming under first year sea ice in the Arctic and Antarctic. As sea ice forms, pockets of concentrated brine accumulate in the sea ice as solutes from seawater are rejected during the freezing process. The brines cool as ambient air and sea ice temperatures decrease to ~ < -10^{o}C; temperatures below that of surrounding seawater (-1.8^{o}C) because of a depressed freezing point due to increased brine salinity. When the brine pockets drain beneath the sea ice into underlying seawater that is at its freezing point, a hollow tube of frozen sea water forms around the descending stream of brine forming a brinicle. The continuous flow of

brine will result in the lengthening and thickening of the brinicle. This research investigates the ability to create brinicles and study their formation in a laboratory setting, following methods similar to those previously outlined. This involves the injection of cold brine into artificial seawater near its freezing point. However, our experimental set up is simpler and less expensive than in previous brinicle work with a view to creating an experimental protocol with wider applicability for educational/demonstration purposes. The addition of a fluorescent dye to the brine allows easy visualization of this process and the density and temperature differences with the artificial seawater. Brinicle formation rates and style were found to be highly dependent on the differences in salinity and temperature between brine and artificial seawater.

Todd Pedersen: Chemical & Biological Engineering
Mentor: Brent Peyton, Rob Gardner - Chemical & Biological Engineering, Center for Biofilm Engineering
Investigating culture effects of light irradiance and initial biomass concentration in Nannochloropsis Oceanica sp. using response surface methodology

Biomass produced from microalgae has the capacity to produce precursors for biofuels and bio-products and research in this field has been stimulated by a paradigm shift to renewable energy and sustainability. Biomass changes and content, such as chlorophyll, accessory pigments, and lipid concentrations, plays a major role in optimizing culturing strategies for industrial realization. With traditional scientific research, it is commonplace to control one variable and evaluate the response. Here, a statistical approach is demonstrated in which two control variables were investigated and results were used to generate three dimensional surface response plots. The two control variables investigated were the initial concentration of biomass and the available photosynthetically active radiation (PAR). A two-phase experiment was conducted with *Nannochloropsis Oceanica* sp. which involved a growth phase for bulk biomass generation and a re-suspension phase to investigate the two aforementioned parameters. Bulk culture was grown in a pH-controlled, fed batch reactor with daily NO_3^- concentrations monitored to indicate the needs for nutrient addition. This culture was grown until peak chlorophyll concentrations were accumulated and then concentrated and re-suspended for the second phase. During the re-suspension phase, eight different experimental conditions were investigated, each representing a different combination of culture concentration and available PAR. Initial biomass concentration were on the order of 1-3x10^8 cells·mL^{-1}, and available PAR ranged from 300-900 µmol Photons·m^{-2}·s^{-1}. Additionally, bicarbonate (HCO_3^-), an inorganic carbon source which has previously been shown to function as a lipid accumulation trigger, was added to promote neutral lipid accumulation. During the re-suspension phase medium pH, culture concentration, Nile Red fluorescence, medium dissolved inorganic carbon (DIC), chlorophyll concentration, and lipid content were monitored daily. Preliminary results have shown lipid accumulation on the basis of Nile Red fluorescence in all conditions with varying intensities, while rapid chlorophyll degradation has been seen in cultures with high light intensities.

Daiane de Fatima Piva: Chemical & Biological Engineering
Mentor: Colin Shaw - Earth Sciences
Supercritical CO_2 and anhydrite caprock interactions: Analyses of conditions for precipitation and dissolution.

This research intends to investigate the limits for precipitation or dissolution of an anhydrite caprock sample when exposed to supercritical carbon dioxide. Previous work has shown that the injection of CO_2 in sedimentary rocks does not change the mineral assemblage, but instead, leads to an increase in acidity and can cause anhydrite to precipitate. The conditions for minerals such as anhydrite to go through precipitation or dissolution, however, are very sensitive to the oxidation state of reacting fluids. Thus, reaction pathways for a decrease in acidity are not well known and further research is necessary. Our hypothesis is that, injection of supercritical CO_2 will produce precipitation of anhydrite when under reducing conditions and dissolution for oxidizing conditions. In order to test this hypothesis, a series of hydrothermal experiments will be performed. Supercritical CO_2 and fragmented anhydrite caprock will react inside serum vials at 50^o C and low pressure during 16 days. In addition, lab-synthesized brine and the following buffer materials will be added to different vials: L-cysteine, sodium sulfite, pyrite, limestone, sandstone and atmospheric oxygen. The analysis will be performed using X-ray microscopy (XRD), gas chromatography and Scanning Electron Microscopy (SEM) to look at the presence of solids and changes in acidity. Anhydrite is the nonporous rock layer responsible for preventing the CO_2 to migrate back to the

atmosphere and its dissolution can lead to the formation of pathways which allow the migration of CO_2 and further leakage. Therefore, knowing the conditions necessary for anhydrite dissolution can represent a useful tool to guarantee the caprock integrity and make carbon capture and storage a safe process.

Bryce Possiel: Mechanical & Industrial Engineering
Mentor: Erick Johnson - Mechanical & Industrial Engineering
Horizontal Axis Marine Current Turbine Design

Marine Current Turbines (MCT's) are being explored as a way of extracting energy from the ocean and other bodies of water containing consistent flows. Current MCT designs are often based off NACA wind turbine airfoils. Due to this, the efficiency of the blades is not idealized for use in a marine environment. My research focuses on exploring various turbine blade designs with environmental factors associated with under water operation, such as fluid density, incompressibility, and Reynolds numbers all taken into consideration. In order to accomplish this, various computational tools are required. A combination of Matlab and WT_Perf was used develop various blade profiles. The output of this process generates a variable airfoil profile with specific performance characteristics for different locations along the length of the blade. Using this data, the turbine blades were evaluated against each other to determine which designs were most efficient depending on inputs such as blade number configuration, fluid velocity and chord length. The next step of the study is to utilize solid modeling CAD software (i.e. Solidworks) to create 3-dimensional models of the various turbine blade designs. The designs will then be evaluated using computational fluid dynamics software to get a better idea of the true flow characteristics around the turbines.

Varsha Rao: Chemical & Biological Engineering
Mentor: Sarah Codd, Joseph Seymour - Mechanical & Industrial Engineering, Chemical & Biological Engineering
Modeling Flow Through Capillaries Formed by Heterogeneous Gelation of Algal Alginate

The alginate polymer naturally crosslinks and forms a rigid hydrogel structure in the presence of divalent cations such as Cu+2 or Ca+2. Alginate can be also be gelled heterogeneously to produce capillary-like structures within the gel matrix. As the gel matrix is not completely rigid, it creates a permeable membrane capable of molecular transport. The analysis of flow through the capillaries could also act as a model for fluids passing through other tissue-like substances. Varying parameters during gelation, including the type of cation, alginate concentration, and different ion-diffusion techniques, can drastically change the properties, such as size and organization, of capillaries. One method to control ion diffusion, the spray technique, involves spraying a fine mist of $CuCl_2$ or $CaCl_2$ solution to the top of the alginate solution, creating a thin layer of gel for the salt solution to pass through. The other requires the placement of a polystyrene membrane to mediate the ion diffusion. In both calcium and copper gels, the capillaries created using the spray technique were more ordered than the capillaries made using a polystyrene annulus for diffusion control. Furthermore, decreasing the concentration of alginate solution used in gelation increased the regularity and organization of the capillaries. Compared to calcium, copper ions are preferentially bound in alginate. The diffusion induced exchanges in the gel matrix were observed by introducing copper (II) chloride solution in a gel made with calcium (II) solution. The imaging of the capillaries and the mass transport of ions were performed using Nuclear Magnetic Resonance.

Acknowledgements: Matthew Sherick (Undergraduate Student) - Chemical & Biological Engineering

Brian Redman: Electrical & Computer Engineering
Mentor: Joseph Shaw - Electrical & Computer Engineering
Validation of a Low-cost All-Sky Infrared Cloud Imager

Information about cloud patterns is useful for Earth-space optical communications research. Thermal infrared sky imaging is a technique that records cloud patterns by measuring the heat radiation emitted by the clouds. This method is particularly well suited for continuous ground-based measurements of cloud cover statistics because it functions equally well during day and night. Sophisticated infrared cloud imagers have been developed previously at Montana State University, but there is an interest in exploring the capabilities of lower-cost systems. A low-cost

infrared cloud imager capable of imaging the entire sky dome has been developed. The system uses a metal dome to reflect the whole sky to an off-axis infrared camera. This poster describes the design of this all-sky infrared cloud imager and the algorithms created to remove the thermal infrared radiation emitted by the dome and correct for the angular and radiometric distortion introduced by the dome. This poster will show the comparisons between the data from the all-sky infrared cloud imager, LIDAR, and two different infrared cloud imagers. This data was taken over a period from 2012 through spring 2014 when the instrument was deployed at Montana State University.

Acknowledgements: Paul Nugent (Doctoral Student) - Electrical & Computer Engineering

Aaron Reynolds: Electrical & Computer Engineering
Mentor: Joseph Shaw - Electrical & Computer Engineering
Producing and Testing Infrared Cloud Imaging Systems

Optical communications offer far greater bandwidth and data rate compared to radio waves, the current method for most satellite to ground data transfer. The foremost issue with Earth-space optical communications is obstructions between the ground station and satellite, of which clouds are the most common. Thus, ground stations need accurate spatial and temporal data of local clouds. The Infrared Cloud Imager (ICI) thermally images the sky and processes the sky radiance data to identify the cloud attenuation to an optical communication signal. From cloud attenuation the viability of an optical communication link can be studied. I assisted in the construction and testing of four ICI systems for the NASA Jet Propulsion Laboratory (JPL) and the NASA Glenn Research Center. My role was primarily concerned with housing and interface fabrication as well as running the ICIs. In addition, I ported the Beaglebone microcontrollers from Angstrom Linux to Debian Linux. This device runs a server inside the instruments which operates as a data logger and system management service. Debian was found to support the necessary functions, as well being more stable than the Angstrom system. I also assisted in system validation. This involved running the MSU LIDAR, collecting data, and processing these data to compare cloud attenuation retrievals between the ICI instruments and the LIDAR system. Two of these systems have been shipped out for installation at the NASA JPL Table Mountain Facility.

Nathan Robertus: Computer Science
Mentor: Hunter Lloyd - Computer Science
A Design and Prototype of an Immersive, Virtual-Reality User Interface

The purpose of this project is to research and develop an augmented-reality user interface that allows a user to interact with a computer on a more tactile and intuitive manner. Our process was to implement three existing pieces of technology: the Oculus Rift, a pair of virtual-reality googles, the Leap Motion Controller, an infrared hand-motion sensor, and a camera system to project a representation of the surrounding environment into the field of vision of the wearer. Digital objects can then be interpolated into this visualization to provide the illusion that they are actually present in the environment. The Leap Motion controller can then be used to track hand movements and allow the user to manipulate the digital objects within their surroundings. To accomplish this project, we worked with a team of professionals at a local engineering firm. They provided guidance while working on both the hardware and software of the user-interface. The code is being written in an object-oriented language and the software serves to maintain the presence of the digital objects in the visualization and handles the data from the accelerometers in the Oculus Rift and the user input provided with the Leap Motion controller. Our preliminary conclusions suggest that this form of user interface could be a successful means of operating a computer but that it is quite difficult to provide a fluid, streamlined experience. Due to limitations of even the most modern virtual-reality equipment, this form of user interface is almost viable, but needs further development.

Amber Schmit: Chemical & Biological Engineering
Mentor: Christine Foreman, Markus Dieser, Heidi Smith - Chemical & Biological Engineering, Center for Biofilm Engineering
Nitrogen cycling in cryoconites from the Canada Glacier in the McMurdo Dry Valleys, Antarctica

On the surface of glaciers and the ablation zone of ice sheets worldwide aquatic miniature ecosystems can be found in the form of cryoconite holes. Cryoconite holes form when debris resting on the frozen surface gradually melts to an equilibrium depth in the ice. As such, they form a cylindrical depression filled with water and substrates. Intensive research has shown that cryoconite holes host a diverse mixture of autotrophic and heterotrophic community members capable of carbon production and transformation, and molecular evidence suggests the potential of a microbially mediated nitrogen cycle. The current investigation focuses on the nitrogen cycle within these aquatic ecosystems using culture dependent and culture independent assays. Cryoconite samples were obtained from Canada Glacier, McMurdo Dry Valleys, Antarctica, and brought back to Montana State University. To enrich for microbes involved in nitrogen fixation, nitrification, and denitrification, cryoconite sediments were suspended in various, selective growth media and incubated at 4^{o}C and 15^{o}C. Bacterial growth and nitrite production has been observed in the ammonia oxidation media. Isolation is in progress for Azotobacter and Rhizobium, two genera involved in nitrogen fixation. In addition, nucleic acids were extracted from cryoconite sediments. Currently, PCR amplification is being used to screen DNA templates for genes involved in the nitrogen cycle using primers specific for the nifH, amoA, nirS/nirK, nosZ, hao, and narG genes.

Matthew Sherick: Chemical & Biological Engineering
Mentor: Joseph Seymour, Sarah Codd, Jennifer Brown - Chemical & Biological Engineering, Mechanical & Industrial Engineering
An Examination of Microcapillary Formation and Coalescence in Diffusive Microbial Alginate Gelation using Magnetic Resonance

Alginate is a biopolymer isolated from brown algae and certain genera of bacteria, such as *Pseudomonas aeruginosa*. Research involving alginate is relevant to biotechnology and biomedical applications due to its ability to form a physical gel with divalent cations, such as Ca^{2}+ and Cu^{2}+. In this work, gelation properties of algal alginate and alginate from two mucoid *P. aeruginosa* strains are examined using magnetic resonance (MR) techniques. Each type of alginate studied differs in molecular structure and/or molecular weight, and differences in gel properties can be associated with these molecular variations. Gelation under diffusive reaction conditions has previously been conducted and examined for algal alginates, which allows for analysis of microscale structure formation, such as capillaries. Capillaries in algal alginate gel are ordered and have been shown to coalesce under certain conditions. This work details a similar study conducted on bacterial alginates. By varying the concentration of NaCl in aqueous solution with bacterial alginate, the coalescence and order of the capillaries is affected. Imaging techniques have primarily been used to observe capillary formation in each type of alginate gel. Additionally, a MATLAB program has been developed to generate data on high-resolution axial MR images of capillaries in algal alginates gelled with Cu^{2}+, including average capillary size and number of capillaries per gel. Thermodynamic growth laws that describe phase separation in binary liquids have been used to model this data, and the extent to which the model fits the data is discussed.

Acknowledgements: Varsha Rao (Undergraduate Student), Taylor Oeschger (Undergraduate Student), Joshua Bray (Postdoctoral Researcher), Michael Franklin (Associate Professor) - Chemical & Biological Engineering, Mechanical & Industrial Engineering, Microbiology & Immunology

Sean Stettner: Chemical & Biological Engineering
Mentor: Seth Walk - Microbiology & Immunology
Molecular typing of carbapenemase-producing Klebsiella pneumonia isolates by plasmid diversity analysis

Klebsiella pneumoniae is a Gram-negative bacterial pathogen that can cause serious nosocomial infections. Certain *K. pneumoniae* isolates have evolved resistance determinants such as carbapenemases, a beta-lactamase that degrades broad-spectrum antibiotics, so treatment options for clinicians are limited. The genes encoding

carbapenemases are harbored on transposons, which can allow resistance determinants to quickly disseminate through a population via horizontal gene transfer. Carbapenemase-producing isolates can then often acquire transposons harboring other resistance genes that degrade many beta-lactam antibiotics (extended-spectrum beta-lactamase producing isolates). Molecular typing methods have been developed to characterize *K. pneumoniae* outbreaks to understand transfer of these resistance determinants, but more discriminant techniques are needed. Here, we characterized 57 carbapenemase-producing *K. pneumoniae* isolates from patients at the Loyola University Medical Center (LUMC). Previously, multilocus sequence typing (MLST) and multilocus variable number tandem repeat analysis (MLVA) were used and showed that the majority of isolates belonged to the same clone. Further differentiation of isolates was needed because MLST and MLVA could not discriminate between these clonal isolates. Here, we used three primer sets to characterize plasmids of each isolate based on their transposons harboring beta-lactamase genes and their replicon region. Preliminary results suggest that 51 of the 57 isolates have a plasmid with the transposon Tn1331 of varying size with the blaTEM-1 gene encoding for a beta-lactamase. These data support the results from MLST and MLVA. This research provides novel insight to identify and mitigate the spread of this important pathogen.

Jake TeSelle: Mechanical & Industrial Engineering
Mentor: James Wilking - Chemical & Biological Engineering
Rheological Characterization of Biofilm Polysaccharides

Many microbes on earth exist in surface-attached colonies known as biofilms. These films, which are composed of microbes embedded in a soft extracellular matrix of their own creation, cause a variety of biomedical problems. The matrix confers the biofilm with mechanical integrity and allows the biofilm to resist external stresses. As such, an understanding of biofilm matrix mechanics is critically important for applications involving biofilm removal. Here we propose a study of the mechanical properties of the extracellular polysaccharide present in *B. subtilis* biofilms. The primary goal of the project will be to determine the concentration, pH and ionic strength dependence of the extracellular polymer mechanics. This is a necessary step in developing an understanding of the mechanics of *B. subtilis* biofilms, and could inform new experimental strategies for the removal of biofilms.

Joshua Thelen: Electrical & Computer Engineering
Mentor: Hashem Nehrir - Electrical & Computer Engineering
Design and Implementation of a Solar Photovoltaic Energy Conversion Experimental Setup for Education Enhancement

The Power and Energy Conversion Laboratory at MSU has been used to create better understanding of electric power and electro-mechanical energy conversion systems. A solar photovoltaic (PV) simulator, referred to as the Solar PV Experimental Station (SPES), has been developed using a grant from Montana Space Grant Consortium (MSGC) to educate students on the characteristics of solar PV which will be an integral part of the future smart grid. The SPES uses a 1000-Watt high-pressure-sodium light to simulate the sun, and it allows students and some individuals to experiment with many properties of PV panels indoors. Solar PV cells have a unique relationship between current and voltage, which is similar to a diode. PV cell and panel output power is affected by temperature, the intensity of the light, loading and the angle of incidence in which the light hits the panel. The SPES is currently being used for a lab experiment on solar PV energy conversion in the undergraduate energy conversion class in the Electrical and Computer Engineering Department at MSU. Currently, the SPES is being used to test different LED sources for simulating sunlight.

Acknowledgements: Colin Young (Graduate Student) - Electrical & Computer Engineering

Eric Troyer: Chemical & Biological Engineering
Mentor: Ellen Lauchnor, Robin Gerlach - Center for Biofilm Engineering
Optimization of Media for the Hydrolysis of Urea and Precipitation of Calcium Carbonate with S. pasteurii

Calcium carbonate ($CaCO_3$) precipitation is induced by the hydrolysis of urea, which many different soil bacteria catalyze with the enzyme urease. As part of an upcoming field scale test *Sporosarcina pasteurii* will be used to

induce the formation of $CaCO_3$ in order to seal a well. This technology could ultimately be used to prevent leakage of geologically stored CO_2 from the subsurface. In this study various sources and concentrations of urea, ammonium chloride, calcium, and nutrients were tested in order to find an optimized media for microbial induced calcium precipitation (MICP) that would allow for large scale MICP to be a cost effective endeavor. Results from batch tests showed that *S. pasteurii* was able to grow, hydrolyze urea, and precipitate $CaCO_3$ using fertilizer as a source of urea, ice-melt as a source of calcium, yeast extract and molasses as a nutrient source, and less ammonium chloride than originally used. Additionally, a highly saline solution (2.4% NaCl), similar to groundwater composition in some CO_2 injection sites, was used to grow the cultures, confirming that MICP using *S. pasteurii* is a viable approach in high salt or brine environments. Furthermore, up to 15 liters of liquid culture was grown using yeast extract and molasses broth to demonstrate feasibility of a large-scale injection of cells in the well-sealing field test.

Martina Van Hoy: Chemical & Biological Engineering
Mentor: Joan Broderick, Abigail Richards - Chemistry & Biochemistry, Chemical & Biological Engineering
Defing Important Amino Acid Interactions Involved In Pyruvate Formate-Lyase Aactivation

The radical SAM superfamily is a group comprised of hundreds of enzymes that catalyze a remarkably diverse range of reactions and appear throughout the phylogenic tree.[1] Radical SAM enzymes are involved in countless essential biological reactions including DNA repair and the synthesis of heme, lipids, and vitamins.[2-4] Though these enzymes are vastly important, they have been recently discovered and are largely uncharacterized. However, radical SAM enzymes are hypothesized to share a common mechanism for radical generation.[5,6] One of the most extensively characterized enzymes in this group is PFL-AE which activates PFL , an essential enzyme in anaerobic metabolism of *E. coli*.[14] Results obtained through the characterization of interaction between PFL-AE and PFL can potentially be applied to hundreds of biochemically essential enzymes in the radical SAM superfamily. This project focuses on identifying residues that are important in binding and glycyl radical formation during the interaction between PFL-AE and PFL. An array of mutations PFL and PFL-AE have been previously completed in our lab. To identify if these residues are important, activity assays will be conducted to see in the mutants are able to participate in electron transfer and thus glycyl radical formation. Additionally, studies will be performed relating to structural stability, structural comparison, conformational changes resulting from PFL-AE and PFL binding, cofactor binding, and SAM binding to further characterize this interaction. After the ten month time span allotted for this project, a publication and the presentation of experimental results at scientific conferences are the ultimate goals for this endeavor.

Acknowledgements: Adam Crain (Doctoral Student) - Chemistry & Biochemistry

Logan Warberg: Computer Science
Mentor: Clemente Izurieta – Computer Science
NASA Robotic Mining Competition Computer System Design

An interdisciplinary engineering team tasked with building a robot for competitive performance must coordinate and integrate its design decisions to assure a functional and durable final product. To better assess these decisions and their outcomes, each component and subsystem must be thoroughly vetted prior to committing resources to its development and deployment. This project uses an informed perspective to look back and analyze the design and development of the current computer system for the NASA Robotic Mining Competition – to identify the strengths and weaknesses of components, and to learn from experience. The presentation details the research and analysis that lead to design decisions for the three primary components of the computer system: locomotion, vision, and autonomy. The summary evaluates the effectiveness of this process in light of the performance of the robot within a test environment.

Katherine Warthen: Chemical & Biological Engineering
Mentor: Sandra Halonen - Microbiology & Immunology
Analysis of Toxoplasma-infected Murine Brains using CLARITY Brains

CLARITY refers to a process recently developed by a group of researchers at Stanford University designed to transform brain tissue into a clear hydrogel, maintaining neural connections and proteins while allowing whole brain imaging. During the course of this project this technique was implemented with the purpose of studying the neural parasite *Toxoplasma gondii* to ascertain whether the cysts formed by aforementioned parasite affect neuronal structural features including dendritic processes, axons and synapses. The CLARITY process was optimized for the purposes of this study, and clarified brains were stained and imaged. Future steps in this project include clarifying and imaging infected fluorescent brains to determine physical location of cysts in the brain. Behavioral studies may be combined with this technique to correlate the location of cysts and their effect on the behavior of mice.

Shu Ying Wee: Chemical & Biological Engineering
Mentor: Christine Foreman - Center for Biofilm Engineering
Chemotaxis of Antarctic and Arctic Microbial Life Towards Various Carbon Sources Using a Capillary Motility Method

This project aims to investigate the chemotaxis of motile heterotrophic bacteria from the Arctic and Antarctic, towards various carbon sources. By identifying the carbon sources that the bacteria are most attracted to, we can learn more about the organization of psychrotolerant microbial communities in their environment and how they process organic matter such as carbon. This knowledge can be applied to strengthen our understanding of the metabolism of carbon and the prediction of carbon fate for a changing environment. It is hypothesized that positive chemotaxis is expected from all the motile heterotrophic bacteria towards organic carbon sources. Additionally, it is hypothesized that different carbon sources will be stronger attractants for different motile bacteria based upon their metabolic capabilities. To investigate the chemotactic activity in the bacteria, a glass slide capillary motility chamber was designed and optimized. Up to three microcapillaries containing the carbon sources were inserted into the chamber containing the bacterial suspension. The assay was then incubated and imaged for 30 minutes, after which, the contents of the capillaries were flushed out to prepare slides for cell counts. The amount of cells that migrated to the capillary with attractants were compared to that in the initial cell suspension in order to obtain the quantity of cells attracted to a certain attractant and to compare the strength of the attraction. The selected carbon sources represent the different types of carbon sources that the isolates will typically be exposed to in their environment.

Acknowledgements: Heidi Smith (Doctoral Student) - Land Resources & Environmental Sciences

Sila Yanardag: Chemical & Biological Engineering
Mentor: Michael Franklin - Microbiology & Immunology
Identification of Role of RMF and HPF on Cell Viability, Antibiotic Susceptibility and Biofilm Forming Ability of Pseudomonas aeruginosa PAO1 Strain

Pseudomonas aeruginosa (*P.aeruginosa*) forms biofilms and causes chronic infections on the pulmonary tissue of patients suffering from cystic fibrosis (CF). Genetic studies conducted on *P. aeruginosa* isolated from CF patients show that after the completion of intense antibiotic treatment, bacterial biofilms form. Repopulation of bacteria in biofilm is proposed to be because of the cells enter a dormancy phase which are at the bottom of the biofilm. Determination of parameters causing antibiotic resistance in *P. aeruginosa* is an important phenomenon to overcome the challenge of antibiotic resistance and develop novel treatment methods for the lung infections of CF patients caused by this opportunistic pathogen. Ribosome modulation factor (RMF) and hibernation promoting factor (HPF) are two important proteins abundantly present in dormant cells of *P. aeruginosa*. Here the relationship between antibiotic susceptibility and RMF and HPF proteins in P.aeruginosa is identified by exposing cells to different concentrations of specific antibiotics at different time frames of the growth. Prior to the antibiotic susceptibility analysis, minimum inhibitory concentrations (MIC) of antibiotics were determined to obtain more

reliable results. Ciprofloxacin is one of the antibiotics used for this study. Organisms exposed to the ciprofloxacin during the exponential phase of the growth showed an unpredicted growth behavior though the growth behavior of the test organisms was same when they were not exposed to any antibiotics. For this study, RMF and HPF deletion mutants, double knock out strain (both RMF and HPF deleted strain) and wild type *P. aeruginosa* PAO1 are used. Results of this study will give us understanding and innovative insights into the reasons of antibiotic susceptibility.

Acknowledgements: Kerry Williamson (Research Associate), Tatsuya Akiyama (Doctoral Student) - Center for Biofilm Engineering, Microbiology & Immunology

COLLEGE OF LETTERS & SCIENCE

Joshua Allen: Agricultural Economics & Economics
Mentor: Carly Urban - Agricultural Economics & Economics
Racial Income Discrimination in the Rocky Mountain West

My research pertains to racial discrimination in wages in the Rocky Mountain West. I investigate the differences in wages by race, controlling for the effects of education, location, and experience. Aside from the ethical importance of this issue, it is also an issue of economic efficiency. If income is significantly affected by race in addition to factors related to actual job performance, then the result will be an inefficient workplace, and a perception among employees that advancement and income are biased and not performance based. I use data from the Current Population Survey (CPS) to determine whether racial discrimination in income exists specifically for the greater Rocky Mountain West. If discrimination is evident, this should invite policies to reduce any existing income gap and allow individuals of all racial backgrounds equal opportunity in income.

Anna Andrechak: Microbiology & Immunology
Mentor: Seth Walk - Microbiology & Immunology
Multi-locus sequence typing of Escherichia coli isolated from freshwater aquatic sediment samples

Escherichia coli are Gram-negative bacteria of the Enterobacteriaceae family. These organisms are readily sampled from two distinct habitats: i) the primary habitat, or the gastrointestinal tract of warm blooded animals and ii) the secondary habitat, or environments outside the host. In collaboration with investigators at Central Michigan University, we are addressing the hypothesis that *E. coli* isolated from freshwater beaches along Lake Michigan (Ottawa County, MI) are phylogenetically similar to *E. coli* isolated from seagulls known to frequent these beaches. To characterize the phylogenetic relationship between isolates, we are conducting multi-locus sequence typing (MLST). This technique generates DNA sequence data for seven loci around the *E. coli* genome. Sequences will be generated from loci within seven housekeeping genes, namely aspC, clpX, fadD, icdA, lysP, mdh, and uidA. To date, PCR has been used to amplify MLST loci, followed by amplicon purification and quantification via spectrophotometry. Purified amplicons have been submitted for Sanger-style sequencing and analyses are being performed with Lasergene software package. Sequences for six isolates from seagulls and beach sand have been submitted for sequencing with the goal of completing sequence generation and phylogenetic analysis for a total of 50 isolates (25 seagull, 25 beach sand) by the completion of the study.

Katie Atkinson: Ecology
Mentor: Cathy Zabinski - Land Resources & Environmental Sciences
Soil Organic Matter and Enzyme Activity

As part of organic and sustainable farming practices, the grower often adds organic matter to the soil for increasing nutrient availability, rather than inorganic fertilizers. My research addresses the effect of organic matter amendments on the soil itself. What I specifically looked at was how the type of organic matter affects soil carbon, microbial biomass and enzyme activity (all connected). Soils were sampled from plots at the MSU Horticulture Research Farm. The study design consisted of a randomized split-plot design with four replicates of four fertility treatments - hay mulch, straw mulch, urea fertilizer and an untreated control. Soils were also sampled from four Gallatin Valley sustainable farms--Gallatin Valley Botanical, Gallatin Grown, Three Hearts Farm, and Three Fiddles Farm. Soil carbon was measured by determining the quality and quantity of water extractable soil organic matter, and the activity of three enzymes, including α-galactosidase, β-glucosidase, and β-glucosaminidase. I hypothesized that the amount, activity and type of soil carbon, would be correlated with the enzyme activity. Data analysis will compare quantities and types of soil organic matter to soil enzyme activity.

Acknowledgements: Karin Neff (Doctoral Student) - Land Resources & Environmental Sciences

Ryan Bachofer: Chemistry & Biochemistry
Mentor: Martin Teintze - Chemistry & Biochemistry
Evaluation of MRSA resistance developement to a novel antibacterial compound

A past and current issue in medical treatment of infectious diseases is that of multidrug resistant bacteria such as Methicillin-resistant *Staphylococcus aureus* (MRSA). The Teintze lab has previously synthesized a series of novel guanide compounds, which have been investigated for their antimicrobial activity. From this series, trishexylaminomelamine-tris-phenylguanide (THAM-3ΦG) has been shown to have a high specificity towards MRSA, while showing relatively low toxicity towards mammalian cells. In order to further investigate the effects of THAM-3ΦG on MRSA, a MRSA strain resistant to this novel antimicrobial was developed by subculturing cells in increasing concentrations of the compound. This isolated strain has shown consistently high Minimum Inhibitory Concentration (MIC) even after subculturing for two weeks in the absence of THAM-3ΦG, as compared to the parent USA300 strain. Such works suggests that the resistance is due to a mutation rather than an adaptation of the cells. This work looks to further characterize this resistant strain and the mechanism of action of THAM-3ΦG. Initial studies will look to understand changes in growth on varying types of media of both parent and resistant strains. We will then use a biochemical approach to investigate the changes that are occurring within the cell in response to drug treatment in normal and resistant strains. This will include analyzing for the up-regulation of efflux pumps and changes to membrane composition.

Acknowledgements: Alan Weaver (Doctoral Student) - Chemistry & Biochemistry

Kate Backstrum: Cell Biology & Neuroscience
Mentor: Stephanie McDowell – Bridgercare Clinic
Untitled Project

This project investigates the need for comprehensive sexual health education for young adults. Sexual health includes a range of emotional, physical, psychological, and social elements. This project aims to highlight the need for a comprehensive sexual health education system in the United States. Targeting individuals before they become sexually active has been identified as an effective method for reducing unintended pregnancies, sexually transmitted infections and diseases. In the United States, nearly half of the population who contract sexually transmitted diseases are between 18 and 24 years old (Centers for Disease Control, 2012). Because of this, effective condom use has been identified as an important aspect of sexual health education. After abstinence, condoms are the only form of birth control that prevents the spread of sexually transmitted diseases and infections. STIs and STDs can have serious negative effects on an individual's health, and some (including HIV and Herpes), cannot be cured once contracted. Others, including gonorrhea and Chlamydia, can result in infertility (World Health Organization, 2013). Because abstinence-only-programs have been proven ineffective (Malone, 2011), it is important to teach youth that abstinence is the safest choice, while providing them with the information on how to engage in sexual activity safely. The survey presented in this study identified that 70% of 18-25 year olds understand the importance of condom use, while only 25% use condoms every time they engage in sexual activity. Providing youth with the knowledge and support to make personal safe sex decisions is critical.

Nathan Beckman: Ecology
Mentor: Wyatt Cross - Ecology
Identification and quantification of Shovelnose Sturgeon (Scaphirhnchus platorychus) diets in the Yellowstone and Missouri Rivers

Shovelnose sturgeon (*Scaphirhynchus platorynchus*) are an abundant large-bodied fish in the Missouri and Yellowstone Rivers. While both rivers contain sand and cobble substrate that present different foraging habitats, the largely free-flowing Yellowstone has retained a higher proportion of cobble habitat. Current literature on shovelnose sturgeon diets suggests that this consumer is a generalist, however there is a paucity of research linking foraging habitat with dietary data. Our objective was to quantify shovelnose sturgeon diets in different benthic habitats. Twenty-five diets were collected in the Missouri River from Fort Peck dam to the Yellowstone confluence and in the lower Yellowstone River from August-November 2013. Macroinvertebrates from each diet

were identified to the lowest practical taxonomic level (usually genus), counted, and measured to estimate biomass. There was a significant difference in fish size among the reaches ($p<0.001$), with a general trend for larger fish in cobble reaches. Fish caught in cobble reaches had higher EPT (orders: Ephemeroptera Plecoptera Trichoptera) biomass in their diets, while those caught in sand reaches had higher biomass of Diptera. These results suggest that while shovelnose sturgeon feed in multiple habitats, cobble substrate may provide higher quality food resources.

Acknowledgements: Eric Scholl, Brittany Trushel (Doctoral Students) - Biological Sciences

Noah Bosworth: Ecology
Mentor: Andrea Litt - Ecology
Can Montana shrews be identified using morphology of dorsal guard hairs?

Several Montana shrews are considered species of concern by state and federal agencies, primarily due to a lack of information. Current methods for identification of shrew species require lethal trapping and detailed analysis of skull characteristics. These procedures are costly, inaccurate, and logistically challenging. DNA analysis and photomicrography are more accurate methods, but are costly. A novel methodology has been developed in the United Kingdom that uses morphological characteristics of dorsal guard hairs for identification of shrew species. We seek to validate this procedure in hopes that these methods can be applied to shrew species in Montana. We will collect dorsal guard hairs from museum specimens at Montana State University and the University of Montana, and measure four specific length and width characteristics for each hair sample. These data will be analyzed with multivariate tools and we will compare our results with the known identity of each specimen to establish whether this method is viable for identifying shrew species in Montana. With more extensive sampling and improved low-cost identification techniques, several species of shrews potentially could be re-classified as common, allowing for more appropriate management of species.

Acknowledgements: Dan Bachen (Graduate Student) - Ecology

Luke Brandenberger: Microbiology & Immunology
Mentor: Ed Schmidt - Microbiology & Immunology
An Investigation of Hepatocyte Lineage Life-History Dynamics in Vivo

The liver has many vital functions including detoxification, protein synthesis, and regulation of metabolism. Due to its role in central bodily processes, it is a reliable proxy for overall organism health. This also makes it a good model system for studying cellular growth and aging. Previous research has created a protocol for conditionally fluorescently time-stamping hepatocytes using Enhanced Green Fluorescent Protein (EGFP) and Loxp/Cre technology. This allows us to visualize the growth of hepatocytes over time. In order to build a working model of hepatocyte lineage life history dynamics in vivo, we performed MATlab analyses on images of fluorescently tagged liver cells to extract relevant positional and numerical data. Hepatocyte populations were found to have a regular lifespan, move away from the central lobules over time, and generally increase in cell ploidy. Together, these data suggest that hepatocytes travel through a predictable cycle of birth, growth, replication, and death. We are currently working on incorporating these data into liver models for future studies on cell aging and drug metabolism.

Acknowledgements: Ryan Waters (Doctoral Student)- Mathematical Sciences

Hallie Bronec: Microbiology & Immunology
Mentor: Michael Franklin - Microbiology & Immunology
Effect of Anaerobic Sulfate Reducing Bacteria on Corrosion of Steel

Sulfate reducing bacteria, specifically those in the *Desulfovibrio* genus, are frequently observed in biofilms that cause biocorrosion, and have been observed on interior surfaces of pipelines and metals. Corrosion of pipelines can lead to major spills of hazardous materials to the environment. To understand effects on steel, *Desulfovibrio alaskensis* G20 has been anaerobically cultured on stainless steel and carbon steel coupons in CDC reactors and

sent to ExxonMobil to analyze the effects of corrosion on the metals. RNA from batch cultures of *D. vulgaris* with carbon steel beads has been successfully extracted and purified. RNA from the biofilms of *D. alaskensis* grown in CDC reactors will also be extracted and sequenced to better understand the gene expression of the organism during biofilm formation on steel. Future work includes examining the mutualism and interactions between sulfate reducing bacteria such as *D. alaskensis* and methanogenic bacteria because biogenic methane production forms the basis of most anaerobic environments. The effects of corrosion on steel of a coculture of methanogenic bacteria and sulfate reducing bacteria are likely different than a monoculture of only *D. alaskensis*. Discovering more about the microbial role in corrosion can lead to safer pipelines and better techniques to prevent future hazardous leaks.

Acknowledgements: Kerry Williamson (Research Associate), Chiachi Hwang (Research Scientist) - Microbiology & Immunology, Center for Biofilm Engineering

Michael Burt: Chemistry & Biochemistry
Mentor: Martin Teintze - Chemistry & Biochemistry

Development of THAM-3PhG as a Novel Antibacterial Compound against Methicillin-Resistant Staphylococcus aureus

We are in the midst of a global health care crisis. Antibiotic resistant bacteria are becoming ever more prevalent, and once easily treatable illnesses are causing increased patient suffering and death. Every year drug-resistant bacteria such as methicillin-resistant *Staphylococcus aureus* (MRSA) cost the U.S. an estimated $5 billion and are responsible for 90,000 deaths worldwide. Development of new drugs to combat these antibiotic resistant bacteria is vital. The Teintze lab has synthesized a novel antibacterial compound which has similarities to chlorhexidine, a topical microbicide that has been in use for 50 years without any cases of resistant bacteria developing. With its similarities to chlorhexidine, Trishexylaminomelamine-tris-phenylguanide (THAM-3PhG) is believed to have a similar mechanism of action. The goal of this project is to elucidate the mechanism of action for THAM-3PhG.
A strain of MRSA resistant to THAM-3PhG (T-MRSA) was isolated by sequential passaging in increasing concentrations of compound starting at sub-lethal levels. The resulting isolates were compared to a THAM-3PhG-sensititve, wild type community acquired MRSA strain. Through minimum inhibitory concentration plate assays, the T-MRSA strain was found to have a resistance in which eight times the normal minimum inhibitory concentration of THAM-3PhG was needed to inhibit growth. This strain also has shown preliminary resistance to chlorhexidine. Future work includes growth curve, gene expression, and membrane composition analysis of the T-MRSA strain to compare to the wild type. This data will give an insight into the mechanism of action of THAM-3PhG and move towards the development of improved compounds by rational drug design.

Acknowledgements: Alan Weaver (Doctoral Student) - Chemistry & Biochemistry

Andrew Carroll: Agricultural Economics & Economics
Mentor: Carly Urban - Agricultural Economics & Economics

Untitled Abstract Proposal

Federal and Local Governments have passed laws that allow police agencies to keep ownership of assets that are seized during drug arrests. The incentives of such a policy have often been undermined by a reallocation of these assets into other Federal or State budgets. In response to these policies there is an increase in policing for profit. Policing for profit occurs when Federal, State, or Local law enforcement agencies allocate resources to specifically target drug related offenses in an effort to generate revenue through asset forfeiture. Using national arrest data collected over time I expect to show an increase in the number of drug arrests in correlation with amendments to asset forfeiture policies on the Federal and State level.

Joshua Carter: Microbiology & Immunology
Mentor: Blake Wiedenheft - Microbiology & Immunology
Identifying Critical Residues to Cascade Function

CRISPR-Cas are diverse adaptive immune systems that protect prokaryotes against invasive genetic elements such as viruses. The type IE CRISPR-associated complex for anti-viral defense (Cascade), is a 405 kDa RNA-guided surveillance complex composed of eleven protein subunits and a 61 nt CRISPR derived RNA (crRNA). Cascade patrols the intracellular environment and binds foreign DNA targets through base pairing with the crRNA-guide. Target binding triggers a conformational rearrangement of Cascade subunits, and the recruitment of a nuclease-helicase called Cas3 that is responsible for the degradation of DNA targets. To determine the mechanisms of foreign DNA recognition and Cas3 recruitment we have mapped phylogenetically conserved residues onto the X-ray crystal structure of Cascade and a homology model of Cas3. Conserved residues are concentrated at protein-protein interfaces and associated with binding to the crRNA. Conserved residues on the surface of Cascade are anticipated to participate in DNA target binding and/or Cas3 recruitment. The functional role of these residues is currently being investigated.

Acknowledgements: Ryan Jackson (Postdoctoral Researcher) - Microbiology & Immunology

Wee Chun Chan: Agricultural Economics & Economics
Mentor: Carly Urban - Agricultural Economics & Economics
Alternative to bring better life for children in developing countries

Manufacturers which are labor intensive are looking for cheaper labor in developing countries. This issue of child labor is unavoidable in some developing countries; they are working in hazardous situations, and earning below the equilibrium wage. Child labor is joining the work force to reduce the family's economic burden, but the United Nations is enforcing the law to punish those developing countries which do not enforce child labor law. Children are part of the family and they just want to help their whole family into better situation when they are joining the working force. This paper is trying to find out whether or not there are alternatives for child labor laws. From the study of enforcing law paper, detering the law sometimes would bring the better effect than enforcing law. For example, from the study of legalizing marijuana to lower the crime rate. This paper is not trying to defend the manufacturers using child labor, but trying to find out if UN punishing those developing countries is efficiency enough to bring a better life for children. I hope this study will let the public step back and think whether there is any better way to help the children in developing countries. This study will give the manufacturers a scope when planning to build a plant in developing countries.

Warren Colomb: Physics
Mentor: Randy Babbitt - Physics
High Power Continuous Mid-Infrared Difference Frequency Generation

Historically, it has been difficult to generate Mid-IR laser light due to inaccessibility of laser bands in this region; however, utilizing high power and cost effective lasers developed for communication bandwidths, and nonlinear optical materials it is now feasible to generate Mid-IR laser light. The process of difference frequency generation (DFG) can be exploited in conjunction with two common wavelengths, 1064nm and 1550nm, along with a non-linear optical crystal, periodically poled stoichiometric lithium tantalite (PPSLT), to reliably produce Mid-IR CW laser light at ~3.4um. This poster will cover the basic theory of difference frequency generation, models used to predict power output and wavelength bandwidths, and experimental results.

Elizabeth Corey: Sociology & Anthropology
Mentor: John (Jack) Fisher - Sociology & Anthropology
Osteoporosis & the Negative Effects of Elongated Human Life Spans: An Evolutionary Perspective

Osteoporosis, meaning "porous bones" in Greek, is defined as a degenerative disease resulting in the loss of bone tissue that increases bone fragility and the risk of fracture. Osteoporosis primarily affects the elderly, defined as

individuals over the age of 70 or persons that have lived through senescence. The disease has historically primarily affected Caucasian women of European & Asian ancestry with markedly lower diagnoses in men and peoples of African ancestry. Bone mineral density (BMD), an accurate marker of an individual's susceptibility to fracture, has been the key variable in the majority of osteoporosis studies. BMD has been linked to specific genes, environmental factors, lifestyle, and gender. As female children & adolescents are affected negatively through environmental degradation and poor nutrition resulting in early menarche and lower bone mineral density, the percentage of the population with osteoporosis requiring economic and emotional care is expected to increase. The elongating lifespans of humans as a result of advanced medical treatment and technological advances, specifically in regards to food production, have effectively increased the average human lifespan. The elongated lifespan is beneficial at the emotional level while decreasing the reproductive fitness of future generations physiologically, biologically, & socioeconomically. In order to mitigate the negative effects of longer lifespans, the period of reproductive viability must be extended and the efficiency of calcium and vitamin D absorption must increase.

Jordan Dood: Chemistry & Biochemistry
Mentor: Bern Kohler - Chemistry & Biochemistry
Determination of DNA Radical Spectroscopic Features

The long lived excited states observed in DNA polyneuclotides have been theorized to result from photoinduced charge transfer, generating highly reactive charged or neutral radicals. Molecular calculations of model DNA oligomer photophysics have produced several competing models which cannot be easily reconciled. Experiments to detect the formation of charge separated states have been hindered by both low radical populations as well as the fast decay of DNA radicals. Transient absorption (TA) spectroscopy in combination with photo-activated radical generator (dithiosulfate) has the potential to overcome both of these challenges. The ultrafast time resolution of TA experiments coupled with the ability to generate significant radical populations instantaneously provides the best chance at observing the spectroscopic fingerprints of DNA radicals.

Acknowledgements: Tom Zhang (Postdoctoral Researcher) - Chemistry & Biochemistry

Alisha Downs: Liberal Studies
Mentor: Dr. Patricia Catoira - Modern Languages & Literatures
Ernesto "Che" Guevaras "Hombre Nuevo" vs. "Generacion ni-ni": Cuba's Generation Gap and Evolving Ideals

Ernesto "Che" Guevara, one of the most influential revolutionary figureheads during Cuba's Revolution that began in 1953 and which saw Fidel Castro come into power in 1959, envisioned a socialist movement that encouraged the people of Cuba to work towards productivity and to sever all ties to capitalist mechanisms and materialistic incentives, to re-educate society to conform their ideals into a collective consciousness and promote egalitarianism, as well as the need for the self actualization through labor and education. These characteristics were to be embodied by Che's vision for Cuba's "New Man" or "Hombre Nuevo" Ironically, Che's image is now being used as a capitalistic marketing ploy, being plastered on everything from postcards, to T-shirts to posters; something that he would undoubtedly and vehemently be against if he were alive today. In Cuba's effort to survive yet another catastrophic economic collapse, as the country experienced during the 1990's after the crash of the Soviet Bloc, the fifty-four year old regime headed by Raul Castro, Fidel Castro's younger brother, has been faced with difficult decisions regarding the salvation of the economy and the adherence to its socialist revolution. In addition, there are whole generations that have come to live with a survival mentality, experiencing only the failures of the Revolution. The Cuban people are tirelessly searching for new ways to get ahead, and in particular, the Cuban youth feel there are no incentives in pursuing an education or working, hence *generación ni ni*, referring to the generation of Cubans who neither wish to work nor study (ni trabajan ni estudian). This is especially true when the economic structuring of the country and the ever growing inverted pyramid allows for an individual to earn more money engaging in private enterprise, as opposed to in a state appointed professional position. This

has resulted in a decline of work ethic among youth, as well as a lack of desire to pursue an education. The purpose of my study was to examine the growing disconnect between young Cubans and the state, which has given rise to alienation and development of individualism; a stark contrast to the socialist push for collectiveness by Che and Castro.

Melissa Emery: Chemistry & Biochemistry
Mentor: Charles McLaughlin - Chemistry & Biochemistry
Student Perceptions Toward the TEAL Approach to Enhance Chemistry Education

TEAL, Technology-Enhanced Active Learning, uses a pedagogy approach to encourage collaboration amongst students. This approach was incorporated into the second semester of general chemistry at Montana State University and during the 2013 summer session, when one out of six weekly lectures was held in a TEAL classroom. Since a double lecture was traditionally scheduled on Tuesdays, the class was split with half attending a traditional lecture and the other half attending the newly designed TEAL classroom. In the TEAL environment students sit at round tables facing one another to promote the creation of a small learning community. The chemistry students were surveyed on their perceptions toward the classroom environment at the beginning and end of the six week course. The comparison between the pre and post surveys showed that students overwhelmingly agreed the TEAL experience enriched their learning experience and increased their classroom participation.

Samuel Engblom: Physics
Mentor: Charles Kankelborg - Physics
Extended Analysis of Optical Distortion in the MOSES Rocket Instrument

The Multi-Order Solar Extreme ultraviolet Spectrometer (MOSES) is a probe used to acquire images of the sun that will characterize the dynamics of the solar atmosphere using the solar He II emission line at 304 angstroms. These images can be analyzed to yield detailed information on the dynamics of the solar transition region, including Doppler velocities and non-thermal line broadening. By using a diffraction grating and three individual detectors, three images are produced, which are then mapped onto each other during a coalignment procedure. This is a prerequisite to determine line profiles in the observed spectrum. A USP grant allowed me the opportunity to work in Dr. Kankelborg's lab last summer, during which time I developed a model of the optical distortion present in the MOSES payload. Over the following academic year, my work has been focused on applying this model to improve existing data reduction procedures with the purpose of increasing the accuracy of Doppler shift determination for MOSES. Included in this process is the rewriting of the current co-registration algorithm and the variation of specific parameters in order to find an accurate remap. After this is completed, I will continue to work with the MOSES team on data analysis by searching for residual distortion that may correspond to Doppler shifts in the original MOSES dataset.

Matthew Evans, Nicholas Peyton: History & Philosophy
Mentor: Robin Hardy - History & Philosophy
The New North Africa

Our project is a historical research comparing the changes to women's identities and rights in Morocco in the 20th century. We examine how movements such as the Arab Spring of 2011, the effects of Western influence and business, social media, and the role and history of Islam in the region have created the modern Muslim woman in the region. We include interviews, primary sources written by Moroccan women, and secondary sources written by Westerners about the politics of gender in the Maghreb. Our ultimate thesis and conclusions we have reached is that women in Morocco will likely start to take a greater role in politics, retain Muslim dress such as the Hijab, and maintain a unique Islamic identity into the future by incorporating traditions of Islam and incorporate those into liberal elements of Western women and femininity.

Gaoyang Fan: Mathematical Sciences
Mentor: Tomas Gedeon - Mathematical Sciences
Boolean Network Model for Transcriptional Cell-cycle Oscillator in Yeast

Understanding how cells regulate their gene expression is very important for development of the organisms, as well as treatment of many diseases. Since gene products often regulate other genes, scientists often represents these mutual interactions as networks. Analyzing dynamics of a gene regulation network is the process of studying the time evolution of the gene products over time. A common type of non-equilibrium dynamics, which plays fundamental role in neuroscience and molecular biology, is a periodic dynamics. My research is focused on exploring the yeast cell-cycle transcriptional network using a family of models named wave pool models. First, I examined the consequences of including self-regulation in the model, where self-regulation means that a gene product affects its own production. Secondly, using Conley-Morse Database, which is software developed by our collaborator prof. Mischaikow and his lab from Rutgers University, we are developing a new approach to analysis of models over multiple parameters and arbitratry initial data. We are testing this approach to compare different wave pool models and test them against the experimental data.

Acknowledgements: Bree Cummins (Research/NTT Faculty) - Mathematical Sciences

Jayme Feyhl-Buska: Ecology
Mentor: Eric Boyd - Microbiology & Immunology
Deciphering the Microbial Contribution to Geochemical Cycling in the Georgetown Lake Ecosystem

Geochemical analyses of a vertical water column present at Georgetown Lake (GL) in Anaconda, Montana, reveal strong spatial and temporal gradients. To identify a potential role for biology in the generation of these gradients, we extracted DNA from filtered water samples and characterized the diversity of 16S rRNA genes using the IonTorrent sequencing platform. Concentrations of DNA were low in near surface samples and peaked at a depth of 5.5 meters, which corresponded to the location where the strongest gradients in hydrogen sulfide, ammonium, phosphate, and methane geochemical parameters existed. The abundance of specific genera of organisms with inferred metabolic properties corresponded with gradients in chemicals potentially produced by those processes. Analysis of genetic sequencing data indicates that the abundance of microbial taxa correlates strongly with the chemical gradients seen in this system. This result strongly suggests that the geochemical gradients observed in Georgetown Lake are heavily influenced by microbial processes rather than abiotic factors.

Megan Figura: Ecology
Mentor: Luther Talbert - Plant Sciences & Plant Pathology
Qualitative Trait Locus Analysis of Recombinant Inbred Lines

Wheat samples from the same population were tested in two different systems of PCR, agarose and KASP (Kompetitive Allele Specific PCR). The KASP system is a relatively new method for genetic analysis, and less is known about the best methods for reliably producing and interpreting data compared to agarose. Agarose PCR provides quantitative data by interpreting the different numbers of base pairs for alleles at the same locus, whereas KASP provides a relative interpretation by how much a sample fluoresces at RFU1 or RFU2 in order to determine allele 1 or allele 2. The systems were tested for accuracy using parent wheat with known traits and then for consistency by using the progeny. The subject population of the research was generated from a cross between Choteau spring wheat and Mountrail durum wheat. The initial Choteau/Mountrail cross had already been genotyped for genes that express traits of interest, such as plant height and yield production. From the parent cross, 152 recombinant inbred progeny were produced. The purpose of comparing the two PCR systems was to determine which might be more reliable to use for examining whether the positive genes identified in the parent cross would have similar effects in other crosses. The method that was used is known as qualitative trait locus analysis, which uses statistical analysis to compare phenotypic and genotypic data. The long term impacts of this research will be the identification of positive alleles that may be transferred into spring wheat breeding programs to produce varieties that perform well under heat and drought stress. The benefit of comparison of PCR

techniques will be an increased understanding of KASP methods and the ability to determine which system may be more appropriate for a given genetic research.

Jacob Gardner, Jack Wilson, Holley Flora: Earth Sciences
Mentor: Chris Organ - Earth Sciences
Rates of Biomechanical Evolution Preceding Shifts in Dinosaur Locomotion

The greatest evolutionary transitions in the history of animal life involve dramatic shifts in locomotion. Yet we know little about how major innovations in locomotion are coupled with shifts in evolutionary rate. To address this issue, we analyze the primary moment arms of dinosaur hindlimb retraction using phylogenetic Bayesian methods. The moment arms define the velocity ratio that relates the mm. caudofemoralis longus and iliotibialis lateralis, which are responsible for locomotion in non-avian and avian dinosaurs, respectively. The velocity ratio is a straight forward biomechanical assessment of effort versus load during retraction. Fast animals like gazelle have high velocity ratios while animals that rely on torque, like badgers, have low velocity ratios. We use moment arm measurements to transform the phylogenetic branch lengths of dinosaurs, which can detect rapid shifts in evolutionary rate through the tree. The rates of the moment arms along branches can then be compared in a statistical context to detect relative shifts in the velocity ratio, but also to detect significant rate shifts among groups and directional evolutionary patterns associated with body size and ontogeny. We hypothesize that rapid evolutionary change in the velocity ratio are associated with transitions to graviportal quadrupedality (sauropods) and flight (avialans). Our results will help clarify how key innovations in locomotion evolve: whether they are slowly modified from ancestral forms or shift rapidly.

Emery Gaylord: Agricultural Economics & Economics
Mentor: Carly Urban - Agricultural Economics & Economics
The Effect of Regulation on Side-Country Avalanche Deaths

The goal of my project is to determine the effect of side-country (back-country skiing accessed via ski areas) regulations on the number of avalanche fatalities that have occurred in the side-country. Economic theory would predict that as the cost of accessing the side-country increases due to imposed regulation, the number of people utilizing it will decrease along with the number of fatalities. However, other theory, moral hazard, might suggest the opposite outcome due to changing behavior as a result of imposed regulation. My data, from the Colorado Avalanche Information Center, contains information on every side-country fatality since 1956. I will then run a test to find the effect of high, low, or no regulation respectively on the number of fatalities. If regulation decreases the number of fatalities, this can be used to implement changes at ski areas regarding their access policies. If regulation has no effect on the number of fatalities, then ski areas can reevaluate the use of their resources to regulate side-country access.

Sarah Gilkerson, Jared Heuck (MSU Alum): History & Philosophy
Mentor: Michael Reidy, Ada Giusti - History & Philosophy, Modern Languages & Literatures
Zawiya Ahansal: Environmental geology and human history in the High Atlas

Although there are many factors that shape how isolated cultures develop, the former glaciation of the High Atlas Mountains of Morocco has profoundly influenced the way that the politics and culture of the Zawiya Ahansal region are today due to water distribution, mining deposits, and geographical isolation. The methods of this study were split into three sections: creating environmental geomorphologic maps, a historical comparative analysis, and an interview based sample of the population. It is hypothesized that the culture and overall population development in the Zawiya Ahansal region has formed in a geographically isolated pattern that is now changing due to phosphate deposits formed in part by glacial uplift, with villages struggling with the associated hazards of glaciated water supplies. In conclusion, through the use of environmental geology as a tool of analysis for determining the outcome for environmentally focused political and geographical factors, this study aids in the overall understanding of the relationship between societal development and physical spaces. This is essential due to the implications for international policies focusing on how to plan population development in the context of serious environmental changes.

Edward Gillig: Chemistry & Biochemistry
Mentor: Mary Cloninger - Chemistry & Biochemistry
Uptake of Lactose-functionalized PAMAM Dendrimers

Dendrimers are highly branched, symmetrical molecules that we are using to study multivalent protein-carbohydrate interactions. Based on our ultimate desire to use sugar functionalized PAMAM dendrimers as therapeutic agents for cancer treatment, an assay was developed to test whether our compounds would be taken up by cells. To this end, lactose functionalized dendrimers were tested to see if they would be taken up by three different cancer cell lines: HT-1080, A549, and DU-145. Testing involved an uptake assay that utilized fluorescently tagged dendrimers being incubated with the three cell lines. Uptake was determined using both epifluorescent and confocal microscopy. Our compounds were found to reside extracellularly, unless there was membrane disruption which allowed for our compounds to enter the cells.

Grant Gittus: Sociology & Anthropology
Mentor: Jack Fisher - Sociology & Anthropology
Archaeological Analysis of the Coal Creek Spring Stone Artifact Scatter

In Montana, archaeologists are often confronted with surface stone artifact (lithic) scatters. Many questions can be addressed with lithic scatters including: was there an extensive trade network between groups, what stages of tool manufacture are present at the site, and what sort of activities took place at this site. This was the main reason for conducting research at Coal Creek Spring in southeastern Montana. In collaboration with the United States Forest Service, undergraduate students from MSU including myself made trips to retrieve artifacts from certain areas. Using standard archaeological procedure and GPS positioning 146 lithic artifacts were recovered and documented. Each specimen was analyzed at MSU taking note of many attributes including raw material type, weight, length, and stage of flake production. Of the material types present, porcellanite was the most common. Porcellanite is available locally. Other raw materials (obsidian, chert, and siliceous siltstone) that are not locally available are much less common. The mean weight is quite low and the frequency of incomplete and unretouched flakes is large. These data suggest that the site was occupied by groups with high mobility and that long distance trade between groups was minimal. Most of the artifacts lack substantial surface cortex, which along with small size, is evidence of middle to late stage manufacturing in stone tools. These data support preliminary conclusions about high mobility. Dating this lithic scatter is difficult because there are no temporally diagnostic artifacts and surface scatters can represent accumulations of artifacts over many years.

Kyle Glose: Cell Biology & Neuroscience
Mentor: Steven Stowers - Cell Biology & Neuroscience
Signal Processing from Mechanoreceptive and Nociceptive Neurons in Drosophila

Little is known about the neural mechanism by which two simultaneous signals are processed into an appropriate response. Drosophila (fruit fly) larvae possess nervous systems that are simple enough that they can be more easily understood than those of larger, more complex animals, yet complex enough that results from studying their nervous systems will likely translate to these same larger species. Using the recently developed Drosophila Green Fluorescent Protein (GFP) Reconstitution Across Synaptic Partners (dGRASP) technique allows us to use GFP to view specific, single synapses as they connect in the larval nerve cord. GFP, which is split into two parts, pre- and post-GRASP, is distributed across two adjacent synaptic partners. When these synapses fire, pre- and post- GRASP, which are independently non-fluorescent, recombine to form fluorescent GFP, allowing neural synapses to be visibly observed and mapped. Pairing this technique with a recently developed collection of GAL4 drivers, known as the Rubin GAL4 collection, we are able to isolate the dispersion of pre- and post-GRASP to sparse subsets of neurons. Through examining the expression patterns of GFP reconstitution, we will be able to observe the pathway that is followed by a stimulus through the larval nervous system as it is processed into a motor response. Preliminary results show that pre- and post-GRASP are able to be isolated to pre- and post- synaptic membranes with high specificity, and we have begun screening the lines in the Rubin GAL4 collection. It is impossible to comment on the results of this screening at this point, however.

Kayla Gnerer: Agricultural Economics & Economics
Mentor: Carly Urban - Agricultural Economics & Economics
The Impacts of Head Start on High School Graduation Rates in Montana

This paper examines the state-level impact of the early childhood development program, Head Start, on high school graduation rates. Montana children are the variable of interest, and this paper looks at their success in graduation to determine if there is a causal relationship or a correlation with respect to their involvement in Head Start. Previous studies have primarily shown the impact of Head Start on African American boys, whereas this study focuses on a predominantly Caucasian populous. Data collected from the census, the Montana State site, and Head Start provide the empirical analysis; and the results will be juxtaposed with results from the control group, Mississippi.

Brett Green: Physics
Mentor: John Neumeier - Physics
Analysis of the BRAN Forward High Luminosity Detectors at the LHC

To optimize collisions in the Large Hadron Collider, we have built a detector, Beam Rate of Neutrals - American (BRANA). With it, we are measuring the LHC’s luminosity by detecting neutral particles from primary collisions, which produce secondary showers that are measured by BRANA's high-pressure ionization chamber. Proton-proton, proton-lead, and lead-lead collisions have been measured. We have simulated the detector for these collision types (pp, pPb, and PbPb) in the modeling program FLUKA. The detector takes measurements in both pulse height and counting modes for four separate quadrants, allowing the measurement of energy deposition ratios which are proportional to the crossing angle of the colliding beams. Pulse height mode measures changes in voltage caused by incoming particles, whereas counting mode measures the number of times a threshold was exceeded. All data is available with resolution precise enough to identify individual buckets. We characterize the detector by analyzing data from each mode in both the time and bucket domains. We show that the detector is capable of studying the beam structure and optimizing collisions on a bucket-by-bucket basis. We calculate an energy ratio proportional to the crossing angle, and show that such ratios may be used to calibrate the detector. We show that the detector functions over the range of luminosities spanned by the reactions, which is over three orders of magnitude. We show that the detector can measure reaction asymmetry in pPb collisions.

Acknowledgements: Howard Matis, Alex Ratti - Lawrence Berkeley National Laboratory

Brandon Haller: Microbiology & Immunology
Mentor: Jovanka Voyich - Microbiology & Immunology
Role of Leukocidin A/B in Staphylococcus aureus Virulence

Methicillin-resistant *Staphylococcus aureus* (MRSA) is a bacterium that can cause pneumonia, endocarditis, sepsis, toxic shock syndrome and necrotizing fasciitis as well as highly contagious skin infections. Dr. Jovanka Voyich's lab believes that the two-component leukocidin A/B (LukA/B) secreted by MRSA is partly responsible for killing human phagocytes thereby directly contributing to pathogenesis of the bacteria. For my project, I hypothesize that LukA/B modulates the host response by promoting pro-inflammatory cytokines. Over the course of this school year, I will perform numerous experiments using mouse models to determine if LukA/B contributes to the production of cytokines known to be important in inflammation including TNF and IFNg. Since January 2013 I have been working on this project, and have accomplished my original goal and shown that in fact LukA/B does modulate the host response and is a factor in MRSA virulence. Although I have shown this through numerous experiments, our lab is just now incorporating different strains such as SAE and PVL. We are using these strains to compare similarities and differences regarding their virulence in *Staphylococcus aureus*. It is very important to determine which toxins are most important to the bacterium, and also how the different toxins interact with each other to fully understand the pathogenesis of MRSA in mouse models. I look forward to be given the opportunity to continue studying in a bacterial pathogenesis laboratory as it directly relates to my career goal of becoming a medical laboratory scientist.

Emma Hannigan: Chemistry & Biochemistry
Mentor: Mary Cloninger - Chemistry & Biochemistry
Cancer Cell Aggregation Studies Using Carbohydrate Functionalized PAMAM Dendrimers

Many cancer cells, such as the A-549 lung cancer cell line, over-express the lectin galectin-3 (gal-3). Gal-3 has a β-galactoside-specific binding site, which allows it to bind to carbohydrates at the cancer cellular surface. The collagen-like tail on gal-3 can oligomerize, causing cellular aggregation and tumor formation. The Cloninger lab uses dendrimers - branched macromolecules that can be functionalized with different ligands such as carbohydrates - to study the gal-3 mediated aggregation processes. The specific aim of this project concerns the aggregate behavior of cancer cells in the presence of carbohydrate functionalized poly(amidoamine) (PAMAM) dendrimers to better understand how cancer cells are affected by these protein-carbohydrate interactions. Cellular aggregation assays are performed to understand how different cancer cells behave when glycodendrimers are placed in solution with the cancer cells. Initial finding have shown that smaller glycodendrimers inhibit cellular aggregation, while larger generations promote aggregation. Further assays are being performed to discover whether this trend is universal for all cancer cells that over-express gal-3. The results from these assays will allow us to better understand how cancer cells that over-express gal-3 can be modified and controlled. A better understanding of these interactions could lead to possible therapeutics that could block the gal-3 mediated pathway that causes cellular aggregation and tumor formation in patients.

Acknowledgements: Jessica Ennist, Anna Michel (Doctoral Students) - Chemistry & Biochemistry

Devin Hansen: Physics
Mentor: Nicolas Yunes - Physics
Can Gravitational Waves Rule Out Lorentz Violations in Gravity?

Gravitational wave astronomy will provide opportunities for observational tests of alternative theories of gravity. These waves contain information about the underlying theory of gravity that can be extracted with appropriate data analysis techniques. We examine one such modified theory, Einstein-Aether theory, which violates Lorentz symmetry. We study whether the gravitational waves emitted in the late inspiral of neutron star binaries can be used to place constraints on this theory, once these waves are observed with the gravitational wave detectors Advanced LIGO and Advanced Virgo. By analyzing a simulated waveform, we calculate constraints which could be placed on the constants of Einstein-Aether theory given a gravitational wave detection consistent with general relativity.

Leanna Hansen: Cell Biology & Neuroscience
Mentor: Florence Dunkel - Plant Sciences & Plant Pathology
Local Knowledge of Malaria and its Transmission Risks

According to the CDC, 3.3 billion people worldwide live in areas with a risk of malaria transmission. Billions of dollars have been spent on research to eliminate and cure the disease, but there is currently no vaccine on the market to combat malaria. Meanwhile, significantly less investment has been made to investigate the understanding of malaria among the people living in at-risk areas. The goal of this project is to explore the current understanding of malaria and its transmission by a community in an at-risk setting. The rural subsistence farming community of Khwisero, Kenya in western Kenya was chosen. Dr. Florence Dunkel served as a mentor for the project, as she has worked with a community in Mali on similar issues, including malaria, specifically cerebral malaria. Interviews were conducted with sixty women in Khwisero in their homes with the assistance of a pair of translators who spoke the native tribal language, Luhya, as well as Swahili and English. From this research, it has been possible to learn more about how to properly educate community members on methods of prevention that will reduce malaria risk. Nearly all of the subjects owned and regularly used a bed net. However, only one in five would use a bed net during the day when they were sick with malaria. This illuminates a lack of understanding of how the *Plasmodium* can be transferred from one person to another. This transfer can only happen when a person infected with malaria is bitten by a female Enophiles mosquito. Subsequently, that mosquito can bite and infect a

healthy person. Interviews revealed how malaria relates to the Khwisero women's overall goals for their quality of life and how malaria education might be incorporated into currently existing community institutions.

Benjamin Havens: Agricultural Economics & Economics
Mentor: Carly Urban - Agricultural Economics & Economics
Obesity's Predictive Power on Labor Force Participation

This research explores the ability of obesity rates to predict labor force participation. This research is socially relevant because of its potential to help stunt obesity climb by informing policy makers of externalities associated with labor force participation. This study uses a panel data set on a state level accumulated from the United States Bureau of Labor Statistics, Center for Disease Control and Prevention, National Climate Data Center, United States Census Bureau, and the United States Department of Agriculture. The data, while still being collected, will use labor force by state as the dependent variable of interest, percentage of obese adults by state as the explanatory variable, and climate, population density, and climate as control variables. Predictions of the variable effect will be found using a linear regression. The true results of this estimation are still unknown as the dataset has yet to be completed.

Ben Hills: Earth Sciences
Mentor: Jordy Hendrikx - Earth Sciences
Snowpack Densification: An Investigation of Density Change Through Snow Melt and Metamorphosis

Snowpack density was tracked at two neighboring sites to examine the correlation of density variation to both temperature and new-snow accumulation profiles. Thirty density samples were taken every week from each site in order to describe densification rates over the spring season. Although the sites are in close proximity, there is a disparity in the available solar radiation input between them. Temperature and snow accumulation profiles from the surrounding SNOTEL sites at Sacajawea and Brackett Creek are compared with the measured density profile to identify external influences that correlate with deep layer snow densification. Average densities at each site increased by approximately 3-5% each week, more so later in the spring. However, correlation between collected data and SNOTEL data is relatively low. Low correlation may mean that densification is more dependent on internal properties and processes. Perhaps densification rates depend on the length of time in which air temperature exceeds the melting point, or the magnitude of the temperature gradient within the snowpack. Understanding how a snowpack reacts to external influences over time is important in describing how local climate influences snowpack properties, and how that might change in the future. With more research, this data could lead to a better understanding of snow metamorphism rates and the formation of glacial ice, as well as the timing of snowmelt input into the water budget.

Trace Hobbs: Chemistry & Biochemistry
Mentor: Robin Gerlach - Center for Biofilm Engineering
Development of a Clinically Relevant Model Flow System for Observing Struvite Formation by Proteus mirabilis Biofilms

Kidney stones form when ions in urine become supersaturated, resulting in mineral precipitation and aggregation. Struvite ($MgNH_4PO_4 \cdot 6H_2O$) precipitation can be induced by bacteria associated with urinary tract infections, which often consist of *Proteus mirabilis* biofilms. *P. mirabilis* is a ureolytic bacterium; it produces urease, an enzyme that catalyzes the hydrolysis of urea ($CO(NH_2)_2$), generating ammonium (NH_4^+) and increasing the pH of the urine. As the pH rises and ammonium concentrations increase, struvite precipitation can occur in the presence of magnesium and phosphate (PO_4^{3-}). Planktonic culture studies confirmed precipitation of struvite in artificial urine that correlated with growth of *P. mirabilis* or *Escherichia coli* MJK2 (a genetically engineered ureolytic and green fluorescent protein producing model organism). A model flow system has been developed to simulate biofilm formation in the kidney and ureters. The system is being used to investigate the process of microbially induced struvite formation. The flow system is filled with artificial urine and inoculated with ureolytic bacteria to simulate an infected kidney. Liquid and mineral samples have been analyzed to demonstrate that biofilm growth resulted in struvite formation based on mineral analyses and stoichiometric changes of the dissolved ions in the bulk fluid. The

goal of developing the model flow system is to observe initial biofilm growth and struvite mineral formation, and ultimately to develop mechanistic relationships between the two in a clinically relevant system.

Acknowledgements: Ellen Lauchnor (Postdoctoral Researcher), Logan Schultz (Postdoctoral Researcher), Dirk Lange (University of British Columbia) - Center for Biofilm Engineering

Devra Hock, Coralyn Kai Bingman, Zach Reid: Earth Sciences
Mentor: Frankie Jackson, David Varricchio - Earth Sciences
A New Occurrence of Dictyoolithus eggs from the Cretaceous Tiantai basin, Zhejiang Province, China

Due to the large amount of specimens found and the high level of preservation, China has become a key region for research in the study of dinosaur eggs in recent years. The Cretaceous Tiantai basin of Zhejiang Province has yielded numerous new discoveries since 1958 and the Zhejiang Natural History Museum (ZNHM) houses many of these specimens, representing many different ootaxa. A grant from the Natural Science Foundation's International Research Experience for Students has allowed undergraduate students from Montana universities and colleges to conduct research on the collections at ZNHM since 2010. The goal of our research is to provide a comprehensive description of *Dictyoolithus* through microanalysis of eggshell structure, including nucleation sites, eggshell layers and gas conductance. In addition, macroanalysis of these eggs will include ornamentation, eggshell thickness and egg size. Preliminary results of the macroanalysis include averages of egg size and eggshell thickness, as well as comments on the completion of the eggs and the description of surface ornamentation. We sampled four specimens from ZNHM and plan to further analyze thin sections using scanning electron microscope (SEM) images and ImageJ in order to identify diagnostic characteristics of Dictyoolithus. This study will change the way *Dictyoolithus* eggs are identified and provide a better understanding of how this eggshell structure evolved.

Nicholas Holom: Agricultural Economics & Economics
Mentor: Carly Urban - Agricultural Economics & Economics
The Economics of Violence

As gun violence in the U.S. continues to influence policy, the effectiveness of such policies has remained unclear. This study examines how gun violence rates and beating/stabbing rates vary across states of strict and lenient gun policy. The experiment uses Brady Scores, a grading system developed to estimate the stringency of each state's gun laws. States are grouped on a pass/fail basis determined by each state's Brady Score. The groups are then compared using statistics from the FBI's Uniform Crime Reports and the Census Bureau. A linear regression model estimates the effects of population density, education, poverty, and pass/fail status on gun violence rates and beating/stabbing rates.

Holly Howe: Psychology
Mentor: Rebecca Brooker - Psychology
Cognitive Control: Physical Responses of At Risk Adults Due to High Allostatic Load

Cognitive control describes mental flexibility and attention control (Viding, 2004); High levels of cognitive control are typically associated with fewer internalizing and externalizing psychological symptoms (Beach, 2013) and greater academic achievement (Coldren, 2013). Recently, cognitive control has also been associated with high allostatic load, a long term risk factor for physical health problems, in individuals with chronically high stress levels (Seeman, 2001). First-generation college freshmen experience greater stress than returning-generation college students (Hellhammer, 2004), which may require greater cognitive control and lead to greater allostatic load. If this is the case, high cognitive control could lead to decreased physical health for first-generation students despite psychological benefits. Investigating this possibility is the goal of the current study. In a population of 40 first-generation undergraduates, mental health symptoms are measured via self-report. Allostatic load is measured via salivary cortisol levels, resting heart rate, and self-reported physical health. Neural markers of cognitive control are also assessed. Academic achievement will be measured using academic transcripts. Data collection and analyses are ongoing; however, we hypothesize that first-generation college freshmen with high levels of cognitive control

will have greater allostatic load but better mental health and stronger academic achievement than students with low cognitive control.

Sydney Jaramillo: English
Mentor: Dave Swingle - History & Philosophy
The Making of an Effective Visitor-Orientated Museum

A museum is an institution whose purpose is to serve and educate the public while preserving history through its collections; however, a museum cannot exist without its visitors. Although strong research programs and rich collections are important and essential items to a museum, a research program without visitors is simply a research facility; and a museum with excellent collections but without visitors is only a collection. Visitors are essential to a museum's success. A museum's effectiveness can be evaluated on its research programs, collections or visitor experiences. This paper will focus on visitor experience, as it is the most vital element of a museum's existence. There is no way to conjure a list of ways a museum can be effective for visitors and there is no formula to follow. The only way to discover a museum's effectiveness is to observe quality museums. By visiting a variety of museums, I was able to deduce some aspects of a successful museum that make it visitor-orientated.

Spencer Jenko: Economics
Mentor: Carly Urban – Agricultural Economics & Economics
Effect of medical marijuana laws on standardized test scores among underage youth

This paper examines the effect of medical marijuana laws on standardized test scores among underage youth. Medical marijuana programs are a part of a growing movement to provide the drug as an alternative pain medicine for patients with qualifying conditions. Yet addicts can exploit these programs as a legal means to acquire the substance and re-sell it for profit on the black market. With underage consumption of marijuana on the rise across the U.S, dispensaries in urban areas increase availability to underage users, which in turn can harm academic performance. Using ACT data from the National Center for Educational Statistics, and marijuana statistics from individual State government databases, we conducted a DDD estimation of the treatment effect on states that enact the law. We find that states with a program in place had a small, but significant increase in ACT score averages across all sections. The results suggest that having a medical marijuana program in place doesn't negatively impact standardized testing scores, and that improvement on testing is significant, if not relatively small.

Phyu Pannu Khin: Cell Biology & Neuroscience
Mentor: Christa Merzdorf, Daniel Van Antwerp, Jennifer Forecki - Cell Biology & Neuroscience
Positioning the Midbrain-Hindbrain Boundary during Nervous System Development

One of the important steps in neural development is the formation of the boundary between the midbrain and the hindbrain. We study gene expression and interactions in the development of the midbrain-hindbrain boundary (MHB). Specifically, we examine how the transcription factor gene zic1 contributes to the formation and positioning of the MHB. Previously, the Merzdorf lab has performed standard zic1 gene manipulations on embryos; observing changes in intensity and positioning of en-2 gene expression which is a marker for the MHB. Thus, we have started examining the mechanisms which may help to explain the developmental cell changes at the boundary. These changes may include cell division and apoptosis (programmed cell death). In my project, I have used TUNEL, DAPI , Caspase and phosphohistone-3 (pH-3) stain to determine if apoptosis or cell proliferation, respectively, occur at the MHB as a result of zic1 missexpression. The results of these studies will provide evidence that a net gain or loss of cell numbers causes the shift in en-2 gene expression, which can then lead to malformation of the MHB.

William Kirk: Physics
Mentor: Randy Babbitt - Physics
Multi-Spot laser vibrometry through AOD diffraction

Laser vibrometry offers a non-contact means of detecting vibrations from. When light scatters from a non-moving surface, the reflected light has the same frequency as the incident light. If the surface is moving toward or away from the light source, a Doppler shift is induced upon reflection. By detecting this Doppler shift by optical heterodyning the return light with the transmitted light, vibrational information can be extracted and used to better understand the surface dynamics at the point where the beam is directed. Currently systems use a single beam, which can be scanned across the surface to gain information about the vibrational modes of the whole surface. The proposed set-up uses multiple spots to gain vibrational information from each point simultaneously, enabling faster parallel sensing and correlated measurements across the surface.

Benjamin LaFrance: Chemistry & Biochemistry
Mentor: Trevor Douglas - Chemistry & Biochemistry
Protein Cage Nanoreactors and Hierarchical Assemblies with P22

Our increasing call for energy throughout the world warrants the development of innovative systems to meet these demands. In recent years, nanoreacters have gained popularity due to size, functionality, and versatility.The Douglas Lab has shown a multitude of different nanoreactor cargoes can be encapsulated inside a protein cage known as P22. One specific cargo of interest is a Galactosidase enzyme (GalA), which is a potential candidate for biofuel production. GalA typically forms an insoluble aggregate under heterologous expression in *E. coli*. Our results indicate that genetic encapsulation of GalA inside P22 can salvage GalA from inclusion body formation, and that enzyme activity is not affected by encapsulation. Now that catalytically active cargoes can be encapsulated inside P22, there is a push to create functional materials and large scale assemblies of the system. Such P22-cargo assemblies can provide macroscopic platforms for applications ranging from energy production to flow cell reactors. Current research focuses on creating hierarchical assemblies out of the P22-cargo moieties. Utilizing a genetically modified linker molecule known as Dec, which non-covalently decorates with the P22 exterior, a hierarchical assembly was created and characterized as a proof-of-concept biomaterial. Results from light scattering, TEM, SAXS, and QCM indicate that P22-cargo particles are indeed interacting to form hierarchical assemblies. This protein cage assembly provides a novel biomaterial platform with future applications in biofuels, energy production, and gas storage.

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Shane Leary: Mathematical Sciences
Mentor: Carly Urban – Agricultural Economics & Economics
Effect of Win Percentage on Home Attendance of NFL Games

This project uses linear regression to estimate a model which explains home attendance for the National Football League. The main determinant of interest is home team winning percentage. Other response variables include week of the season the game is played, year (2012 and 2013), indoor or outdoor game, if the team was a playoff team the previous season, conference and division rival. Data was collected from every game of the 2012 and 2013 regular seasons. Early tests show that of all the response variables, being a playoff team the previous season may have the greatest impact on attendance, even more so than home team win percentage.

Jake Lindquist: Physics
Mentor: Aleks Rebane - Physics
Harnessing wavelength-tunable femtosecond laser for accurate measurement of two-photon absorption spectral profiles

Reference standards provide a unique, time saving method of correcting for fluctuations in laser parameters on a daily basis for two-photon absorption (2PA) measurements. In order to get accurate reference standards, one

needs a tunable femtosecond laser, to be able to characterize the beam profile, correct for power fluctuations, and know the pulse duration of the laser very accurately. To do this, we have built a setup around a SpectraPhysics InSight DeepSee laser that includes a second-harmonic generating autocorrelator (2HGAC) to accurately measure the pulse duration, a CCD camera that images the spatial beam profile, two power detectors, and a fluorescence detection setup to measure the 2PA of our sample. We use the method of two-photon excited fluorescence (2PEF) to measure the absorption spectra of multiple commercially available dyes in the wavelength range 680-1300 nm. We will show current results, which have an approximate accuracy of plus/minus 10%.

Patrick Madden: Chemistry & Biochemistry
Mentor: Trevor Douglas - Chemistry & Biochemistry
Investigating the P22-Dec protein system as an influenza vaccine platform

Using the P22-virus like particle (VLP) and the Decoration protein isolated from bacteriophage L to deliver influenza viral proteins to the immune system will allow for a novel influenza vaccine. The Decoration (Dec) protein from bacteriophage L will bind to the outside of the P22 capsid. Hemagglutinin (HA) protein from the influenza virus will be genetically fused to the C-terminus of the decoration protein, which will extend it away from the surface of the P22 capsid. Conserved regions of HA will be used to attempt to elicit a cross-protective antibody response that will protect the mice from multiple influenza strains. The in vivo effects of the P22-Dec-HA construct will be probed by using a model mouse system. The size, length, and fold of the HA protein needed to elicit a broadly neutralizing cross-protective antibody response will be studied using many techniques. Dec binding will be determined using surface plasmon resonance. The data gathered about the ability of the P22-Dec system to elicit an immune response in vivo, as well as the ability of Dec to bind P22 with different sizes of polypeptides will be critical in the development of the P22-Dec system as a vaccine platform for many other viral infections.

Kelsey March: Cell Biology & Neuroscience
Mentor: Thom Hughes - Cell Biology & Neuroscience
Baculovirus Screening for Fluorescent Sensors

Cells, especially neurons, use changes in voltage for signaling. Our lab has been working on creating fluorescent voltage sensors to measure these changes optically. The single largest problem facing our field, however, is that it is very difficult to transfect neurons to express and test our sensors. My goal is to create a simple, highly efficient vector to introduce sensor prototypes into neurons. Baculovirus replicates extremely quickly and efficiently in Sf9 (moth) cells. It can also enter, but not replicate and kill, human cells. This means that if it is carrying a gene of interest, it is a good way to create and deliver many copies of that gene to neurons in culture, but is also safe for experimental use. I am creating a new baculovirus vector from the pFastBac Dual expression plasmid, which can be easily moved via Tn7 sites into the BAC containing everything necessary for buculovirus. I am inserting a human promoter in front of a fluorescent protein for expression in neurons. I am also adding the VSVg sequence with the necessary insect promoter so that the protein will be expressed on the virus, allowing entry into human cells. This system will allow our lab to screen voltage sensors ourselves and reach much quicker results.

Madison Martin: Microbiology & Immunology
Mentor: Michelle Flenniken, Brian Bothner - Plant Sciences & Plant Pathology, Chemistry & Biochemistry
Evaluation of the Metabolic Signatures of Virus-Infection and Agrochemical-Stress in Honey Bees

Honey bees are critical pollinators of agricultural crops (e.g., almonds, apples, oranges) that are valued at $14.6 billion annually in the USA. Since 2006, annual bee colony losses have averaged 32% (up from ~ 12% historically). These losses are partially attributed to Colony Collapse Disorder (CCD), an unexplained phenomenon associated with increased pathogen incidence and abundance, though additional factors may contribute to colony losses. To quantitatively examine the effects of biotic (virus-infection) and abiotic (agrochemical) stress on honey bees, we performed metabolic profiling using mass spectrometry. We hypothesize that the honey bee metabolome is altered by virus-infection and agrochemical-exposure. To address this hypothesis, metabolites were obtained from individual honey bees infected with a model (+)ssRNA virus (Sindbis-GFP) and virus-infected bees that were also exposed to an agrochemical (Pristine®:active ingredients:12.8% pyraclostrobin, 25.2% boscalid) via their diet.

Metabolites were analyzed using liquid chromatography-mass spectrometry (LC/MS) and compared using XCMS and metaXCMS computational programs in the R framework. Principal Component Analyses (PCA) of the metabolomes of virus-infected vs. mock-infected bees were distinct. Differential analysis of virus-infected bees vs. mock-infected bees determined that more than 280 compounds had more than a 3-fold change in abundance ($p<=0.005$); some with putative roles in metabolism and cellular trafficking. In addition, this analysis revealed a greater abundance of the metabolic signatures of the cytochrome P450 (detoxification) pathway in agrochemical-exposed bees. Together our results demonstrate the utility of metabolomics to examine the physiological consequences of biotic and abiotic stress in honey bees.

Acknowledgements: Jonathan Hilmer (Mass Spec Facilities Director), Monika Tokmina-Lukaszewska, (Postdoctoral Fellow, Bothner Lab) and members of the Flenniken Lab: Laura Brutscher (Doctoral Student), Emma Garcia (Undergraduate Student), and Katie Daughenbaugh (Research Scientist)

Jonathan Martinson: Microbiology & Immunology
Mentor: Seth Walk, Blake Wiedenheft, Royce Wilkinson - Microbiology & Immunology
Inactivation of Clostridium difficile toxin gene, tcdB, using CRISPR mutagenesis

Clostridium difficile is an anaerobic, Gram-positive, spore-forming bacterium and is the most common cause of hospital-acquired infection with approximately 5.9 cases of disease per 1000 patient admissions. The severity of disease caused by *C. difficile* varies from mild, self-limiting diarrhea to a life-threatening pseudomembranous colitis (i.e. severe inflammation of the colon). Essential to *C. difficile* pathogenesis are two large toxins, TcdA and TcdB, which inactivate eukaryotic GTP-binding proteins and lead to cell death. The genome of *C. difficile* has been largely inaccessible to manipulation with current molecular biology tools because of its highly developed restriction modification system and the instability of genetically modified mutants. CRISPRs (Clustered Regularly Interspaced Short Palindromic Repeats) act as a prokaryotic immune system and may provide a new mechanism for genetically modifying *C. difficile* isolates. The goal of this project is to create a plasmid genome that encodes the CRISPR mutagenesis machinery and target sequences necessary to create a deletion in the *C. difficile* toxin B gene, tcdB. Challenges with plasmid quality, antibiotic resistance, and assembly of genetic loci are being addressed.

James Mauch: Earth Sciences
Mentor: Colin Shaw - Earth Sciences
Fluid inclusion and microstructure insights into deformation conditions of the Cordillera Blanca Detachment shear zone, Peru

The Cordillera Blanca Detachment (CBD) shear zone in central Peru represents an important class of mid-crustal extensional structures in convergent orogenic settings. The CBD has an ignimbrite/basin fill hanging wall and granodiorite footwall, is 200 km long, and dips WSW at <40°. This project uses fluid inclusions and their microstructural settings to constrain pressure, temperature, and fluid composition during CBD deformation. Microstructure features of mylonite samples from Quebrada Honda include 2-9 mm diameter feldspar porphyroclasts embedded in a fine grain recrystallized quartz matrix. Quartz exhibits subgrain rotation and grain boundary migration, qualitatively indicating moderate-high temperature deformation. Fluid inclusions occur in three settings, all interpreted to be synkinematic to CBD deformation: 1) recrystallized quartz veins, 2) quartz tails of sheared porphyroclasts, 3) quartz-filled Mode I fractures in feldspar porphyroclasts. Microstructure measurements indicate Mode I fractures average 68° from the up-dip S_1 foliation. ~90% of observed fluid inclusions occur in a scattered distribution, ~10% occur in linear arrays interpreted as annealed microcracks. Linear arrays average 78° from the up-dip S_1 foliation. Inclusions are 0.5-6.0 µm in diameter, and ~75% have liquid and vapor phases at ~25°C. Preliminary heating/freezing stage analysis indicates fluid inclusions are H_2O-electrolyte aqueous solutions with a 3.5°C freezing point depression and ~6% salinity. Homogenization temperature from liquid-vapor to liquid phase is ~165°C. Continued work will involve constraining temperature of the eutectic point and other phase transitions, which will allow determination of fluid molar volume and pressure/temperature deformation conditions along the CBD.

Will McGuinness: Microbiology & Immunology
Mentor: Jovanka Voyich - Microbiology & Immunology
Propensity of Novel Staphylococcus aureus Bacteriophage Therapeutics in Conjunction with Iron-doped Nanoparticles

There are approximately 10^31 tailed bacteriophage in the biosphere, making them the most abundant organism. Phage are viruses that infect bacteria. Due to the large diversity and abundance, no two bacteriophage that have been isolated are genetically identical. Phage products have potential in disease therapy to mitigate the steady advance of antibiotic resistant strains of bacteria, such as methicillin-resistant *Staphylococcus aureus* (MRSA). In the current study, a bacteriophage specific to *S. aureus* was isolated from bovine hair. The bacteriophage was characterized using purification, amplification, cesium chloride banding, gel electrophoresis, transmission electron microscopy and scanning electron microscopy. These characterizations were the first step in understanding the distinct properties associated with Staphylococcal phage JB. We next investigated the ability of nanoparticles to increase the infectivity of JB phage. Results show mixing JB with a 30.0% iron-doped hydroxyapatite nanoparticle caused a significant increase in bacteriophage infectivity. To determine if the phage-nanoparticle cocktail influenced the ability of the bacteriophage to eliminate *S. aureus* infection we used in vivo mouse models, which included skin and intraperitoneal infections, Results demonstrate that the phage-nanoparticle cocktail had a significant impact on reducing bacterial burden in both models. These data suggest phage-nanoparticle cocktails could be developed to treat complex multi-drug resistant infections and/or wound management.

Acknowledgements: Austin Moody (Graduate Student), Marisa Pedulla (Professor, Montana Tech), Rajendra Kasinath (Associate Professor, Montana Tech) - MSU Graduate School, Biological Sciences, Environmental Engineering

Logan Moriarty: Modern Languages & Literatures
Mentor: Pascale Hickman - Modern Languages & Literatures
Moroccan French Phonetics: Beyond Le Français Standard

The spoken language of the middle rung of Paris's traditional middle class – the bourgeoisie – carries the title of *Le Français Standard*, or "Standard French". However, by labelling this minuscule variant of the entire language as "standard", the remaining majority of French found in all corners of the world goes neglected and virtually undocumented. This project focuses on the phonological differences of one of these underrepresented minorities – Moroccan French. I have crafted 36 phrases that test French's 36 phonemes a minimum of ten times each. Native Moroccans will be recorded reading the phrases, and these recordings will be transcribed into the International Phonetic Alphabet and compared to those of *Le Français Standard.* After travelling to Morocco to gather data, I expect to find results of Arabic influence in Morocco's spoken French. With the information gained from this project, I hope to crack the surface on studying, preserving, and celebrating the diversity in French.

Luke Morton: Chemistry & Biochemistry
Mentor: Trevor Rainey - Chemistry & Biochemistry
Elucidation of Palladium-catalyzed Enantioselective Reactions

As the market for biologically active chemicals grows, increasingly sophisticated methods for synthesizing these chemical species have necessarily been developed to meet the demands for increased control over the minutia of organic synthesis. One such synthetic process, known as the Wacker process, was first discovered some fifty years ago and has since been continuously utilized to achieve a significant variety of organic synthetic goals. Since then, variation has allowed a great number palladium-catalyzed reactions to evolve from the principle behind this process. While the Wacker process has been thoroughly utilized and many mechanistic pathways are fairly well understood, there are many which have not been perfected, many which do not have entirely understood mechanisms, and many potential synthetic routes which have not yet been probed. The proposed research continues with three primary objectives: to utilize the knowledge of synthetic and analytical techniques garnered during the previous term of research to screen five substrates synthesized therein to complete the optimization of the reaction conditions for a palladium-catalyzed enantioselective intramolecular oxidative amination, the next is to probe the mechanistic pathway of the reaction, and the last is to test a proof-of-concept for the

enantioselective oxidation and Suzuki Cross-Coupling of organo-palladium intermediates. Each of these goals will help to expand the possibilities for developing new and more effective methods for synthesizing any number of biologically active compounds and may open many doors in the future due to a potential for increased control over the enantiomers produced during synthesis.

Acknowledgements: Andrew Aebly (Doctoral Student) - Chemistry & Biochemistry

Lindsay Murdock: Sociology & Anthropology
Mentor: Cody Warne, Danielle Hidalgo - Sociology & Anthropology
The Female President: Equality as a Top Down Strategy

This research seeks to determine how administrators at a Land Grant University act out gender and how the these gender roles impact the Promotion and Tenure process, credibility within the department, and finally, how gender discrepancies are propagated by the division of labor. The majority of the literature on gender roles in leadership focuses on government, community or K-12 education so the current research seeks to fill those gaps. Though there were several emergent themes, the two that stood out the most were the "Small Touches" theory and the women vs. women phenomena present in other research. Additionally, being female does allow for more exploration of masculinity in leadership styles, but feminine leadership styles are still criticized. There was also an incredible emphasis on mentorship within the workplace - and there have been significant strides to increase both funding to and outputs from current mentorship programs. Finally, throughout this research there was talk about the feminization of higher education and the implications for future female leaders in higher education. Utilizing data from within MSU and from the other 109 Land Grant Universities nationwide, this research seeks to support these emerging themes with data on promotion, tenure and salaries at all levels of the institutions bureaucracy.

Connor Murnion: Cell Biology & Neuroscience
Mentor: Frances Lefcort - Cell Biology & Neuroscience
Motor Innervation in a Familial Dysautonomia Mouse Model

Familial dysautonomia is a human genetic disease of the peripheral nervous system caused by a mutation of the gene which codes for the protein IKAP. The disease is characterized by many symptoms including unstable blood pressure, decreased sensitivity to pain and temperature, vomiting crises, and susceptibility to pneumonia. Of particular interest to this project was understanding the mechanisms behind the muscle weakness and scoliosis which affect those with the disease. Using fluorescent immunohistochemical staining of IKAP conditional knock out mouse tissue, a number of differences in the neuromuscular juncitons (NMJs) of the mutant were found. These include a decrease in axonal innervation and Schwann cell association, and differences in endplate morphology. These results indicate that FD does indeed affect proper innervation and formation/maintenance of NMJs.

Patrick Murphy: Mathematical Sciences
Mentor: Tomas Gedeon - Mathematical Sciences
Models for Division of Labor in Microbial Consortia

Multi-species consortia are prevalent in nature, where the interactions between species can create systems that allow different species to specialize in one part of metabolic process. This specialization is thought to allow individual species to increase their fitness and survival rate. Classes of equations for chemostat or chemostat-like environments often model the change in the nutrients, inhibitors, and the biological species present by a set of variables, whose evolution in time is governed by a system of differential equations. My project was to analyze these models for bacterial consortia to determine if they modeled this kind of behavior and what kinds of predictions could be derived from them. We showed that the dynamics of a large class of models can be reduced to a smaller driving system of four variables, which could be reduced further to two variables. The long term dynamics of the system could then be determined from the dynamics of this smaller system. We found that based on the equilibria of the system and their stability, these models do predict that multi-species coexistence equilibria

are stable. These results are important since, by finding when and how these types of consortia work together, applications of microbial cultures such as waste treatment and biofuel production can be better understood and utilized.

Aniko Nelson: Agricultural Economics & Economics
Mentor: Carly Urban - Agricultural Economics & Economics
Football Success and Student Body Academic Success

This paper will be analyzing the possible relationship between NCAA football success at Montana State University and the academic success of students enrolled in Economics 101 during the fall semester. To measure football success I will create a binary variable, with the dummy variable equal to 1 for a win. I will also measure football success in terms of winning percentage based on the final scores of each game. Then a comparison to the weekly mean homework, quiz, and test scores following each game for the ECNS 101 students. Results of this project lends supportive evidence to the growing literature on the effect of athletic success and academic success at universities. This literature has policy relevance due to the substantive funding universities receive from various levels of government, based on academic quality.

Kristen Newman: American Studies
Mentor: Robert Rydell - History & Philosophy
Service Animals and Museum Collections: Navigating Equal Opportunity in Employment, Volunteerism and Visitor Services While Maintaining Low Impact on Preservation Standards

Museums are an invaluable repository for public history and within them they house some of our nation’s most important artifacts. Many museums follow strict preservation standards which minimize potential for destructive pests to infiltrate collections. Within these standards, many museums have adopted strict “no pet” policies; however, they must adhere to the Americans with Disabilities Act “generally, permitting service animals to accompany people with disabilities in all areas where members of the public are allowed to go.” Museums face a unique situation in which they could legally claim the service animal as an “undue financial hardship” referring to the potential for the animal to introduce harmful pests to the collection. Service animals are a fast growing alternative and complimentary approach to treatment of not only medical conditions but psychiatric conditions as well. As many of our veterans are being diagnosed with traumatic brain injuries and post traumatic stress disorder, they are being paired with service animals who have been specially trained to ameliorate their symptoms. Thus, we are seeing an influx of service animals accompanying people in museums, who previously may not have had to concern themselves with navigating equal access to sensitive areas.The Smithsonian Institution has been successful in integrating service animal teams in all areas of their facility. Using the Smithsonian as a model, as well as personal experience in strict service animal hygiene standards, museums can refer to this suggested protocol as they navigate through equal opportunity in all areas while maintaining strict preservation standards.

Brigit Noon: Chemistry & Biochemistry
Mentor: Brian Bothner - Chemistry & Biochemistry
Metabolite Diffusion of a Microfluidic H-Filter

The analysis of metabolites from biological fluids is of particular interest to the biomedical community because metabolites can be used as biomarkers to identify organismal disease, environmental stress and genotype alteration. There is considerable interest in the development of microfluidics devices that are capable of separating proteins and other large biomolecules from metabolites to improve efficiency and cost of sample preparation and analysis. The H-filter in particular is an appealing design for such a separation because of its simplicity; it is capable of separating analytes based on molecular weight through simple diffusion across a laminar flow interface fed by two discrete sources. However, my past research has demonstrated that a prototypic model with a linear central channel is not highly effective in practice. A design incorporating a central channel that spirals inwardly is likely to be more efficient because it allows for an elongated region of fluid contact in addition to subjecting analytes to a centripetal force, aiding in separation and sample purity. H-filter chips used in the lab are fabricated from PDMS (polydimethylsiloxane) and sealed to glass microscope slides using oxygen plasma. Separation of proteins and

small molecules is quantitated by UV-Vis spectrophotometry and verified with mass spectrometry. In the future, if devices that incorporate these basic microfluidic designs and techniques can become fully automated, they have potential to be used for diagnostics, particularly impacting low-resource areas and developing countries.

Acknowledgements: Joshua Heinemann (Doctoral Student) - Chemistry & Biochemistry

Delaney O'Hara: Sociology & Anthropology
Mentor: John Fisher - Sociology & Anthropology
The Relationship Of Ballistics And Bone Fragmentation: Firing Distance Identification In Postmortem Deer Long Bone

Wound ballistics proves to be an important field of study in forensic cases for determining evidence in crimes involving firearms. Studying how firearms affect human tissue has enabled investigators to gain an even deeper insight into the cases they study. One important aspect of wound ballistics is firing distances and its effect on human tissue. In this experimental study, four deer metacarpal/metatarsal bones are fired at from four different distances with a 9mm pistol in order to determine whether distance has an effect on the amount bone fragmentation. Distances of 5 feet, 10 feet, 15 feet, and 20 feet were selected in order to re-create close distance firearm crimes. If bone demonstrates unique fragmentation patterns to each distance, this knowledge would be highly useful in investigating crime scenes . After firing a single bullet into each deer metacarpal/metatarsal, including surrounding muscle, skin, and fur, the bones were cleaned and fragments were counted and measured. The distances of 10 feet and 15 feet showed the highest fragmentation levels, with 15 feet being the most destructive. Five feet had the lowest amount of fragmentation, most likely due to the high velocity of the bullet at impact at that distance. Based on the results of this study, it is highly likely that there are different amounts of bone fragmentation from different firing distances. Further research should be done in order to increase sample size to further substantiate or refute the results of this pilot study.

Jacob Parker: Physics
Mentor: Charles Kankelborg - Physics
Continuing Radiometric Calibration of the MOSES Rocket Payload

The Multi-Order Solar Extreme Ultra Violet Spectrograph (MOSES) rocket payload is a novel instrument for imaging the solar atmosphere in extreme ultraviolet (EUV) wavelengths. We report progress toward the radiometric calibration of the MOSES rocket payload. The first run of our experiment has provided several images of our EUV source. Analysis of these images allows us to identify areas for improvement in both our ground support equipment (GSE) and our experimental procedure. We are developing improved data processing routines and building new GSE for a second run of radiometric calibration testing.

Kirra Paulus: Microbiology & Immunology
Mentor: Blake Wiedenheft, MaryClare Rollins - Microbiology & Immunology
Viral Suppressors of CRISPR-mediated Immune Systems in Bacteria

Viruses that infect bacteria are the most diverse and abundant biological agents on earth, cause roughly 10^{24} infections every second. To escape viral predation bacteria have evolved sophisticated adaptive defense systems that rely on Clusters of Regularly Interspaced Short Palindromic Repeats (CRISPRs). Immunity to viruses is acquired by integrating short fragments of invading DNA at one end of the CRISPR locus in the bacterial genome. CRISPR loci are transcribed and the RNA is processed into a library of short RNAs the guide the immune system to DNA targets that are complementary to the RNA guide. However, viruses have evolved diverse mechanisms to suppress the bacterial immune system. Here we show how virally encoded suppressor of the CRISPR system shut down the bacterial defense and render the host sensitive to viral infection. Three tagged anti-CRISPR proteins were grown from plasmids transformed into *E. coli* cells and purified the proteins utilizing a resin with an affinity for the tag. Experiments have begun with expectations to determine the exact interaction between the anti-CRISPR protein

and the CRISPR complex. The study of this system has great implications on the development of phage therapy to combat bacteria that have developed multi-antibiotic resistance.

Acknowledgements: MaryClare Rollins (Research Associate), Delisha Meishery (Doctoral Student) - Microbiology & Immunology, Molecular Biosciences

Natasha Pettinger: Chemistry & Biochemistry
Mentor: Bern Kohler - Chemistry & Biochemistry
Ultrafast Photoreduction of Cerium Oxide Nanocrystals and Precursor Complexes in Aqueous Solution

Several aqueous Ce(IV) systems were studied using ultrafast transient absorption. When present in water above pH 0.7, Ce(IV) was found to spontaneously form nanoparticles of around 8 nm in diameter. Nanoparticle formation occurs at constant pH, but exhibits a strong solvent kinetic isotope effect, indicating a mechanism involving proton transfer. CeO_2 nanoparticles display distinct photochemical and photophysical behavior from their precursor complexes, and from Ce(IV) dissolved into low pH (<0.5) aqueous solution. Transient absorption signals of CeO_2 nanoparticles show strong excited state absorbance above 330 nm that decays following a second order kinetic model. Second-order kinetics in nanoparticle systems model diffusion controlled electron-hole recombination. In contrast, solutions containing Ce(IV) monomers and dimers undergo efficient reduction by a complexed oxygen, with back electron transfer occurring within the first 2 ps after excitation. Hydroxyl radical is produced during the photoexcitation of both the Ce(IV) nanoparticles and the Ce(IV) monomers and dimers.

Nicholas Peyton, Matthew Evans: History & Philosophy
Mentor: Robin Hardy - History & Philosophy
The New North Africa

Independence in Morocco brought enormous change to the gender dynamics and international position of the country, reflecting an overall shift to greater gender equality and a more international outlook. These two changes are deeply intertwined, with domestic Moroccan gender dynamics playing an enormous role in shaping international views on Morocco, particularly in the West; Morocco' s role as a gender-progressive Muslim country has been extremely important in building close links to the West. This new gender dynamic was borne out of the struggle for independence, in which women took an active role in the resistance to French colonialism and played a pivotal role in freeing the country. Another influence on gender dynamics in Morocco was the intermixing of Berber and Arab culture during the independence movement, creating a uniquely Moroccan concept of gender that draws on both traditions. Despite some attempts to downplay women's role in independence, the new gender dynamic borne out of the independence movement still carries enormous weight in Moroccan society, creating a uniquely Maghrebi and Islamic brand of feminism. Finally, Western influence through globalization and the French colonial legacy has created pressure on women to look, dress, and act European, a trend seen particularly in public Moroccan women such as actresses and models.

Scott Phelan: Agricultural Economics & Economics
Mentor: Carly Urban - Agricultural Economics & Economics
State Gun Laws and School Related Violent Deaths

The goal of this project is to examine a relationship between state gun laws and school shootings. Understanding how state gun laws affect the outcome of school shootings is important in helping develop policies that curb gun violence in schools. This project utilizes data from the National School Safety Center's Report on School Associated Violent Deaths. The dataset contains all school associated violent deaths in the United States from 1992 to 2010. In addition, this project utilizes state legislation to isolate when a given gun law was passed. The project uses a difference-in-difference model by looking at comparing states to themselves across time as well as each other. The difference-in-difference estimate determines a relationship between state gun laws and school shootings.

Julia Platt: Mathematical Sciences
Mentor: Tomas Gedeon, Lisa Davis - Mathematical Sciences
Mathematical simulation of traffic flow and torque for bio-polymerization processes

Bio-polymerization processes are vital for cellular function. In the case of transcription, the rate at which *E. Coli* can transcribe DNA and produce proteins is critical to the cell's ability to adapt to a changing environment. The MSU Math department is currently working on a project concerning the traffic flow of RNA polymerases along the rrn gene of *E. Coli*. There are three working computer models, a stochastic model, a partial differential equation model (PDE), and an ordinary differential equation model (ODE). For this project, we will be altering the existing models to account for extended polymerases (as the current models make the assumption that each polymerase enzyme is only one nucleotide long). The next phase of this project is to alter the models to account for resisting torque and relaxing torque that each polymerase exerts ahead and behind itself, respectively, as it transcribes the DNA. As the stochastic is the most simple and fundamental model, we will alter its code to accommodate for these changes. I will be running the code for the stochastic model and experimenting with different parameter values to determine its accuracy. Then I will use the stochastic model for initial comparisons with the PDE and ODE models as they are altered to accommodate extended polymerases and torque. The overall goal of this project is to make the three models as accurate as possible in order for us to better understand the mathematics of transcription.

Charles Plummer, Amanda Weber: Ecology, Chemistry & Biochemistry
Mentor: Robert Sharrock - Plant Sciences & Plant Pathology
Structure/Function of the Protein Phytochrome B in Arabidopsis Thaliana

In all vascular plants exists the protein Phytochrome B. This protein undergoes a conformational change when subjected to red light and is directed to the nucleus of the cell in order to activate cellular responses. These responses include, among other attributes, hypocotyl growth, de-etiolation, regulation of the circadian rhythm and resource partitioning. Over the past few decades, many important advances into the understanding of this protein have been made, however the region of the protein that initiates dimerization and signals for nuclear insertion is still greatly misunderstood. Over the past year, mutations involving regional deletions, as well as single nucleotide polymorphisms, were observed in transgenic populations in order to discover how these structural mutations affected the function of Phytochrome B. This study has shown that some single nucleotide polymorphisms in the C-terminus of Phytochrome B will inhibit its ability to dimerize, as well as affecting its movement into the nucleus. Without movement into the nucleus, many developmental signaling pathways are inhibited and the plant will not mature. Other transgenic populations were observed to have fully functioning Phytochrome B when regions containing the locations for these single nucleotide polymorphisms were entirely deleted. As of this time, no firm conclusion for this has been found.

Jacob Remington: Chemistry & Biochemistry
Mentor: Bern Kohler - Chemistry & Biochemistry
Further Probing the Structural Dynamics of Single Stranded DNA Labeled with the Fluorescence Probe 2-Aminopurine Using Time-Resolved Fluorescence Measurements

2-Aminopurine (2AP), a florescent structural isomer of the natural nucleobase adenine, has been used extensively in the literature to elicit protein-DNA interactions. In order for an accurate determination of protein-DNA interactions, a complete understanding of the quenching mechanisms available for 2AP in DNA is necessary. Despite the broad use of 2AP labeled oligomers, a full description of quenching mechanisms has not been determined. This hole in the scientific process is exemplified through the position dependance of 2AP quenching lifetimes in single stranded homo-adenine oligomers. In particular, when the florescent quenching rates of the 2AP on the 5' end are compared to 2AP in the middle of the strand, rates are found to be faster on the end contradicting the best established models. To carefully analyze this paradoxical system, the time correlated single photon counting method will be used to find quenching kinetics using excitation wavelengths that have not been discussed in the literature. During last year's project it was shown that these excitation wavelengths systematically skew the excited 2AP population toward the 2AP in close proximity with neighboring adenines. The goal of this

project is to use this new information to help lay to rest questions that remain in 2AP quenching mechanisms. This will ultimately allow more information to be gained from protein-DNA experiments using 2AP.

Amanda Richards: Microbiology & Immunology
Mentor: Michael Franklin - Microbiology & Immunology
Fluorescent Imaging of Pseudomonas aeruginosa Biofilms

A biofilm is and organized community of cells that use extracellular matrix materials to adhere to surfaces. The matrix is thought to be composed primarily of a polysaccharide. *Pseudomonas aeruginosa*, the test organism, is an opportunistic pathogen that may be found in the lungs of patients with chronic pulmonary diseases such as cystic fibrosis. Interestingly, *P. aeruginosa* has the ability to selectively secrete one of three chemically distinct polysaccharides termed Pel, Psl, and alginate (Alg). Work was primarily done with the strain PAO1 which secretes the Psl polysaccharide. The wildtype as well as mutant strains were used to assess the structures of the biofilm produced through the use of confocal scanning laser microscopy. Also assessed was the effect of calcium on the growth of the biofilm when calcium chloride, normally present in the media, was excluded. It was found from use of a PAO1 ΔpilA mutant strain that the biofilms formed are distinct from each other. This suggests that the pilA gene is necessary for the formation of proper biofilm structure. When calcium chloride is excluded from the media the biofilm formed was not at thick as when calcium chloride is added to the medium. This shows that calcium, although not necessary for biofilm formation, enhances growth of the biofilm.

Stephen Riggs: Agricultural Economics & Economics
Mentor: Carly Urban, Franke Wilmer - Agricultural Economics & Economics, Political Science
How Has Same Day Voter Registration Affected Voter Turnout?

Since the 1960s voter turnout in the United States has been in decline, and remains lower than in many other comparable democracies. This low voter turnout is a troubling sign that citizens are not engaged in the fundamental process of choosing their leaders. Citizens across the United States deal with time conflictions, lack of transportation, and confusing rules. Some fail to remember to register before deadlines. States have sought policies to remedy the problem of deficient turnout, where 10 states have currently enacted a same day voter registration law in an effort to ease the burden of voting. The goal of my research is to create a quantitative study aimed at discovering the effect of same day voter registration on voter turnout by comparing the states that have enacted same day voter registration policies to those that have not. The results gleaned from this study will give insight into the effectiveness of same day voter registration.

Sadie Robertus: English
Mentor: Doug Downs - English
Recollection's Recourse: Analyzing the Rhetoric of Memorial Places

As places designed to retain public memory, memorial sites rhetorically impact public perception of historical events, individuals, and groups of people. This study is currently a work-in-progress; the finished product will survey the rhetorical design and effects of war memorials from multiple countries. The present research specifically concentrates on English war memorials, providing a detailed analysis of the rhetorical pull of the memorial sites as well as the results of such rhetoric on a random selection of the public. Methodology for this project included photography, field notes, interviews, and historical background research.

Michael Ruiz: Sociology & Anthropology
Mentor: John W. Fisher - Sociology & Anthropology
Dead Men Do Tell Tales

The process of removing soft tissue from the remains of a decedent to reveal demographics that are obscured from the view of the anthropologist is known as maceration. Historically there have been a number of acceptable methods of loosening and removing soft tissue including immersion in water, boiling, removing with various chemical solutions, dermestid beetles, and manual removal with a sharp instrument. Each of these methods has

demonstrable drawbacks in time, safety, the potential to damage the remains and required workspace. This methodological report presents the findings of an alternative safe and effective bleaching method for removing soft tissue introduced in 2012 by Mann and Berryman using undiluted household bleach at 8.25% concentration (sodium hypochlorite).

Alyssa Sandner: Ecology
Mentor: Jioanna Carjuzaa, Janelle Rasmussen - Education, International Programs
The story of pursuing a STEM (Science, Technology, Engineering and Math) career as a Middle Eastern undergraduate student

With globalization becoming the natural trend in today's world, the need for STEM (Science, Technology, Engineering and Math) focused majors in the United States' higher education system is becoming more apparent. According to Congress, the economy depends on the increase of the number of STEM careers for America to once again become competitive with other high achieving countries. With only 17 percent of degree distributions focused in STEM, there is a lack of accredited scientists and engineers in the United States to compete with other leading countries like Japan (64%) and China (52.1%). English for Scientific Purposes under the English for Specific Purposes language curriculum has become the leading pedagogical method for other countries to prepare their students. The international classroom and laboratory is becoming a more English dominated field. Six English-fluent students in STEM majors from all over the Middle East were interviewed to discern their experience learning English and selecting their major. The students had to answer questions that inquired about their English studies, their STEM studies, their reasoning for selecting STEM, and if they have worked in **'a'** lab. An analysis of the patterns found among these students has been conducted based on their motivations, experiences, and contributions to the scientific world. The students created many interesting connections between helping people and the pursuit of a STEM major.

Rebekah Schields: Sociology & Anthropology
Mentor: Michael Neeley - Sociology & Anthropology
Archaeology Field School Artifact Analysis and Historical Research

During the summer of 2013, the Montana State University Archaeology Field School was held in Virginia City, Montana. The excavations examined a city block that bordered the main street leading up to the gold mines. Thousands of artifacts were unearthed and students acquired hands on archaeological experience. The aim of the USP project was to process the material remains in order to infer the economic base of early Virginia City businesses through a selected sample of artifacts and historic documentation. Twenty- four artifacts were selected for analysis, including whole glass bottles, and ceramics with visible maker's marks. Historical inventories were used to determine place and time of manufacture, contents, and advertised use. Archival research was conducted at several locations including Virginia City, Helena, and Bozeman to better understand and interpret the history and use of buildings in this historic mining city. This project combines artifact information and historical sources to enhance our understanding of how early residents of Virginia City lived and interacted, and what role this street played in a unique part of American history.

Riley Shearer: Chemistry & Biochemistry
Mentor: Trevor Douglas - Chemistry & Biochemistry
Using Protein Cages as T1 enhanced contrast agents for Magnetic Resonance Imaging

Protein cages, assembled from multiple copies of individual subunits, are versatile materials that have been used in many different applications. We have examined bacterioferritin as well as the capsid derived from the bacteriophage P22 as macromolecular contrast agents for magnetic resonance imaging. We have demonstrated the ability to incorporate manganese (III) protoporphyrin (MnPP) within these protein cages, either at native heme binding sites in bacterioferritin or by conjugation to a cross-linked polymer network (xAEMA) inside the P22 capsid. There was no enhancement in T1 relaxivity of the MnPP loaded P22 cage as compared to free MnPP on a per Mn basis, due to the intermolecular interactions between the MnPP that prevent water access to the metal site.

However, a high loading capacity of more than 1,200 manganese ions means that each P22 cage exhibits a significantly enhanced per particle relaxivity. The bacterioferritin, with natural heme binding sites, were explored in hopes of preventing the intermolecular interactions. We were able to replace the natural heme groups in bacterioferritin with MnPP by removing the natural heme groups with a series of acetone washes before incubating the protein with dissolved MnPP. However, this method does not fill all of the natural heme binding sites, and with only 3 MnPP loaded per cage there was not a high enough concentration to measure relaxivity. To maximize the number of ions loaded per cage toward creating an enhanced MR contrast agent, polymerized P22 will be explored using metals such as Fe(III), Mn(III), and Gd(III) coupled with chelating ligands such as DTPA. Different porphyrins will also be explored with the intent of reducing the intermolecular interactions and maximizing waters access to the metal.

Joshua Sinrud, Jake Danczyk: Physics
Mentor: Hugo Schmidt - Physics
Liquid Lithium/BZY Proton Conducting Fuel Cell

This project focuses on creating a BZY/Liquid Lithium proton conducting fuel cell. To create the BZY the Glycine Nitrate Process will be used. The synthesized BZY will then be formed into a tape cast. This tape cast will then be used to create the electrolyte for the cell with LSM as a cathode and liquid lithium as an anode. Since the lithium will be in liquid form, the electrolyte must be formed into a bowl or conical shape. Various tests will be performed on the BZY electrolyte such as Electrochemical Impedance Spectroscopy and Density test using Archimedes principle. An operating cell will be tested using 3% hydrogen 97% Argon gas. Measurements will be taken along the V-I curve to characterize the power output.

Alec Skuntz: Chemistry & Biochemistry
Mentor: Lori Christensen - Gallatin Valley Food Bank
Strategy identification for positive health outcomes among the rural Montana elderly

Elderly populations throughout the United States suffer from many deficiencies that detrimentally affect their health. These areas include poor nutrition, food scarcity, transportation complications, chronic health concerns, housing difficulties and social isolation. Seniors living in rural areas, such as Montana, are much more likely to be at risk when compared to the elderly in other, more metropolitan areas. This project aims to identify those populations most at risk, and distinguish the aspects of their health that requires the most attention in order to positively effect health outcomes in the community. The American Association of Retired Persons (AARP) is sponsoring a grant through Montana's Human Resources Development Council (HRDC) and the Gallatin Valley Food Bank (GVFB) in order to fulfill these goals. This grant helped develop the Cultivating Accessible, Affordable, Adequate, and Appropriate Nutrition for Seniors (CAAAANS) program to create an outcome matrix in order to identify health concerns and implement new strategies and services. The model developed in this program will facilitate the identification of seniors' needs in our region and in other rural Montana communities with struggling seniors.

Roy Smart: Physics
Mentor: Charles Kankelborg - Physics
Software Development for MOSES Flight Operations

The Multi-Order Solar EUV Spectrograph (MOSES) is a sounding rocket payload that observes the sun during flight. A flight computer is necessary for this experiment to command and control the instrument after launch. Replacing the old flight computer with a new embedded system necessitated the design of new flight software. My contribution to this software included testing the read and write speeds of the non-volatile memory, testing reading and writing through linux pipes, and designing an in flight communications program. This program sends information about the flight over a telemetry link and also allows commands to be received from the telemetry to control the computer.

Tiana Smith: Cell Biology & Neuroscience
Mentor: Joshua Obar - Microbiology & Immunology
Investigating the Role of Mast Cells in Respiratory Syncytial Virus

Respiratory Syncytial Virus (RSV) is a non-segmented negative-strand RNA virus that causes disease in immunocompromised populations. In susceptible hosts, virus replication initiates in the nasopharynx and spreads rapidly to the lower respiratory tract, where mast cells, alveolar epithelial cells, endothelial cells, tissue-resident alveolar macrophages and dendritic cells initiate an immune response. It has recently been demonstrated that influenza A virus A/WSN/33 activated mast cells to degranulate and produce inflammatory cytokines/chemokines, and leukotrienes (Graham, 2013). Thus, we propose mast cells are able to respond similarly with other respiratory pathogens, including RSV. To test our hypothesis, bone marrow cultured mast cells (BMCMCs) were differentiated from mouse bone marrow and activated with RSV. We demonstrate that RSV infection causes mast cell activation, as we were able to detect mast cell mediators including cytokines/chemokines, and LTB4. Using BMCMCs differentiated from mice lacking key signaling components, we found that cytokine/chemokine levels were down-regulated in a MAVS dependent matter, suggesting signaling through MAVS is important in the cytokine/chemokine response during RSV infection. Specifically, IL-6 was the most significantly burdened in the absence of MAVS, which may help elucidate specific signaling cascades. It was found that LTB4 was expressed in a MyD88-independent manner. Future studies will analyze signaling cascades in the presence of inhibitors and further, in mouse models to determine if in vivo biological systems complement in vitro models. By understanding the role of mast cells during RSV infections, we can develop novel therapeutic interventions for the prevention of disease.

Acknowledgements: Amy Graham (Doctoral Student), Kimberly Hilmer (Research Associate) - Microbiology & Immunology

Brian Spencer: Cell Biology & Neuroscience
Mentor: Steve Stowers - Cell Biology & Neuroscience
Mapping the Thermoreceptive and Mechanoreceptive Neural Pathways in Drosophila

When sensory information is processed in any organism, the underlying neural circuitry is a major component. Analyzing how information can be passed from neuron to neuron through the circuit leads to a greater understanding about how each sensory circuit works. In this lab, two distinct behaviors of fly larva are being examined. These reactions are the response to heat (thermoreceptive) and touch (mechanoreceptive). The primary neurons in these circuits have already been identified through previous experiments in the lab. The goal now is to use a technique known as GRASP (GFP Reconstituiton Across Synaptic Partners) to show fluorescent reconstituion in synaptic clefts between primary and secondary neurons. The GRASP technique targets GFP11 constructs to presynaptic terminals and GFP1-10 constructs to postsynaptic terminals. When these protein fragments bind to each other, a functional GFP is reconstituted and it begins to fluoresce. This technique has shown promise, but has lacked in specificity for distinct neuronal pathways. For this reasons, making the GRASP technique more specific has been the primary focus. Our data indicate that the technique has been improved, leading to greater specificity. The benefits of this method to previous methods such as electrophysiology and electron microscopy are that it is less time intensive and could lead to mapping neural circuits at a much quicker rate. The Drosophila nervous system is simple enough that trying to understand these pathways in depth is probable but its complexity will also give great insight into the neural circuits of more complex animals.

Acknowledgements: Duane Mooney (Research Scientist) - Chemistry & Biochemistry

Adam Starecheski: Ecology
Mentor: Laura Burkle - Ecology
Plant and Pollinator Species Richness and Beta-diversity After Wildfire Across a Productivity Gradient in Montana

Ecologically balanced plant and pollinator communities are of extreme importance to any ecosystem, maintaining biodiversity and pollination services. In the Rocky Mountain region, wildfire is an essential disturbance that balances the health of the forests in this region. For over a century humans have been suppressing wildfires

whether they are natural or caused by humans. This has resulted in a buildup of fuel in the forests, which in turn has shifted the way that most fires burn. Now most wildfires burn with high severity over large areas, potentially homogenizing the landscape. Historically, most fires burned in a mixed severity, patchy style. How this shift in dominant fire type has affected plant and pollinator communities is not yet known. My research project looked at how the different fire types affect both species richness and diversity of plants and pollinators. I also looked at how net primary productivity (NPP, the annual biomass growth in a given area) affects how these communities respond to the different fire burn patterns. My first hypothesis is that as you increase NPP, species richness also goes up, and this will influence what plant species recolonize an area, as well as how many different species recolonize the area. My other hypothesis is that this new dominant fire regime is negatively impacting plant and pollinator communities, in terms of species richness and diversity. The outcome of this project will help inform conservation and management options related to fire-policy.

Acknowledgements: Elizabeth Reese (Research Technician), Laura Heil (Graduate Student), Michael Simanonok (Graduate Student) - Ecology

Chase Stefani: Agricultural Economics & Economics
Mentor: Carly Urban - Agricultural Economics & Economics
The Effect of Income Inequality on Long-Term Growth Rates in OECD countries

Income inequality is a central component of economic development measurements, but inequality among OECD countries, including the United States, is also rising. Social welfare and redistributive policies aimed at reducing income inequalities are often politically contentious and their effectiveness is usually measured at the target population level. This paper aims to analyze the macroeconomic effects of changes in income inequalities on a country's long-term growth rates with a focus on high-income, OECD countries. I attempt to control for differences among OECD countries and years by including country and year specific variables for each observation. Additionally, I control for differences in health care and education expenditures, which affect human capital accumulation. The empirical data was collected from the World Bank, OECD StatExtracts and UNU-WIDER and consists of panel data for high-income OECD countries since 1961 representing Gross National Income and measurements of income inequality, including GINI coefficients. Data was also collected for OECD countries on private and public expenditures on health care and education per capita. The results of this study will attempt to show if a relationship exists between income inequality and long-term growth rates in GNI in OECD countries. I will also use a theoretical approach to adding income inequality as an explanatory variable within existing macroeconomic growth models.

Katherine Stocker: Physics
Mentor: Angela Des Jardins, Jiong Qiu - Physics
Interpreting Solar Flare Reconnection from the Data of X-rays and Ultraviolet

Reconnection of the Sun's magnetic field lines is the accepted mechanism governing energy release within solar flares. Hard X-ray (HXR) and extreme-ultraviolet (EUV) data was pulled from NASA's RHESSI and SDO satellites and observed to reveal the behavior of a flare that occurred on February 15th of 2011 in regards to further expand on the evidence supporting this theory. The free magnetic energy released from reconnection deposits into the flare loops, exciting particles and forming brightened flare ribbons that outline a conjugate pair of flare foot points on the surface. In this two-ribbon flare, foot point sources in 35 Kev - 100 Kev traced out broad patterns of movement parallel to the magnetic neutral line between tem in the flare's first impulsive peak - reflecting the dynamics of the reconnection. Separation of the sources with respect to the magnetic neutral line occurred in the second, third, and fourth impulsive peaks- fitting to the standard flare model with progressive reconnection occurring at growing heights in the corona. Energy was deposited into the loops over a small fraction of the time taken by other X-class flares. Overlaying HXR contours on the EUV ribbons suggested that the HXR ribbons are more localized around the point of reconnection than the EUV ribbons. Successive measurements of the magnetic field in the regions covered by the HXR foot point sources revealed the intensity of the field was greatest near the magnetic neutral line and diminished as the sources separated. Sources in the negative regions of the sunspot

exhibited magnetic bottling due the greater intensity of the magnetic field. My observations will contribute to Dr. Jiong Qiu's previous work.

James Sutton: Cell Biology & Neuroscience
Mentor: Sheila Nielsen - Microbiology & Immunology
Differential Recognition of Candida albicans by Human Monocytes due to Microgravity

Candida albicans is the most common human fungal pathogen and constitutes part of the gut flora of 80% of the world's population. Characterized by dimorphic growth, *C. albicans* may grow as either budding yeast cells or filamentous cells. When grown in an environment that mimics that of a human host, *C. albicans* forms filaments which is likely an important factor in tissue invasion and establishing its virulence. Our previous studies have shown that *C. albicans* exhibits filamentous morphology when grown in microgravity or a simulated environment characterized by low fluid shear (LSMMG, low shear modeled microgravity). Analysis of cytokine production by monocytes upon exposure to *C. albicans* of both morphologies indicates a distinct differential cytokine response. We hypothesize that this differential response is due to alterations in the *C. albicans* cell wall. Microarray analysis of *C. albicans* cells exposed to microgravity demonstrates altered gene expression for multiple vital constituents of the biosynthetic pathways of yeast cell wall components. In the literature and our trials, it has been demonstrated that there is an altered cytokine response by human monocytes dependent on the morphology of *C. albicans* and this disparity is due to alterations in the *C. albicans* cell wall. Our results may indicate that *C. albicans* is evading certain aspects of the human innate immune response under microgravity or LSMMG conditions due to changes in its gene expression which alters recognition and response by human monocytes. Upcoming flight opportunities will help to further inform the relationship between *C. albicans* and human monocytes as it relates to adaptation to the microgravity environment.

Julian Thorne: Cell Biology & Neuroscience
Mentor: Frances Lefcort, Marta Chaverra - Cell Biology & Neuroscience
Morphological Characterization of IKAP Deficient Mice through Immunocytochemistry

This study was done to phenotypically assess the Lefcort lab's "knock-out" mice which are a model for Familial Dysautonomia, or Riley Day syndrome. This disease affects the autonomic nervous system and has a variety of physiological and cognitive affects. The primary mode of investigation used was immunocytochemistry staining comparison of mutant to control mice. Due to the fact that complete knock-outs died early in development, conditional knock-outs were made with the gene knocked out in either the entire central nervous systems or only in neural crest cells. Different tissue types from the knock-out or mutant mice were examined including optic nerve, retina, medulla oblongata, and neuromuscular junctions of the erector spinae muscles which were each stained with specific primary antibodies. It was found that cell death, as evidenced by caspase staining, was equal in mutant and control optic nerves, that there are notable differences in neuromuscular junction morphology, and that there may be an increase in GABA receptor delta in the medulla oblongata of mutant mice as shown through IHC.

Linn Thrane: Physics
Mentor: Charles Kankelborg - Physics
Inspection of Image Offset During First MOSES Flight in 2006

MOSES, Multi-Order Solar Extreme Ultraviolet Spectrograph, is a solar mission that launched on a NASA rocket in 2006 to gather high-resolution images of a broad section of the sun. There was a drift in the images taken during the launch in 2006, so some data was lost due to this offset. I have been working on determining the cause of this drift. My work has included heating up the mount our sun sensors, MASS and LISS, are attached to and measuring the drift in the mount caused by increased temperature of the mount material. MASS and LISS aligns the rocket with the sun when the images are captured. The data collected can be compared to the expected drift during flight due to sunlight heating up the mount, and the actual offset we saw in our images during last flight. The experiment

has shown a drift in the MASS and LISS mount similar to the drift seen in images. This information will be used to avoid similar problems in upcoming flights by redesigning the mount.

Acknowledgements: Roy Smart (Undergraduate Student) - Physics

Cassia Wagner: Chemistry & Biochemistry
Mentor: Mark Young - Plant Sciences & Plant Pathology
Isolation and Initial Characterization of a New Archaeal Virus from a Yellowstone Hot Spring

To expand current knowledge of archaeal virus diversity and function, we have used culture-dependent approaches to isolate new archaeal viruses. We have isolated a previously unknown DNA virus from an enrichment culture established from an archaeal dominated, high-temperature (82C), acidic (pH2.9) hot springs found in Yellowstone National Park, USA. The purified virions are 60-75 nm in diameter and are likely enveloped icosahedral particles. We have completed the sequence of its 9.7kb DNA genome. Preliminary DNA sequence analysis shows little match to other known viruses, indicating this is an entirely new virus.

Acknowledgements: Derek Loudermilk (Graduate Student), Benjamin Bolduc (Doctoral Student) - Microbiology & Immunology, Chemistry & Biochemistry

Amanda Weber, Charles Plummer: Chemistry & Biochemistry, Ecology
Mentor: Robert Sharrock - Plant Sciences & Plant Pathology
Sensing and signaling in Phytochrome B in Arabidopsis

The main goal of the proposed project is to explore the roles of mutations in the carboxy-terminal domains of the phytochrome B when comparing mutant vs. wild type absorption spectroscopy profiles. The spectroscopic effects of mutations in the N-terminal photosensing and signaling domains have been studied extensively previously. Mutations in the C-terminal dimerization and nuclear localization domains are not expected to have any effect on the wavelength of phytochrome absorption, but this has not previously been tested. We propose to develop an *E. coli* expression system to be used to further the understanding of the effects of both missense mutations and domain deletions on Arabidopsis phytochrome’s ability to sense different wavelengths of light. The contributions of this project could allow for the ability to manipulate growth patterns of plants by changing the wavelength exposure, which could lead to more efficient crop growth or new energy sources in the future. The *E. coli* expression system used did provide us with mutated protein, but not enough was produced to be sent off for spectral data. In hopes of gathering more data, the project turned more towards expression of these mutations in plants rather than bacterial systems. This has allowed us to see the phenotypic effects of these changes and deletions. The conclusions drawn from this project have shone light on the physical aspects of the C-terminus section of the phytochrome protein, especially showing that the epitope region for the phytochrome antibody is located in the PAS1-PAS2 domains and is not effected by a HKRD deletion.

Jake Weimer, Nicholas Tunell, Grant Ganoom, Phillip Boyet: Agricultural Economics & Economics
Mentor: Gary Caton - Business
Analysis of a Particular Stock Investment

Efficient management of financial assets is a very large issue in national economics. Whether or not capital is allocated efficiently to its highest valued uses plays a significant role in the long-term growth prospects of any economy. On an individualized basis, earning appropriate risk-adjusted returns on savings or making poor investment decisions can be the difference between a comfortable retirement and one that is spent below the poverty threshold. Investment research plays a key role in the pricing of assets in the financial markets, ensuring that particular securities are not over- or undervalued (implying lower or higher returns, respectively) relative to the risk implied by the investment. In this project our team financially analyzed a public company, Potlatch Corp., to arrive at a value that we think the company's equity should be worth. This research entailed an industry overview and analysis of the competitive position of the company as well as research into macroeconomic factors that affect the industry in general. To arrive at our valuation of the company's stock we used several valuation methods including discounted cash flows, price/earnings, and net asset value measures.

Martha Welander: Chemistry & Biochemistry
Mentor: Bern Kohler - Chemistry & Biochemistry
Photophysics of Flavin Adenine Dinucleotide

Flavins are optically-active protein co-factors that are widespread in nature. Flavin adenine dinucleotide (FAD) is an important model system for how many flavin proteins function. In FAD, adenine is covalently linked to a flavin (isoalloxazine) via a flexible link. In aqueous solutions, it has been shown that oxidized FAD exists in two distinct conformations: a closed conformation in which the isoalloxazine and adenine are π-stacked, much like the bases in DNA, and an open conformation in which the isoalloxazine and adenine are unstacked. Quenching of FAD fluorescence is thought to occur via electron transfer between the two delocalized π-systems. It is possible that this only occurs in the stacked conformation of FAD. We plan to investigate this theory by the use of time resolved transient absorption measurements. Initial steady state measurements of FAD have been performed. Circular dichroism has been used to verify the existence of a melting curve of FAD, which describes the change from stacked to unstacked conformations. UV and visible measurements were made to identify appropriate pump wavelengths for the transient absorption measurements.

Summer Whillock, Andrew Manigault: Psychology
Mentor: Ian Handley - Psychology
The Fleeting Quality of Unconscious Thought: Relative Impact of Decision Speed on the Unconscious Thought Effect.

Unconscious Thought (UT) Theory suggests that individuals who are distracted from thinking consciously about task (but can still think unconsciously) develop better judgments than individuals who think consciously for the same period of time or make immediate judgments. This so called "unconscious-thought effect" (UTE) arguably occurs because UT has a much greater processing capacity. However, the size of this effect is modest, perhaps because people can think consciously during the judgment phase of the experiments. Importantly, the amount of time people take to render a judgment is likely linked to the amount they think consciously during the decision phase. Indeed, analyses of past studies demonstrates that longer judgment times are associated with poorer unconscious judgments. The present research seeks to investigate the causal effect of judgment time on the UTE. In this experiment, participants will receive information, then make judgments immediately, after a 3min distraction (unconscious thought), or after 3min of conscious deliberation. Further, when participants will render their judgments at their own pace or will be forced to respond within 5sec. We hypothesize that participants in the unconscious-thought condition will render better information-based judgments in the 5sec- versus self-paced condition, whereas the decision time will have no effect among participants in the conscious and immediate conditions. This study has the potential to identify some important boundary conditions of UT effect and shine some light on the UT replication problem currently discussed in the literature.

Spencer White: Chemistry & Biochemistry
Mentor: John Peters - Chemistry & Biochemistry
Expression, Purification, and Characterization of Mercuric Reductase from Three Thermoacidophilic Archaea

Proteins involved in catalyzing biochemical reactions (enzymes) have been refined through in some cases several billions of years of evolution through selective pressure to be highly specific for the substrates of their respective reactions. Such a high level of specificity is often the envy of engineers attempting to design highly selective chemical sensors. In our work we are attempting to exploit enzyme specificity by incorporating stable enzymes into materials that couple the binding and transformation of specific chemical compounds to a detectable signal. We are focusing on electron transfer reactions or oxidation reduction reactions where substrate turnover can be coupled to redox active colorimetric and fluorescent dyes or electrode surfaces. As proof of concept we are focusing on mercuric reductase that reduces mercuric ion to volatile elemental mercury. Microorganisms use this reaction as a mechanism to tolerate mercury in the environment. We are targeting a mercuric reductase from a hyperthermophilic microorganism for use as a sensor due to the higher stability and half-life of hyperthermophilc enzymes and increased resistance to proteolytic degradation. The mercuric reductase from the thermophile

Metallosphaera sedula was expressed using an *Escherichia coli* system and purified using Ni-NTA column chromatography. The structure was determined using x-ray diffraction methods and refined to a 1.6 Å resolution. Kinetic characterization was performed using a NADPH oxidation-linked mercury reduction assay indicating a temperature optimum of greater than 80° C. These results indicate that this enzyme is indeed highly stable, and provide a basis for incorporating it into a robust sensor system.

Acknowledgements: Corey Fugate, Oleg Zadvornyy (Postdoctoral Researchers) - Chemistry & Biochemistry

Brett Wilkins: Physics
Mentor: Galina Malovichko - Physics
Magnetic and Optical Properties of Double Doped Lithium Niobate

Lithium Niobate, $LiNbO_3$ is used extensively in the telecoms market. Conventional commercial crystals are usually grown from congruent melt with the Li/Nb ratio about 0.94. This means that they have about 6% of intrinsic defects: lithium vacancies and antisites NbLi. From one side, these intrinsic defects are responsible for the relatively low threshold to the intensity of laser irradiation (a negative effect). Conversely, they facilitate non-isovalent substitutions by impurities (partly positive, partly negative effect). We made a study of samples grown from the melt with a significantly increased Li/Nb ratio (about 1.2-1.5), studied with the help of Electron Paramagnetic Resonance, EPR. Dependencies of EPR spectra on microwave power and magnetic field orientation were investigated in detail. Obtained spectra show significant difference from registered in congruent samples: decreased width of resonance lines and appearance of new lines. Possible reasons of observed discrepancies will be discussed alongside copies of the angular dependencies in the final report.

Laura Williams: Microbiology & Immunology
Mentor: Sandra Halonen - Microbiology & Immunology
Determination of INF gamma Resistant Genes in Toxoplasma gondii

Toxoplasma gondii is an intracellular protozoan parasite that infects over half of the human population worldwide and is capable of infecting most animals. This research will explore the interaction between this parasite and the host immune system. Interferon-gamma (IFNγ) is a very important cytokine in the brain, contributing to host resistance to *Toxoplasma gondii*. This interferon can stimulate astrocytes to acquire anti-toxoplasmacidal mechanisms with the use of immunity-related GTPases (IRG) proteins. The parasite usually grows in host cell vacuoles, where IRG proteins accumulate and stimulate them to disrupt, resulting in destruction of the parasite. *Toxoplasma gondii's* ability to resist this IFNγ-mediated killing is a very important pathogenic mechanism. A type II strain (sensitive to IFNγ) that contains a cosmid from a type I strain (resistant toIFNγ), called Me49T was used in this experiment. These transfected parasites were grown in an astrocyte cell line (C8-D30) and were stimulated with IFNγ to select for IFNγ-resistant parasite mutants, specifically looking for mutants that inhibit the IRG-mediated vacuolar killing. A polyclonal population of Me49T parasites resistant to IFNγ were created via growing these parasites under IFNγ pressure (called Me49T-IR). The polyclonal populations were diluted to monoclonal parasites expressing resistance to IFNγ. IRG effect will be screened via an IFA assay. The resistant clones will be sequenced to identify the genes that are responsible for IFNγ resistance in *Toxoplasma gondii*. This research is important in advancing our understanding of this parasite's resistance and identification of virulence factors that help it survive in the human body.

Katherine Wright: Chemistry & Biochemistry
Mentor: Carl Yeoman - Animal & Range Sciences
Establishing Non-invasive Methods to Quantify Intestinal Permeability In Lambs Using FITC- Dextran 4000

The goal of this research is to validate and optimize a non-invasive methodology for assessing gastrointestinal permeability as it relates to gastrointestinal health in sheep. The intestinal permeability varies with the integrity of tight junctions, the space between the cellular membranes in an animal's gut epithelium. FITC-Dextran 4000 (FITC-D4) is a fluorescent tagged polysaccharide whose passage across the epithelium to the blood stream is entirely dependent on tight junction integrity. We are currently exploring the recalcitrance of FITC-D4 to microbial

degradation in the rumen via an in vitro study. Once we have determined a method to maintain FITC-D4 integrity through rumen-passage, we will develop a standard curve to quantify FITC-D4 concentrations in whole sheep blood based on the resulting fluorescence. Finally, equal groups of lambs will be gavaged FITC-D4 or FITC-D4 and Sodium Lauryl Sulfate, a chemical known to increase gastrointestinal permeability. From a range of blood samples we will ascertain whether there is a significant difference in the concentration of FITC-D4 in the two groups of sheep. Representative lambs will then be humanely euthanized and the true gastrointestinal permeability established using Transcellular Endothelial Resistance.

Grant Zimmerman: Agricultural Economics & Economics
Mentor: Carly Urban - Agricultural Economics & Economics
The Effect on Accident Rates from Bans on the Use of Cellular Phones while Driving in Montana

Over the past four years, a number of Montana cities, including Bozeman, have implemented bans on the use of a cellular phone while driving unless a hand held device is used. This study uses data on individual traffic accidents from Montana, Idaho and Wyoming Departments of Transportation to determine what, if any effect the implementation of a ban had on accident rates. Accidents rates for Montana cities that implemented bans are compared pre and post implementation to each of the cities' surrounding counties, as well as to cities of comparable size without a ban in Montana and surrounding states. This study has possible implications for other municipalities considering bans as well as for the future of the laws currently in place.

COLLEGE OF NURSING

Emilie Kuster: Nursing
Mentor: Ann Bertagnolli - INBRE
Perceptions of Mental Health on the Fort Peck Reservation

American Indian and Alaska Native populations both experience significant mental health disparities. Although these populations have higher rates than the general population of using mental health services, their needs continue to be unmet. Barriers to mental health care for American Indians/Alaska Natives include lack of funding, geographic distances, and Western mental health approaches and practices. Experts on delivery of mental health services to American Indians/Alaska Natives, including practitioners, researchers, and policy makers, argue that evidence-based practice is not the most appropriate in working with these populations. Through a series of 5-10 interviews using snowball sampling, I will query tribal council members, members of the Fort Peck Health Promotion and Disease Prevention Program, as well as community members to gain their perspective on the status of mental health care delivery and subsequent mental health outcomes on the Fort Peck Reservation and their insight into what works most effectively to promote mental health in their community.

Allison Nesseth: Nursing
Mentor: Laura Larsson - Nursing
Industry Thoughts on Radon Resistant Construction Policies

Purpose: 1)To conduct a national inventory of radon resistant new construction (RRNC) policies, 2)test association between high-radon geographical risk with existing policies, and 3)survey local building industry members for current practice and opinions on RRNC adoption in Montana. Method: A policy inventory using the LexisNexis Academic search engine was conducted for radon related statutes, codes and regulations in each state. States were sorted into high and low risk groups based on their EPA zone designation. States were further sorted on the presence or absence of existing RRNC policy. An odds ratio (OR) analysis was performed to test association between risk and policy adoption. Surveys were distributed at local building associations and the Building Division office. Results: An analysis of RRNC policies compared with geographic radon risk indicated high-risk states are increasingly turning to RRNC as a policy approach to reducing radon-related lung cancers. States with more radon risk were five times more likely to have implemented some level of RRNC compared to states with less risk (χ^2=2.34, OR=5.00, 95% CI 1.2-19.3, p< .05). Survey (n=22) findings indicated local builders install RRNC systems regardless of policy. The majority (n=17, 77.3%) of respondents did not want to have a certified radon contractor for system installation. Implications: Nursing roles address the environmental hazards that present risk for their patients and community. The policy inventory results indicated high-risk states are increasingly adopting RRNC to reduce radon-related lung cancer. This information may contribute to a collaborative public health solution utilizing the building industry as partners.

UNIVERSITY STUDIES

Amanda Nicolau: University Studies
Mentor: Lucia Rodrigues - Federal University of the State of Rio de Janeiro
Quality Assessment of Table Salt Consumed by Children and Adolescdnts in the City of Rio De Janeiro, Brazil

Salt has an important role in our body, it is an essential micronutrient. However, a high salt intake is related to a high intake of iodine. The exposure of thyroid gland for a long period and excessive amount of iodine may predispose the population to early development of autoimmune thyroiditis and risk of hyperthyroidism. Hence, it becomes relevant to monitor the amount of iodine added to salt. The main objective of this study is to describe levels of iodine in salt consumed by Brazilians. We analyzed levels of iodine present in 24 samples from 8 different brands of salt. These samples of table salt were collected from patients selected to participate in a project to analyze their urinary iodine. The samples were analyzed in accordance with the technical recommended by the Brazilian Ministry of Health. The mandatory addition of iodine to salt determined by ANVISA (National Health Surveillance Agency) from 2003 is 20-60 mg of iodine/kg of salt. All samples were in accordance with the ANVISA legislation, excepting two samples that presented 62,01 mg/kg and 18,63 mg/kg. The majority of samples collected were in accordance with the legislation. This evaluation should be conducted frequently to obtain a better control of the quality of the salt consumed by the population, with the aim of preventing iodine deficiency without providing a risk of illness associated with excessive intake of this important micronutrient. As a result of high consumption of salted food in Brazil, ANVISA is aiming to change the legislation to 15-45 mg /kg of Iodine added in table salt.

Acknowledgements: Fernanda Ribeiro, Anderson Junger - Federal University of the State of Rio de Janeiro

MONTANA INBRE NETWORK STATEWIDE SYMPOSIUM PRESENTERS

Dale DuCharme: Health and Human Performance (Blackfeet Community College)
Mentor: Dee Hoyt - Education and Health
How Drastically Do Emotions Affect Overall Health?

The data used was to find out if basic human emotions such as anger, joy/happiness, sorrow/sadness, and the feeling of being overwhelmed affect overall health. Data collected will be surveys on how one is affected after a relationship break-up (male/female), affects of the loss of a loved one, and the sometimes overwhelming feeling of college life. Information will be gathered on the Blackfeet reservation and the encompassed community. The Project will be using a qualitative research method.

Janice Froman: Health and Human Performance (Blackfeet Community College)
Mentor: Dee Hoyt - Education and Health
Take Shape in a Small Community

In my community a new "diet" has become contagious, Take Shape For Life. I want to know if its going to work for my sister who is starting this for the third time. Are the success stories of the community still on the 5-1 Take Shape For Life meal plan? For those who didn't stick with it, what was the reason for the change? Did they gain the weight back or did they keep it off after Take Shape For Life? For thirty days I will document my sister's journey through Take Shape For Life, to what will hopefully be a happier healthier lifestyle.

Rochelle Johnson: Clinical Lab Science (Montana State University - Billings)
Mentor: Kurt Toenujes, Joy Goffena - Biological & Physical Sciences
Two-Hybrid Analysis of GMP1 and TSA1

Candida albicans is an opportunistic and commensal fungal pathogen commonly found within humans. Cell growth of *C. albicans* is either yeast or filamentous/hyphal. It is not understood how the switch to filamentous growth is made, as well as its role within cell growth and morphogenesis. Ubiquitin F-Box proteins, CDC4 and GRR1, play a role in both cell growth and morphogenesis. These proteins are found within the SCF complex which acts during the E3 stage of ubiquitation and contains an ubiquitin protein ligase that catalyzes the ubiquitation of proteins destined for proteasomal degradation. F-Box proteins role in the complex is to direct potential protein targets to the ubiquitin ligase. Using 2D-Difference Gel Electrophoresis GMP1 and TSA1 are hypothesized potential target proteins of CDC4 and/or GRR1. GMP1 is a phosphoglycerate mutase in glycolysis and gluconeogenesis. TSA1 is a thioredoxin peroxidase that helps with chaperoning proteins under oxidative stress and required for telomere length maintenance. Testing interaction of GMP1 and TSA1 to the F-Box proteins through a two-hybrid approach will give a better understanding as to whether they are "bonafide" target proteins. GPM1 had minimal growth interaction with CDC4 and GRR1. The interaction of TSA1 with CDC4 and GRR1 is still in process.

Taruha Kirkaldie: Allied Health (Aaniiih Nakoda College)
Mentor: Dan Kinsey - Integrated Environmental Science
West Nile Virus Serveillance on Fort Belknap Reservation

WNV made its first appearance in Montana 2002. The Milk River is the Northern boundary of the Fort Belknap Reservation. Flood irrigation is used along the Milk River valley and periodic flooding creates optimal condition for large populations of mosquitoes. The species of mosquitoes known to carry the WNV in Montana are *Culext tarsalis*. Students of the Aaniiih Nakoda College started collecting mosquitoes in 2000. The first batch of mosquitoes that tested positive for WNV in Montana was collected in 2003, by the students of Aaniiih Nakoda College, on a site along the Milk River four miles from the college campus. A collaborative relationship was developed with Montana State University and Carroll College to continue mosquito and WNV research. The current research project consists of collecting mosquitoes from sampling sites along the Milk River and Little

Rockies. Mosquitoes are collected once a week with CDC traps that are set during the evening and collected the following morning. The mosquitoes are then placed in the freezer to preserve for later sorting and identification. During sorting the *Culex tarsalis* are separated and analyzed for the WNV using real time PCR. Typically in late July and August is when we see high numbers of the *Culex tarsalis*.

Dustin LittleOwl: Natural Resources (Little Bighorn College)
Mentor: Neva TallBear - Science Department
The Apaake Project at Little Big Horn College (West Nile Virus) on the Apsaalooke Reservation

The apaake (WNV) project at Little Big Horn College collaborates with Fort Belknap College, Carroll College and Montana State University-Bozeman to determine the incidence of the WNV in the state of Montana. Methods: The five sites across the Apsaalooke (Crow) Indian Reservation will be monitoring and identifying species of mosquitoes in the region (*Culex tarsalis* & *Cules Pipens*). Results: The five Apaake Project trap sites collected the mosquitoes (*Culex tarsalis* & *Cules Pipens*) to determine the potential for West Nile Virus infected in animals, birds, & humans. Conclusion: Found that there are more *Culec pipiens* at Site 3: For Smith; and at Site 1: L.B.H.C.; Site 2: Lodge Grass; Site 4: Pryor; Site 5: Wyola had a higher *Culev tarsalis*. Further Information: Neva F. Tall Bear, Science Instructor, Principal Investigator, Little Big Horn College, 8645 South Weaver Drive, Crow Agency, MT 59022, (406) 638-3100. tallbearn@lbhe.edu

Acknowledgements: Elizabeth Othermedicine, Elvina Hogan, April Huerta

Elizabeth Mullins: Biology (Montana State University - Billings)
Mentor: David Butler, Kurt Toenjes, Joy Goffena - Biological and Physical Sciences
Identification of potential targets of the Grr1p SCF ubiquitin ligase in fungi

The opportunistic pathogen *Candida albicans* causes both superficial and life-threatening systemic infections, especially in immunocompromised populations. *C. albicans* can grow in different morphologies, including yeast and filamentous forms, such as true hyphae and pseudohyphae. Yeast hyphae and pseudohyphae have been observed at the sites of *Candida* infection and there is strong evidence that yeast-to-filamentous morphogenesis is essential for virulence. Several studies have implicated ubiquitin-dependent proteolysis in morphogenesis regulation, but this mechanism is largely unknown. Previously, we have demonstrated that deletion of the GRR1 gene results in constitutive filamentous growth forms. Grr1p is a component of an SCF ubiquitin ligase system that selectively targets proteins for degradation. The loss of Grr1p-mediated proteolysis presumably leads to the aberrant accumulation, and inappropriate activity, of a protein or proteins that induce filamentous growth. The spectrum of Grr1p protein targets is not known. Our goal is to identify Grr1p targets in *Saccharomyces cerevisiae*, an experimentally tractable model system for pathogenic fungi. We are using a novel proteomics-based approach to isolate and characterize proteins that are ubiquitinated in a Grr1p-dependent fashion. Identification of Grr1p targets is important for developing a working model of the pathways involved in the yeast to filamentous growth transition in pathogenic fungi.

Shauna Newton: Biology (Montana State University - Billings)
Mentor: Tom Lewis – Biological & Physical Sciences
Mutations abrogating siderophore transport in Pseudomonas aeruginosa

Iron is an essential nutrient for most organisms. In response to limiting iron availability, many microorganisms and plants produce siderophores, low molecular weight, excreted molecules with high binding affinity for ferric iron and which allow transport of iron into cells via specific receptors on cell surfaces. We have observed a type of positive autoregulation termed signaling by the siderophore PDTC (pyridine dithiocarboxylic acid) in mutant strains of the bacterium *Pseudomonas putida* lacking specific PDTC:iron receptors. This work is aimed at determining whether unrecognized receptors are responsible for that signaling, or whether it represents a unique, receptor-independent mode of signaling. We have used the bacterium *Pseudomonas aeruginosa*, an opportunistic human pathogen with well-characterized siderophore transport and signaling systems, as a surrogate host for *P. putida* genes. Our methods are aimed at reconstituting signaling by PDTC in *P.aeruginosa*, a bacterium which does not

produce PDTC. In order to test whether conventional, receptor-dependent signaling explains PDTC signaling, we have constructed *P. aeruginosa* mutants lacking TonB energy-transducing proteins necessary for known siderophore transport systems in *P. aeruginosa*. Data presented will include description of those constructs and tests of their ability to respond to purified siderophores using transcriptional reporters.

Karly Old Person: Allied Health (Blackfeet Community College)
Mentor: Dee Hoyt - Education and Health
Stress Before and After Exercise

Stress is a crippling component of the mind. When life begins demanding, the wearing of the body and mind start to become evident. Give students an alternative other than a drug prescription that may cause other health issues. The Target group Blackfeet Community College students, staff and adult family member participate in a stress survey before the physical activity; one month swimming pool pass. After 30 days the test stress survey will be given. Data will collected and calculate benefits of working out. Does the given opportunity to participate in a physical activity opt for a healthy lifestyle by alleviating stress?

Chelsea Spotted Eagle: Health and Fitness (Blackfeet Community College)
Mentor: Dee Hoyt - Education and Health
Feedlot Beef vs Home Grown Beef

What is the difference between home grown beef and feedlot beef? Home grown cows are fed only grass, hay, alfalfa, and cow cake. Feedlot cows are raised on grain, corn to bring their weight up for slaughter. Hormones and antibiotics are given to the cows to make sure they are gaining weight all the time. Researchers linked health problems such as heart disease, stroke,and diabetes to heavy meat consumption. More farmers and ranchers are raising grass fed beef on a natural diet.

Tafuna Tusi, Lani Paulson Miller, Michelle Strain, Casey Rasmussen: Communications (Montana State University - Billings)
Mentor: Sarah Keller - Communication & Theater
Preventing Suicide in Montana

Montana has one of the highest suicide rates in the nation and has ranked in the top five states for the past thirty years. The suicide rate for Montana's youth in 2010 and 2011 was double the national average. In order to address this public health issue among youth, ages 14 to 18, an innovative community-based media project was implemented in Billings, MT in the Fall of 2013. The project involved a youth theater production, youth art workshop, social media and a website designed to highlight suicide prevention resources and enable young people to discuss emotions related to suicide and depression. The goal of the community-based media project is to highlight suicide prevention resources and enable young people to discuss emotions related to suicide and depression. Quantitative and qualitative methodologies were used to assess youths' attitudes toward treatment for depression and suicidal thoughts and to evaluate the impact of the community-based media project on suicide prevention. Results from the quantitative data are pending. Qualitative data supports the hypotheses that exposure to the community-based media project increases youths' self-efficacy to help others and to confront their own thoughts of suicide and depression.

Sarah Witt: Health Promotion (Montana State University - Billings)
Mentor: Kathe Gabel, Shawn Hinz - Health & Human Performance, Riverstone Health
Risk Factors that Predict Incidence of Drinking Alcohol during Gestation

Drinking during pregnancy is dangerous for an unborn child and leads to Fetal Alcohol Spectrum Disease (FASD), yet women continue to drink during pregnancy. The aim of this study was to identify risk factors that could be targeted in effective interventions for young women. Data were collected from records of home visits in the Riverstone Health "Healthy Tomorrows" program, a FASD intervention program. SPSS (Version 18) software was used to perform statistical analysis. Five predominant identifying factors were noted: 1) No dental cleaning in the

last year, 2) Medical risk, 3) No education beyond the 12th grade or no GED, 4) Lack of an emotional support system, and 5) Past alcohol, tobacco, or drug abuse. The relationship between drinking during pregnancy and prevalence of a risk factor was highest among those who had no dental cleaning in the last year and those who had medical risks. Lack of education and previous abuse of alcohol, tobacco, and drugs also showed a high prevalence of clients who drank during pregnancy. In conclusion, these risk factors could be targeted when developing FASD prevention programs and individuals who exhibit risk factors could receive closer monitoring.

ALPHABETICAL LISTING OF STUDENTS

Student, Mentor, Project	Session	Poster #	Abstract Page #
Jon Adams, Alex Shchepetkin: Computer Science Clem Izurieta -- Computer Science *A Database System to enhance Leadership Institute Capabilities*	am	43	58
Joshua Allen: Agricultural Economics & Economics Carly Urban -- Agricultural Economics & Economics *Racial Income Discrimination in the Rocky Mountain West*	pm	118	81
Anna Andrechak: Microbiology & Immunology Seth Walk -- Microbiology & Immunology *Multi-locus sequence typing of Escherichia coli isolated from freshwater aquatic sediment samples*	am	72	81
Quinn Andrews: Chemical & Biological Engineering Paul Gannon -- Chemical & Biological Engineering *Investigation on Effects and Prevention of Hot Corrosion*	am	77	58
Katie Atkinson: Ecology Cathy Zabinski -- Land Resources & Environmental Sciences *Soil Organic Matter and Enzyme Activity*	am	40	81
Benjamin Babcock: Art Josh DeWeese -- Art *Celadon: A Search for Indigenous Answers and Local Solutions*	pm	109	50
Ryan Bachofer: Chemistry & Biochemistry Martin Teintze -- Chemistry & Biochemistry *Evaluation of MRSA resistance developement to a novel antibacterial compound*	pm	51	82
Kate Backstrum: Cell Biology & Neuroscience Stephanie McDowell -- Bridgercare Clinic *Addressing the Need for Comprehensive Sexual Health Education for Adolescents*	am	122	82
Megan Baker: Health & Human Development Renee Harris -- Area Health Education Center *Successful Interventions in Pediatric Obesity: A Comparative Study*	am	63	55
Adam Bartz, Alison Figueira: Computer Science Clemente Izurieta -- Computer Science *Japanese-On-The-Go: A Japanese Kanji Image Translation App for the Android*	am	71	58
Ana Baselga Mateo: Physics Randall Babbitt -- Physics *Displacement measuring interferometer for comparison to calibrated FMCW ladar system*	pm	6	36
Nathan Beckman: Ecology Wyatt Cross -- Ecology *Identification and quantification of Shovelnose Sturgeon (Scaphirhnchus platorychus) diets in the Yellowstone and Missouri Rivers*	pm	66	82
Ashley Beckstead: Chemistry & Biochemistry Bern Kohler -- Chemistry & Biochemistry *Monitoring the Photo-induced Electron Transfer Capability of 8-oxo-7,8-dihydro-2'-deoxyguanosine Using Ultrafast Time-Resolved IR Spectroscopy*	pm	49	36

Student, Mentor, Project	Session	Poster #	Abstract Page #
Tyler Bellville, Spencer Dahl: Chemical & Biological Engineering Ryan Anderson -- Chemical & Biological Engineering *Heat Transfer through Encapsulated Phase Change Material*	pm	36	59
Andrew Bender: Mechanical & Industrial Engineering Sarah Codd -- Mechanical & Industrial Engineering *Variables Affecting the Growth of Biofilm in Porous Media*	am	97	59
Paul Bennett: Music Bolte Jason -- Music *Classical Downtempo Hybrid Composition*	am	53	50
Steven Berkas, Madison Gabig, Trae Schwenneker: Architecture Maire O'Neill -- Architecture *The Crouse Homestead*	pm	Multi-media C	28
Emily Bermel: Chemical & Biological Engineering Christine Foreman -- Chemical & Biological Engineering *The Effects of Ultraviolet Light on Biofilm Formation and Pigment Production of Janthinobacterium sp. Strain CG23_2*	pm	27	59
Ashley Berninghaus: Chemical & Biological Engineering Robin Gerlach -- Chemical & Biological Engineering *Growth of Two Alkaliphilic Microalgal Isolates in Recycled Harvest Water Supplemented with Anaerobic Digestate*	pm	28	60
Chaparral Berry: Chemical & Biological Engineering Roberta Amendola, Paul Gannon -- Mechanical & Industrial Engineering, Chemical & Biological Engineering *Fundamental investigation of hydrogen transport in ferritic stainless steel for S.O.F.C interconnect applications*	am	1	60
Alissa Bleem: Chemical & Biological Engineering Ross Carlson -- Chemical & Biological Engineering *A survey of acetic acid substrate and product inhibition kinetics for Escherichia coli K-12 MG1655 wild-type and select gene deletion mutants*	pm	30	61
Rachel Bochy: Health & Human Development Carmen Byker, Christopher Seitz -- Health & Human Development *Using PhotoVoice to Understand Food Access and Experiences Among Seniors in Gallatin County*	pm	107	55
Orrin Boese: Chemical & Biological Engineering Wataru Nakagawa -- Electrical & Computer Engineering *An Optical Characterization System for the Evaluation of Grating Coupling Efficiency and the Index of Refraction of Nano-structured Polymer Materials*	am	69	61
Eric Bogenschutz: Chemical & Biological Engineering William Inskeep -- Land Resources & Environmental Sciences *Mechanisms of Oxidative Stress Response in the Thermoacidophilic Crenarchaeon Metallosphaera yellowstonensis*	pm	29	61
Michael Bonde: Mechanical & Industrial Engineering Ron June -- Mechanical & Industrial Engineering *Mouse Knee Pressure Distribution Sensing*	am	113	62
Kelly Borden, Kaysha Young: Health & Human Development, Mechanical & Industrial Engineering Laura Stanley, Carolyn Plumb -- Mechanical & Industrial Engineering *A Peer-to-Peer Traffic Safety Campaign*	pm	11	55

Student, Mentor, Project	Session	Poster #	Abstract Page #
Noah Bosworth: Ecology Andrea Litt -- Ecology *Can Montana shrews be identified using morphology of dorsal guard hairs?*	pm	65	83
Logan Boucher: Chemical & Biological Engineering Macur Rich -- Center for Biofilm Engineering *Lipid and Proteomic Analysis of a Lignocellulosic Degrading Fungi*	am	36	62
Luke Brandenberger: Microbiology & Immunology Ed Schmidt -- Microbiology & Immunology *An Investigation of Hepatocyte Lineage Life-History Dynamics in Vivo*	pm	104	83
Ryan Brandt, Karen Igo: Computer Science Clem Izurieta -- Computer Science *A mobile and web enabled application to help with organization and academic excellence*	am	44	62
Hallie Bronec: Microbiology & Immunology Michael Franklin -- Microbiology & Immunology *Effect of Anaerobic Sulfate Reducing Bacteria on Corrosion of Steel*	am	49	83
Spencer Bruce: Chemical & Biological Engineering Stephanie Wettstein -- Chemical & Biological Engineering *Conversion of xylose to furfural in gamma-valerolactone using novel zeolite catalysts*	pm	91	32
Lindsey Brunken: Film & Photography Tom Watson -- Film & Photography *The Hunt : A Short Film*	am	Multi-media D	50
Michael Burt: Chemistry & Biochemistry Martin Teintze -- Chemistry & Biochemistry *Development of THAM-3PhG as a Novel Antibacterial Compound against Methicillin-Resistant Staphylococcus aureus*	am	13	84
Alayna Caffrey: Microbiology & Immunology Joshua Obar, Robert Cramer, Bridget Barker -- Microbiology & Immunology *IL-1α is critical for leukocyte recruitment during pulmonary Aspergillus fumigatus infection*	pm	97	25
Grace Caldwell, McLain Leonard, Lik Ming Aw (Graduate Student): Mechanical & Industrial Engineering, Chemical & Biological Engineering Roberta Amendola, Paul Gannon -- Mechanical & Industrial Engineering, Chemical & Biological Engineering *Synthesis of Cr2AlC MAX-phase protective coating on nickel-based super alloys in low temperature hot corrosion via magnetron sputtering*	pm	13	63
Russell Callahan: Land Resources & Environmental Sciences Tony Hartshorn -- Land Resources & Environmental Sciences *Can Zirconium Serve as an Indicator of Post-Fire Soil Burn Severity?*	pm	52	44
Andrew Carroll: Agricultural Economics & Economics Carly Urban -- Agricultural Economics & Economics *Untitled Abstract Proposal*	pm	120	84
Joshua Carter: Microbiology & Immunology Blake Wiedenheft -- Microbiology & Immunology *Identifying Critical Residues to Cascade Function*	am	101	85
Michelle Cassens: Business Gerard J. Carvalho, Harry Benham -- Business *Student Opinion on Bring your Own Device at the Jake Jabs College of Business and Entrepreneurship*	am	55	54

Student, Mentor, Project	Session	Poster #	Abstract Page #
Ethan Cayko: Music Jeremiah Slovarp -- Music *Sounds and Scenes of Spain/Morocco Tour*	am	54	50
Wee Chun Chan: Agricultural Economics & Economics Carly Urban -- Agricultural Economics & Economics *Alternative to bring better life for children in developing countries*	am	124	85
Patrick Cole: Plant Sciences & Plant Pathology Li Huang -- Plant Sciences & Plant Pathology *Investigating the role of beta-l,3-1,4-glucanase in the resistance of Triticum aestivum to Puccinia infection*	pm	45	44
Warren Colomb: Physics Randy Babbitt -- Physics *High Power Continuous Mid-Infrared Difference Frequency Generation*	am	6	85
Zachariah Conley: Animal & Range Sciences Clayton Marlow -- Animal & Range Sciences *The Effects of Russian Olive and Black Cottonwood On Fish Growth*	pm	55	45
Elizabeth Corey: Sociology & Anthropology John (Jack) Fisher -- Sociology & Anthropology *Osteoporosis & the Negative Effects of Elongated Human Life Spans: An Evolutionary Perspective*	am	9	85
Michael Coryell: Microbiology & Immunology Seth Walk, Timothy McDermott -- Microbiology & Immunology, Land Resources & Environmental Sciences *Do gut endosymbiotic microbes mediate arsenic uptake by the host?*	am	106	36
Connor Dack: Electrical & Computer Engineering Brock LaMeres -- Electrical & Computer Engineering *Designing and Benchmarking Space Imagining Algorithms through the use of the Montana High Performance Computing Cluster*	am	75	63
Matt Danczyk: Mechanical & Industrial Engineering Sarah Codd -- Mechanical & Industrial Engineering *Experimental Two-Phase Flow Through A Porous Medium*	am	98	63
Rebecca Danforth: Physical Chemistry Bern Kohler -- Chemistry & Biochemistry *Electron Dynamics of Aqueous Iron(III) at Varying pH*	am	110	37
Katie Davis: Center for Biofilm Engineering Matthew Fields, Al Cunningham, Robin Gerlach -- Microbiology & Immunology, Center for Biofilm Engineering, Chemical & Biological Engineering *Biogenic Coal Bed Methane Enhancement: Methods for Field-relevant Experiments*	am	78	32
Sarah Devitt: Health & Human Development Dawn Tarabochia -- Health & Human Development *The assessment of Professional Caregivers Perceptions and Attitudes of Sexual Health Issues and Behaviors associated with the Elderly Population and the Need for Educational Programs*	am	121	29
Patrick Donnelly: Computer Science John Sheppard -- Computer Science *Clustering Spectral Filters for Feature Extraction in Musical Instrument Identification*	am	30	32

Student, Mentor, Project	Session	Poster #	Abstract Page #
Tara Donohoe: Land Resources & Environmental Sciences William Dyer -- Plant Sciences & Plant Pathology *Physiological Analysis of Oxidative Stress Response in Multiple Herbicide Resistant Avena fatua Biotypes*	am	109	45
Jordan Dood: Chemistry & Biochemistry Bern Kohler -- Chemistry & Biochemistry *Determination of DNA Radical Spectroscopic Features*	pm	71	86
Ryan Downey: Electrical & Computer Engineering David Dickensheets -- Electrical & Computer Engineering *The Carrion Interferometer*	am	76	64
Alisha Downs: Liberal Studies Patricia Catoira -- Modern Languages & Literatures *Ernesto "Che" Guevara's "Hombre Nuevo" vs. "Generacion ni-ni": Cuba's Generation Gap and Evolving Ideals*	pm	9	86
Dale DuCharme: Health and Human Performance (Blackfeet Community College) Dee Hoyt -- Education and Health *How Drastically Do Emotions Affect Overall Health?*	am	59	117
Gerrit Egnew: Chemical & Biological Engineering Brian Bothner -- Chemistry & Biochemistry *Thermal Characterization of VP1 N-terminal Domain in Parvovirus Capsids*	pm	80	64
Melissa Emery: Chemistry & Biochemistry Charles McLaughlin -- Chemistry & Biochemistry *Student Perceptions Toward the TEAL Approach to Enhance Chemistry Education*	am	10	87
Samuel Engblom: Physics Charles Kankelborg -- Physics *Extended Analysis of Optical Distortion in the MOSES Rocket Instrument*	pm	19	87
Bailey Engle: Animal & Range Sciences Jennifer Thomson, Jane Ann Boles -- Animal & Range Sciences *Gene Expression of Skeletal Muscle of Red Face Hereford Steers*	am	86	45
Yanet Eudave Marin: Health & Human Development Suzanne Christopher, Bethany Letiecq -- Health & Human Development *Coping and Depression among Frontier Migrants: Status and Gender Matter*	pm	41	29
Matthew Evans, Nicholas Peyton: History & Philosophy Robin Hardy -- History & Philosophy *The New North Africa*	am	8	87
Gaoyang Fan: Mathematical Sciences Tomas Gedeon -- Mathematical Sciences *Boolean Network Model for Transcriptional Cell-cycle Oscillator in Yeast*	pm	73	88
Jayme Feyhl-Buska: Ecology Eric Boyd -- Microbiology & Immunology *Deciphering the Microbial Contribution to Geochemical Cycling in the Georgetown Lake Ecosystem*	pm	114	88
Megan Figura: Ecology Luther Talbert -- Plant Sciences & Plant Pathology *Qualitative Trait Locus Analysis of Recombinant Inbred Lines*	pm	44	88
Nathan Fortier: Computer Science John Sheppard -- Computer Science *Abductive Inference in Bayesian Networks using Distributed Overlapping Swarm Intelligence*	pm	95	33

Student, Mentor, Project	Session	Poster #	Abstract Page #
Michael Fox: Health & Human Development Alison Harmon, Mary Miles, Carmen Byker -- Health & Human Development *A Comparison of Freshly Harvested Organic Lettuce and Conventionally Grown Bagged Lettuce as Assessed by Blood Sugar Levels and Insulin Requirements of Type 1 and Type 2 Diabetic Subjects*	pm	38	30
Nathan Fritz: Mechanical Engineering Dave Miller, Doug Cairns, Daniel Samborsky -- Mechanical & Industrial Engineering, Chemical & Biological Engineering *An Investigation of the Effects of Bond Line Thickness on the Strength of Scarf Joints*	pm	37	64
Janice Froman: Health and Human Performance (Blackfeet Community College) Dee Hoyt -- Education and Health *Take Shape in a Small Community*	am	61	117
Edgar Gamero: Chemical & Biological Engineering Rich Macur -- Center for Biofilm Engineering *Lipid production from fungal mixture ENV1*	am	37	65
Emma Garcia: Chemical & Biological Engineering Michelle Flenniken -- Plant Sciences & Plant Pathology *Honey Bee Host Response to Virus and Agrochemical Stress*	am	35	65
Jacob Gardner, Jack Wilson, Holley Flora: Earth Sciences Chris Organ -- Earth Sciences *Rates of Biomechanical Evolution Preceding Shifts in Dinosaur Locomotion*	am	67	89
Katie Garrison: Psychology Ian Handley -- Psychology *The effect of initial mindset and mode of thought on decision quality: Unconscious and analytical processes at play*	am	89	37
Emery Gaylord: Agricultural Economics & Economics Carly Urban -- Agricultural Economics & Economics *The Effect of Regulation on Side-Country Avalanche Deaths*	pm	87	89
Sarah Gilkerson, Jared Heuck (MSU Alum): History & Philosophy Michael Reidy, Ada Giusti -- History & Philosophy, Modern Languages & Literatures *Zawiya Ahansal: Environmental geology and human history in the High Atlas*	pm	Multi-media A	89
Edward Gillig: Chemistry & Biochemistry Mary Cloninger -- Chemistry & Biochemistry *Uptake of Lactose-functionalized PAMAM Dendrimers*	am	14	90
Grant Gittus: Sociology & Anthropology Jack Fisher -- Sociology & Anthropology *Archaeological Analysis of the Coal Creek Spring Stone Artifact Scatter*	am	16	90
Kyle Glose: Cell Biology & Neuroscience Steven Stowers -- Cell Biology & Neuroscience *Signal Processing from Mechanoreceptive and Nociceptive Neurons in Drosophila*	pm	21	90
Kayla Gnerer: Agricultural Economics & Economics Carly Urban -- Agricultural Economics & Economics *The Impacts of Head Start on High School Graduation Rates in Montana*	pm	112	91
Joshua Gosney: Chemical & Biological Engineering Jeffrey Heys -- Chemical & Biological Engineering *FEM of Microbubbles in biological flows*	am	108	65

Student, Mentor, Project	Session	Poster #	Abstract Page #
Amy C. Graham: Microbiology & Immunology Joshua Obar -- Microbiology & Immunology *Activation of mast cells by influenza A virus stimulates virus-induced immunopathology*	am	48	25
James Gray: Chemical & Biological Engineering Ross Carlson -- Chemical & Biological Engineering *Synthetic Escherichia coli Consortia and Emergent Properties*	am	38	66
Brett Green: Physics John Neumeier -- Physics *Analysis of the BRAN Forward High Luminosity Detectors at the LHC*	am	19	91
Sarah Haack: Health & Human Development Carmen Byker -- Health & Human Development *Psychosocial Factors and Dietary Habits Affecting Food and Beverage Choices of College Students: A Theory-Based Approach*	pm	39	30
Brandon Haller: Microbiology & Immunology Jovanka Voyich -- Microbiology & Immunology *Role of Leukocidin A/B in Staphylococcus aureus Virulence*	pm	98	91
Emma Hannigan: Chemistry & Biochemistry Mary Cloninger -- Chemistry & Biochemistry *Cancer Cell Aggregation Studies Using Carbohydrate Functionalized PAMAM Dendrimers*	am	11	92
Devin Hansen: Physics Nicolas Yunes -- Physics *Can Gravitational Waves Rule Out Lorentz Violations in Gravity?*	pm	5	92
Leanna Hansen: Cell Biology & Neuroscience Florence Dunkel -- Plant Sciences & Plant Pathology *Local Knowledge of Malaria and its Transmission Risks*	pm	17	92
Benjamin Havens: Agricultural Economics & Economics Carly Urban -- Agricultural Economics & Economics *Obesity's Predictive Power on Labor Force Participation*	am	123	93
Tamra Heberling: Mathematical Sciences Lisa Davis, Billie Kerans -- Mathematical Sciences, Ecology *Modeling the Direct and Indirect Effect of a Non-Host on Parasite Transmission*	am	Topical Session Math	37
Halley Heintz: Art David Swingle -- History & Philosophy *Museum of the Rockies: The Hybrid of a Rural and Metropolitan Museums*	am	7	51
Logan Henke: Music Linda Antas -- Music *Signal Processing: Creating Art with Science*	am	52	51
Melissa Herrygers: Animal & Range Sciences James Berardinelli, Robert Garrott -- Animal & Range Sciences, Ecology *Pregnancy Rate and Metabolites in Bighorn Sheep (Ovis canadensis) at the End of Breeding Season and in Mountain Goats (Oreamnos americanus) Before the Breeding Season and the First Trimester of Pregnancy*	pm	67	46
Ben Hills: Earth Sciences Jordy Hendrikx -- Earth Sciences *Snowpack Densification: An Investigation of Density Change Through Snow Melt and Metamorphosis*	am	66	93

Student, Mentor, Project	Session	Poster #	Abstract Page #
Lana Hoagland: Electrical & Computer Engineering Phillip Himmer -- Electrical & Computer Engineering *Nanopositioning of a Optical Translation Stage*	pm	61	66
Trace Hobbs: Chemistry & Biochemistry Robin Gerlach -- Center for Biofilm Engineering *Development of a Clinically Relevant Model Flow System for Observing Struvite Formation by Proteus mirabilis Biofilms*	pm	42	93
Devra Hock, Coralyn Kai Bingman, Zach Reid: Earth Sciences Frankie Jackson, David Varricchio -- Earth Sciences *A New Occurrence of Dictyoolithus eggs from the Cretaceous Tiantai basin, Zhejiang Province, China*	pm	85	94
Wyatt Holmes: Mechanical & Industrial Engineering Joseph Shaw -- Electrical & Computer Engineering *Micro Wind Turbine Power for Infrared Cloud Imager Instrumentation*	pm	14	66
Nicholas Holom: Agricultural Economics & Economics Carly Urban -- Agricultural Economics & Economics *The Economics of Violence*	am	118	94
Holly Howe: Psychology Rebecca Brooker -- Psychology *Cognitive Control: Physical Responses of At Risk Adults Due to High Allostatic Load*	pm	100	94
Ahmed Imtiaz: Mechanical & Industrial Engineering Laura Stanley -- Mechanical & Industrial Engineering *Hazard Perception Differences between Experienced and Less Experienced Drivers While Driving in Real World Hazards*	pm	12	33
Lindsey Jackson: Education Marilyn Lockhart -- Education *Technology Enabled Active Learning Classrooms at Montana State University*	am	15	30
Benjamin Jackson: Mathematical Sciences Isaac Klapper, Robin Gerlach -- Mathematical Sciences, Chemical & Biological Engineering *Biofilms and Mathematics: Examining Urea Metabolism in a Bacterial Community*	pm	Special Topics Math	38
Sydney Jaramillo: English Dave Swingle -- History & Philosophy *The Making of an Effective Visitor-Orientated Museum*	am	18	95
Spencer Jenko: Economics Carly Urban -- Agricultural Economics & Economics *Effect of medical marijuana laws on standardized test scores among underage youth*	pm	121	95
Chaitanya Johar: Mechanical & Industrial Engineering Mark Anderson -- Agricultural Economics & Economics *Examining Economics Students' Psychology Using Recycling Preferences as a Test Mode*	pm	15	67
Rochelle Johnson: Clinical Lab Science (Montana State University - Billings) Kurt Toenujes, Joy Goffena -- Biological & Physical Sciences *Two-Hybrid Analysis of GMP1 and TSA1*	am	80	117
Stephanie Johnson: Health & Human Development Laura Larsson -- Nursing *Exploring Treatment Barriers to Postpartum Anemia in Rural WIC Users*	pm	33	56

Student, Mentor, Project	Session	Poster #	Abstract Page #
Stephanie Johnson: Health & Human Development Alison Harmon, Melody Anacker, Laura Larsson -- Health & Human Development, Nursing *Exploring Food Security Issues at MSU Through Food Group Choices*	pm	34	56
Daniel Kanewske: Mathematical Sciences Tianyu Zhang -- Mathematical Sciences *2D Modeling of Biofilm as a Visco-Elastic Fluid*	am	Topical Session Math	38
Katherine Kent: Chemical & Biological Engineering Jennifer Brown -- Chemical & Biological Engineering *Rheological Characterizations of Polymer-Particle Dispersions with Silicon Dioxide Nanoparticles*	pm	94	67
Phyu Pannu Khin: Cell Biology & Neuroscience Christa Merzdorf, Daniel Van Antwerp, Jennifer Forecki -- Cell Biology & Neuroscience *Positioning the Midbrain-Hindbrain Boundary during Nervous System Development*	am	2	95
William Kirk: Physics Randy Babbitt -- Physics *Multi-Spot laser vibrometry through AOD diffraction*	pm	83	96
Taruha Kirkaldie: Allied Health (Aaniiih Nakoda College) Dan Kinsey -- Integrated Environmental Science *West Nile Virus Serveillance on Fort Belknap Reservation*	am	82	117
Kostyantyn Kravchenko: Electrical & Computer Engineering Wataru Nakagawa -- Electrical & Computer Engineering *Optical Sensing Using Surface Electromagnetic Waves*	am	94	68
L.J. Krumenacker: Earth Sciences Dave Varricchio -- Earth Sciences *Taphonomy of the Cretaceous Wayan Formation of Idaho*	am	68	38
Samuel Kuhlin: Mechanical & Industrial Engineering Erick Johnson -- Mechanical & Industrial Engineering *Design and Optimization of a Vertical Axis Water Turbin*	am	115	68
Katharine Kujawa: Psychology Mike Babcock, Frances Lefcort -- Psychology, Cell Biology & Neuroscience *Familial dysautonomia: An evaluation of anxiety using the elevated plus maze*	pm	99	39
Emilie Kuster: Nursing Ann Bertagnolli -- INBRE *Perceptions of Mental Health on the Fort Peck Reservation*	pm	32	115
Benjamin LaFrance: Chemistry & Biochemistry Trevor Douglas -- Chemistry & Biochemistry *Protein Cage Nanoreactors and Hierarchical Assemblies with P22*	pm	82	96
Benjamin Larson: Architecture Maire O'Neill -- Architecture *Know Your Town*	am	Multi-media A	28
Shane Leary: Mathematical Sciences Carly Urban -- Agricultural Economics & Economics *Effect of Win Percentage on Home Attendance of NFL Games*	am	46	96
Jesse Lee: Electrical & Computer Engineering Wataru Nakagawa -- Electrical & Computer Engineering *Development of Phase and Polarization Resolved Measurement System for use in Optical Nanostructure Characterization*	am	70	68

Student, Mentor, Project	Session	Poster #	Abstract Page #
Jake Lindquist: Physics Aleks Rebane -- Physics *Harnessing wavelength-tunable femtosecond laser for accurate measurement of two-photon absorption spectral profiles*	pm	4	96
Neil Liotta, Kirkwood Donavin (Graduate Student), Jake Ebersole, Colin Gaiser, Alexander Paterson: Chemical & Biological Engineering, Economics, Sociology, Business Sarah Janzen -- Agricultural Economics & Economics *Assessment of Health, Educational, Agricultural, and Psychosocial Outcomes from Engineers Without Borders' Water and Sanitation Projects in Khwisero, Kenya*	am	91	69
Dustin LittleOwl: Natural Resources (Little Bighorn College) Neva TallBear -- Science Department *The Apaake Project at Little Big Horn College (West Nile Virus) on the Apsaalooke Reservation*	am	83	118
Gavin Lommatsch: Electrical & Computer Engineering Joseph Shaw -- Electrical & Computer Engineering *Infrared Cloud Imager Data Analysis for Optical Satellite Communication*	pm	59	69
Patrick Madden: Chemistry & Biochemistry Trevor Douglas -- Chemistry & Biochemistry *Investigating the P22-Dec protein system as an influenza vaccine platform*	pm	81	97
Sarah Mailhiot: Mechanical & Industrial Engineering Joseph Seymour, Ronald June -- Chemical & Biological Engineering, Mechanical & Industrial Engineering *Determination of Diffusion Coefficients in Human Arthritic Cartilage*	pm	105	33
Kelsey March: Cell Biology & Neuroscience Thom Hughes -- Cell Biology & Neuroscience *Baculovirus Screening for Fluorescent Sensors*	pm	46	97
Andy Marshall: Art Josh Deweese -- Art *Native Refractory*	am	12	51
Madison Martin: Microbiology & Immunology Michelle Flenniken, Brian Bothner -- Plant Sciences & Plant Pathology, Chemistry & Biochemistry *Evaluation of the Metabolic Signatures of Virus-Infection and Agrochemical-Stress in Honey Bees*	am	41	97
Jonathan Martinson: Microbiology & Immunology Seth Walk, Blake Wiedenheft, Royce Wilkinson -- Microbiology & Immunology *Inactivation of Clostridium difficile toxin gene, tcdB, using CRISPR mutagenesis*	am	50	98
James Mauch: Earth Sciences Colin Shaw -- Earth Sciences *Fluid inclusion and microstructure insights into deformation conditions of the Cordillera Blanca Detachment shear zone, Peru*	pm	86	98
Will McGuinness: Microbiology & Immunology Jovanka Voyich -- Microbiology & Immunology *Propensity of Novel Staphylococcus aureus Bacteriophage Therapeutics in Conjunction with Iron-doped Nanoparticles*	am	107	99
Michelle Meagher: Chemical & Biological Engineering Brent Peyton -- Chemical & Biological Engineering *Analysis of Selenium Reducing Microbial Communities in Mine Waste Rock*	am	34	69

Student, Mentor, Project	Session	Poster #	Abstract Page #
Delisha Meishery: Microbiology & Immunology Jovanka Voyich -- Microbiology & Immunology *Differential regulation of staphylococcal virulence by the sensor kinase SaeS in response to neutrophil-derived stimuli*	pm	101	26
Joshua Meyer, Benjamin Adams: Computer Science Clemente Izurieta -- Computer Science *An Application to Facilitate Communication Between Physical Therapy Agencies and Their Clients*	pm	75	70
Scott Miller: Electrical & Computer Engineering Randy Larimer, Berk Knighton -- Electrical & Computer Engineering, Chemistry & Biochemistry *Control and monitoring of a near-space balloon payload using the Iridium satellite network*	am	74	70
Sarah Mondl, Lana Hoagland: Electrical & Computer Engineering David Dickensheets, Phil Himmer -- Electrical & Computer Engineering, Electrical & Computer Engineering *Optical Analysis of Aluminum Nitride Thin Films*	pm	62	71
Sarah Mondl: Electrical & Computer Engineering David Dickensheets, Phil Himmer -- Electrical & Computer Engineering, Electrical & Computer Engineering *Phase Unwrapping in Image Processing*	pm	63	70
Logan Moriarty: Modern Languages & Literatures Pascale Hickman -- Modern Languages & Literatures *Moroccan French Phonetics: Beyond Le Français Standard*	am	17	99
Luke Morton: Chemistry & Biochemistry Trevor Rainey -- Chemistry & Biochemistry *Elucidation of Palladium-catalyzed Enantioselective Reactions*	am	23	99
Elizabeth Mullins: Biology (Montana State University - Billings) David Butler, Kurt Toenjes, Joy Goffena -- Biological and Physical Sciences *Identification of potential targets of the Grr1p SCF ubiquitin ligase in fungi*	am	79	118
Lindsay Murdock: Sociology & Anthropology Cody Warne, Danielle Hidalgo -- Sociology & Anthropology *The Female President: Equality as a Top Down Strategy*	pm	Special Topics Sociology	100
Connor Murnion: Cell Biology & Neuroscience Frances Lefcort -- Cell Biology & Neuroscience *Motor Innervation in a Familial Dysautonomia Mouse Model*	am	3	100
Patrick Murphy: Mathematical Sciences Tomas Gedeon -- Mathematical Sciences *Models for Division of Labor in Microbial Consortia*	pm	74	100
Nathan Murphy: Chemical & Biological Engineering Brent Peyton -- Chemical & Biological Engineering *Long Term Cryopreservation of Algal Cultures*	pm	90	71
Lacey Murphy: Microbiology & Immunology Deborah Keil, Jamie DeWitt (East Carolina University), Brenda Buck (University of Nevada Las Vegas) -- Microbiology & Immunology, Toxicology & Pharmacology, Geosciences *Immunotoxicity Profile Following Exposure to Silt Deposit Dust Samples from Nellis Dunes Recreational Area, Clark County, Nevada*	pm	117	39

Student, Mentor, Project	Session	Poster #	Abstract Page #
Flynn Murray: Civil Engineering Michael Berry, Sarah Codd -- Civil Engineering, Mechanical & Industrial Engineering *Feasibility of Reclaimed Asphalt Pavement as Aggregate in Portland Cement Concrete Pavements*	am	117	34
Nichole Murray: Mechanical & Industrial Engineering Berk Knighton -- Chemistry & Biochemistry *The Daring Story of Taking High Altitude Balloons To New Horizons*	pm	24	71
Nicolas Najdovski: Ecology Benjamin Poulter -- Ecology *A modeling approach to estimate carbon emissions from D.R.C. deforestation*	pm	56	39
Drew Narduzzi: Animal & Range Sciences Clayton Marlow -- Animal & Range Sciences *Russian olive (Elaeagnus angustifolia L.) as a food source in Montana stream ecosystems*	pm	54	46
Aniko Nelson: Agricultural Economics & Economics Carly Urban -- Agricultural Economics & Economics *Football Success and Student Body Academic Success*	am	27	101
Allison Nesseth: Nursing Laura Larsson -- Nursing *Industry Thoughts on Radon Resistant Construction Policies*	am	58	115
Kristen Newman: American Studies Robert Rydell -- History & Philosophy *Service Animals and Museum Collections: Navigating Equal Opportunity in Employment, Volunteerism and Visitor Services While Maintaining Low Impact on Preservation Standards*	pm	110	101
Shauna Newton: Biology (Montana State University - Billings) Tom Lewis -- Biological & Physical Sciences *Mutations abrogating siderophore transport in Pseudomonas aeruginosa*	am	81	118
Amanda Nicolau: University Studies Lucia Rodrigues -- Federal University of the State of Rio de Janeiro *Quality Assessment of Table Salt Consumed by Children and Adolescdnts in the City of Rio De Janeiro, Brazil*	am	64	116
Brigit Noon: Chemistry & Biochemistry Brian Bothner -- Chemistry & Biochemistry *Metabolite Diffusion of a Microfluidic H-Filter*	am	22	101
Nate Norberg, Brian Maher: Computer Science Clemente Izurieta -- Computer Science *A Web-based Equipment Administration System for Music Technology*	am	45	72
Taylor Oeschger: Chemical & Biological Engineering Joseph Seymour -- Chemical & Biological Engineering *Growth and Isolation of Bacterial Alginate from Pseudomonas aeruginosa*	am	51	72
Delaney O'Hara: Sociology & Anthropology John Fisher -- Sociology & Anthropology *The Relationship Of Ballistics And Bone Fragmentation: Firing Distance Identification In Postmortem Deer Long Bone*	am	56	102
Karly Old Person: Allied Health (Blackfeet Community College) Dee Hoyt -- Education and Health *Stress Before and After Exercise*	am	60	119

Student, Mentor, Project	Session	Poster #	Abstract Page #
Sarah Olivo: Animal & Range Sciences Shannon Moreaux -- Animal & Range Sciences *Identification and Management of Anthelmintic-Resistant Intestinal Parasites in Equines*	am	85	46
Mariana Olsen: Psychology Sara Waller -- History & Philosophy *Dog-Tired: Breed Differences in Inhibitory Control and Ego Depletion*	pm	26	40
Katie Olson: Microbiology & Immunology Jovanka Voyich, Shannon Moreaux -- Microbiology & Immunology, Animal & Range Sciences *Characterization of Virulence Factors and Antibiotic Resistance levels of Staphylococcus aureus and other Staphylococcal species in Equine Populations*	pm	102	47
Chinomso Onuoha: Chemical & Biological Engineering Paul Gannon, Zach Gill -- Chemical & Biological Engineering *High Temperature Corrosion of Chromium, Silicon and Aluminum on Nickel Base Metal*	am	116	72
David Owen: Business Carly Urban -- Agricultural Economics & Economics *How Medicinal Cannabis Enrollment Effects Public Welfare Programs: A Study of Montana State*	pm	119	54
Shaun Owenby: Psychology Ian Handley -- Psychology *Changing Certain and Uncertain Attitudes: The Opposite Effects of General Action and Inaction Goals*	am	90	40
John Pankratz, Will van Gelder: Chemical & Biological Engineering, Earth Sciences Jennifer Brown, Mark Skidmore -- Chemical & Biological Engineering, Earth Sciences *Brinicle Formation in the Laboratory*	am	92	72
Jacob Parker: Physics Charles Kankelborg -- Physics *Continuing Radiometric Calibration of the MOSES Rocket Payload*	pm	20	102
Jeff Patriarche: Land Resources & Environmental Sciences Lisa Rew, Tim Seipel, Stephanie Ewing -- Land Resources & Environmental Sciences *The role of soil salinity and mineral toxicity as drivers of plant species composition in south Phillips County, Montana*	am	39	47
Kirra Paulus: Microbiology & Immunology Blake Wiedenheft, MaryClare Rollins -- Microbiology & Immunology *Viral Suppressors of CRISPR-mediated Immune Systems in Bacteria*	am	102	102
Alyssa Peck: Mathematical Sciences Jim Robison-Cox -- Mathematical Sciences *Evaluating the Effectiveness of Occupant Protection Programs*	pm	Special Topics Math	41
Todd Pedersen: Chemical & Biological Engineering Brent Peyton, Rob Gardner -- Chemical & Biological Engineering, Center for Biofilm Engineering *Investigating culture effects of light irradiance and initial biomass concentration in Nannochloropsis Oceanica sp. using response surface methodology*	pm	79	73

Student, Mentor, Project	Session	Poster #	Abstract Page #
Natasha Pettinger: Chemistry & Biochemistry Bern Kohler -- Chemistry & Biochemistry *Ultrafast Photoreduction of Cerium Oxide Nanocrystals and Precursor Complexes in Aqueous Solution*	pm	72	103
Nicholas Peyton, Matthew Evans: History & Philosophy Robin Hardy -- History & Philosophy *The New North Africa*	pm	8	103
Scott Phelan: Agricultural Economics & Economics Carly Urban -- Agricultural Economics & Economics *State Gun Laws and School Related Violent Deaths*	am	119	103
Lai Yee Phoon: Health & Human Development Mary Miles -- Health & Human Development *Oxidative Stress and Insulin Sensitivity on Exercise and Sugar-sweetened Beverages*	am	88	56
Daiane de Fatima Piva: Chemical & Biological Engineering Colin Shaw -- Earth Sciences *Supercritical CO2 and anhydrite caprock interactions: Analyses of conditions for precipitation and dissolution.*	am	99	73
Julia Platt: Mathematical Sciences Tomas Gedeon, Lisa Davis -- Mathematical Sciences *Mathematical simulation of traffic flow and torque for bio-polymerization processes*	am	47	104
Charles Plummer, Amanda Weber: Ecology, Chemistry & Biochemistry Robert Sharrock -- Plant Sciences & Plant Pathology *Structure/Function of the Protein Phytochrome B in Arabidopsis Thaliana*	pm	1	104
Bryce Possiel: Mechanical & Industrial Engineering Erick Johnson -- Mechanical & Industrial Engineering *Horizontal Axis Marine Current Turbine Design*	am	114	74
Nathaniel Powell-Palm: Land Resources & Environmental Sciences Cathy Zabinski -- Land Resources & Environmental Sciences *Grazing versus Haying: Harvest methods' affects on Gallatin Valley grassland productivity*	pm	68	48
Varsha Rao: Chemical & Biological Engineering Sarah Codd, Joseph Seymour -- Mechanical & Industrial Engineering, Chemical & Biological Engineering *Modeling Flow Through Capillaries Formed by Heterogeneous Gelation of Algal Alginate*	pm	93	74
Brian Redman: Electrical & Computer Engineering Joseph Shaw -- Electrical & Computer Engineering *Validation of a Low-cost All-Sky Infrared Cloud Imager*	am	95	74
Jacob Remington: Chemistry & Biochemistry Bern Kohler -- Chemistry & Biochemistry *Further Probing the Structural Dynamics of Single Stranded DNA Labeled with the Fluorescence Probe 2-Aminopurine Using Time-Resolved Fluorescence Measurements*	am	24	104
Timothy Reusch: Health & Human Development Alison Harmon -- Health & Human Development *Sustainable Food Systems and the Role of Controlled Environment Production*	pm	35	31

Student, Mentor, Project	Session	Poster #	Abstract Page #
Aaron Reynolds: Electrical & Computer Engineering Joseph Shaw -- Electrical & Computer Engineering *Producing and Testing Infrared Cloud Imaging Systems*	pm	60	75
Arielle Richard: Health & Human Development John Seifert -- Health & Human Development *The Kinematics of Slope Style Skiing: Dominant vs. Non-Dominant Rotations in Professional, Advanced, and Intermediate Level Athletes*	am	57	57
Amanda Richards: Microbiology & Immunology Michael Franklin -- Microbiology & Immunology *Fluorescent Imaging of Pseudomonas aeruginosa Biofilms*	pm	113	105
Stephen Riggs: Agricultural Economics & Economics Carly Urban, Franke Wilmer -- Agricultural Economics & Economics, Political Science *How Has Same Day Voter Registration Affected Voter Turnout?*	am	29	105
Nathan Robertus: Computer Science Hunter Lloyd -- Computer Science *A Design and Prototype of an Immersive, Virtual-Reality User Interface*	am	96	75
Sadie Robertus: English Doug Downs -- English *Recollection's Recourse: Analyzing the Rhetoric of Memorial Places*	pm	108	105
Caroline Rowe: Health & Human Development Renee Harris, Erin Bills -- Montana Office of Rural Health *Outcomes and Implications of the Child Ready Montana Program in the critical access hospitals in Roundup and Lewistown, Montana*	pm	111	57
Michael Ruiz: Sociology & Anthropology John W. Fisher -- Sociology & Anthropology *Dead Men Do Tell Tales*	am	65	105
Alyssa Sandner: Ecology Jioanna Carjuzaa, Janelle Rasmussen -- Education, International Programs *The story of pursuing a STEM (Science, Technology, Engineering and Math) career as a Middle Eastern undergraduate student*	pm	18	106
Rebekah Schields: Sociology & Anthropology Michael Neeley -- Sociology & Anthropology *Archaeology Field School Artifact Analysis and Historical Research*	pm	16	106
Amber Schmit: Chemical & Biological Engineering Christine Foreman, Markus Dieser, Heidi Smith -- Chemical & Biological Engineering, Center for Biofilm Engineering *Nitrogen cycling in cryoconites from the Canada Glacier in the McMurdo Dry Valleys, Antarctica*	pm	78	76
Hannah Schweitzer: Microbiology & Immunology Matthew Fields -- Microbiology & Immunology *Investigation of coal-associated microbial community from a diffusive microbial sampler (DMS)*	pm	115	41
Riley Shearer: Chemistry & Biochemistry Trevor Douglas -- Chemistry & Biochemistry *Using Protein Cages as T1 enhanced contrast agents for Magnetic Resonance Imaging*	am	4	106

Student, Mentor, Project	Session	Poster #	Abstract Page #
Matthew Sherick: Chemical & Biological Engineering Joseph Seymour, Sarah Codd, Jennifer Brown -- Chemical & Biological Engineering, Mechanical & Industrial Engineering *An Examination of Microcapillary Formation and Coalescence in Diffusive Microbial Alginate Gelation using Magnetic Resonance*	pm	92	76
Joshua Sinrud, Jake Danczyk: Physics Hugo Schmidt -- Physics *Liquid Lithium/BZY Proton Conducting Fuel Cell*	pm	84	107
Alec Skuntz: Chemistry & Biochemistry Lori Christensen -- Gallatin Valley Food Bank *Strategy identification for positive health outcomes among the rural Montana elderly*	pm	106	107
Roy Smart: Physics Charles Kankelborg -- Physics *Software Development for MOSES Flight Operations*	pm	57	107
Chad Smith: Agricultural Economics & Economics Anton Bekkerman -- Agricultural Economics & Economics *Economic analysis of the newly emerging wine markets in the northwest United States*	am	28	48
Tiana Smith: Cell Biology & Neuroscience Joshua Obar -- Microbiology & Immunology *Investigating the Role of Mast Cells in Respiratory Syncytial Virus*	pm	47	108
Brian Spencer: Cell Biology & Neuroscience Steve Stowers -- Cell Biology & Neuroscience *Mapping the Thermoreceptive and Mechanoreceptive Neural Pathways in Drosophila*	am	21	108
Mallory Spencer: Microbiology & Immunology Deborah Keil, Jamie DeWitt (East Carolina University), Brenda Buck (University of Nevada Las Vegas) -- Microbiology & Immunology, Toxicology & Pharmacology, Geosciences *Immunotoxicity Profile Following Exposure to Geological Dust Samples Collected from Nellis Dunes Recreational Area Map Unit CBN2*	pm	116	41
Chelsea Spotted Eagle: Health and Fitness (Blackfeet Community College) Dee Hoyt -- Education and Health *Feedlot Beef vs Home Grown Beef*	am	84	119
Adam Starecheski: Ecology Laura Burkle -- Ecology *Plant and Pollinator Species Richness and Beta-diversity After Wildfire Across a Productivity Gradient in Montana*	am	31	108
Charles Stark: Chemistry & Biochemistry Bern Kohler, Trevor Douglas -- Chemistry & Biochemistry *Electron tansfer and localization processes in ruthenium bipyridyl complexes linked via click chemistry*	pm	70	42
Chase Stefani: Agricultural Economics & Economics Carly Urban -- Agricultural Economics & Economics *The Effect of Income Inequality on Long-Term Growth Rates in OECD countries*	pm	88	109
Sean Stettner: Chemical & Biological Engineering Seth Walk -- Microbiology & Immunology *Molecular typing of carbapenemase-producing Klebsiella pneumonia isolates by plasmid diversity analysis*	pm	77	76

Student, Mentor, Project	Session	Poster #	Abstract Page #
Chalice Stevens: Music Jeremiah Slovarp -- Music *Andalusian Music : From Islamic Spain to Modern Morocco*	pm	7	52
Katherine Stocker: Physics Angela Des Jardins, Jiong Qiu -- Physics *Interpreting Solar Flare Reconnection from the Data of X-rays and Ultraviolet*	pm	64	109
Liessman Sturlaugson: Computer Science John Sheppard -- Computer Science *Hazard Analysis with Continuous Time Bayesian Networks for Space Flight Operations*	am	73	34
James Sutton: Cell Biology & Neuroscience Sheila Nielsen -- Microbiology & Immunology *Differential Recognition of Candida albicans by Human Monocytes due to Microgravity*	am	20	110
Kendra Teague: Land Resources & Environmental Sciences Alison Harmon -- Health & Human Development *Indigenous Food Systems: Grains, Global Perspectives and Health Outcomes*	am	87	48
Jake TeSelle: Mechanical & Industrial Engineering James Wilking -- Chemical & Biological Engineering *Rheological Characterization of Biofilm Polysaccharides*	pm	76	77
Joshua Thelen: Electrical & Computer Engineering Hashem Nehrir -- Electrical & Computer Engineering *Design and Implementation of a Solar Photovoltaic Energy Conversion Experimental Setup for Education Enhancement*	pm	Multi-media B	77
Julian Thorne: Cell Biology & Neuroscience Frances Lefcort, Marta Chaverra -- Cell Biology & Neuroscience *Morphological Characterization of IKAP Deficient Mice through Immunocytochemistry*	am	103	110
Linn Thrane: Physics Charles Kankelborg -- Physics *Inspection of Image Offset During First MOSES Flight in 2006*	am	5	110
Cara Thuringer: Film & Photography Alexis Pike -- Film & Photography *Midwest Best*	pm	Multi-media E	52
Lidice Tobar: Health & Human Development Suzanne Christopher, Bethany Letiecq -- Health & Human Development *Legal Status, Perceived Health, and Wellbeing among Migrants in a New Settlement*	pm	40	31
Taylor Travers, Timothy McInerney, Jeff Whitney, Emily Lindquist, Lexi Palagi: Business Omar Shehryar -- Business *Satisfaction Based on User Experience at Montana State University*	pm	48	54
Eric Troyer: Chemical & Biological Engineering Ellen Lauchnor, Robin Gerlach -- Center for Biofilm Engineering *Optimization of Media for the Hydrolysis of Urea and Precipitation of Calcium Carbonate with S. pasteurii*	pm	31	77
Sam Tulganyam: Animal & Range Sciences Craig Carr -- Animal & Range Sciences *Ecological impacts of bladed fire lines in the Northern mixed grass prairie*	am	32	26

Student, Mentor, Project	Session	Poster #	Abstract Page #
Tafuna Tusi, Lani Paulson Miller, Michelle Strain, Casey Rasmussen: Communications (Montana State University - Billings) Sarah Keller -- Communication & Theater *Preventing Suicide in Montana*	am	Multi-media C	119
Paul van Erp: Microbiology & Immunology Blake Wiedenheft -- Microbiology & Immunology *Mechanisms of CRISPR-RNA guided surveillance in Escherichia coli*	am	25	26
Martina Van Hoy: Chemical & Biological Engineering Joan Broderick, Abigail Richards -- Chemistry & Biochemistry, Chemical & Biological Engineering *Defing Important Amino Acid Interactions Involved In Pyruvate Formate-Lyase Aactivation*	am	111	78
Kalina Vander Poel: Environmental Design Pravin Bhiwapurkar -- Architecture *Connecting Art & Science in Fused Glass*	pm	Multi-media D	52
Troy Vanderlinde: Art Rollin Beamish -- Art *Squaring the Circle*	am	Multi-media B	53
Cassia Wagner: Chemistry & Biochemistry Mark Young -- Plant Sciences & Plant Pathology *Isolation and Initial Characterization of a New Archaeal Virus from a Yellowstone Hot Spring*	pm	3	111
Logan Warberg: Computer Science Clemente Izurieta -- Computer Science *NASA Robotic Mining Competition Computer System Design*	pm	96	78
Katherine Warthen: Chemical & Biological Engineering Sandra Halonen -- Microbiology & Immunology *Analysis of Toxoplasma-infected Murine Brains using CLARITY Brains*	am	105	79
Alan Weaver, Jr: Chemistry & Biochemistry Martin Teintze, Jovanka Voyich -- Chemistry & Biochemistry, Microbiology & Immunology *Elucidating the Mechansim of Action of a Novel Antibacterial Agent: Trishexylaminomelamine-tris-phenylguanide*	pm	50	42
Amanda Weber, Charles Plummer: Chemistry & Biochemistry, Ecology Robert Sharrock -- Plant Sciences & Plant Pathology *Sensing and signaling in Phytochrome B in Arabidopsis*	pm	2	111
Shu Ying Wee: Chemical & Biological Engineering Christine Foreman -- Center for Biofilm Engineering *Chemotaxis of Antarctic and Arctic Microbial Life Towards Various Carbon Sources Using a Capillary Motility Method*	am	33	79
Jennifer Weeding: Mathematical Sciences Mark Greenwood -- Mathematical Sciences *An Exploration of the GSIMEX Approach to Modeling Variables with Correlated Measurement Errors in R*	am	26	43
Jake Weimer, Nicholas Tunell, Grant Ganoom, Phillip Boyet: Agricultural Economics & Economics Gary Caton -- Business *Analysis of a Particular Stock Investment*	pm	89	111

Student, Mentor, Project	Session	Poster #	Abstract Page #
Martha Welander: Chemistry & Biochemistry Bern Kohler -- Chemistry & Biochemistry *Photophysics of Flavin Adenine Dinucleotide*	am	112	112
Smith Wells: Animal & Range Sciences Clayton Marlow -- Animal & Range Sciences *Russian Olive (Elaeagnus angustifolia) Leaf Litter as a Food Source in Montana Prairie Stream Ecosystems*	pm	53	49
Jasmine Westbrook: Animal & Range Sciences Craig Carr -- Animal & Range Sciences *Integration of sheep and crop production: effects on cover crop termination, wheat emergence, and sheep live weight gains*	pm	69	27
Summer Whillock, Andrew Manigault: Psychology Ian Handley -- Psychology *The Fleeting Quality of Unconscious Thought: Relative Impact of Decision Speed on the Unconscious Thought Effect.*	pm	25	112
Spencer White: Chemistry & Biochemistry John Peters -- Chemistry & Biochemistry *Expression, Purification, and Characterization of Mercuric Reductase from Three Thermoacidophilic Archaea*	pm	22	112
Benjamin White: Microbiology & Immunology Michael Franklin, Garth James, Phil Stewart -- Microbiology & Immunology, Center for Biofilm Engineering *The Development of Chronic Wound Exudate Media*	pm	103	43
Brett Wilkins: Physics Galina Malovichko -- Physics *Magnetic and Optical Properties of Double Doped Lithium Niobate*	pm	58	113
Laura Williams: Microbiology & Immunology Sandra Halonen -- Microbiology & Immunology *Determination of INF gamma Resistant Genes in Toxoplasma gondii*	am	104	113
Cassondra Wilson: Film & Photography Theo Lipfert -- Film & Photography *The F-Word: A Short Documentary Film on Fertility*	am	Multi-media E	53
Sarah Witt: Health Promotion (Montana State University - Billings) Kathe Gabel, Shawn Hinz -- Health & Human Performance, Riverstone Health *Risk Factors that Predict Incidence of Drinking Alcohol during Gestation*	am	62	119
Katherine Wright: Chemistry & Biochemistry Carl Yeoman -- Animal & Range Sciences *Establishing Non-invasive Methods to Quantify Intestinal Permeability In Lambs Using FITC- Dextran 4000*	pm	23	113
Sila Yanardag: Chemical & Biological Engineering Michael Franklin -- Microbiology & Immunology *Identification of Role of RMF and HPF on Cell Viability, Antibiotic Susceptibility and Biofilm Forming Ability of Pseudomonas aeruginosa PAO1 Strain*	am	100	79
Kaysha Young, Jessica Mueller: Mechanical & Industrial Engineering Laura Stanley -- Mechanical & Industrial Engineering *Characterizing Stopping Behavior at Intersections: Differences Between Experienced and Novice Drivers*	pm	10	35

Student, Mentor, Project	Session	Poster #	Abstract Page #
Sophie Zhu: Pre-Veterinary Medicine Matthew Fields -- Microbiology & Immunology *Effects of light intensity variation on lipid accumulation and carbon fixation of Pheaodactylum tricornutum*	pm	43	49
Grant Zimmerman: Economics Carly Urban -- Agricultural Economics & Economics *The Effect on Accident Rates from Bans on the Use of Cellular Phones while Driving in Montana*	am	120	114