2015 MSU STUDENT RESEARCH CELEBRATION

Thursday, April 9

Celebrating research and creativity
in all academic disciplines.

MONTANA
STATE UNIVERSITY
Mountains & Minds

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

American Indian Research Opportunities (AIRO)
Center for Biofilm Engineering
Hughes Undergraduate Biology
McNair Scholars Program
Montana Space Grant Consortium

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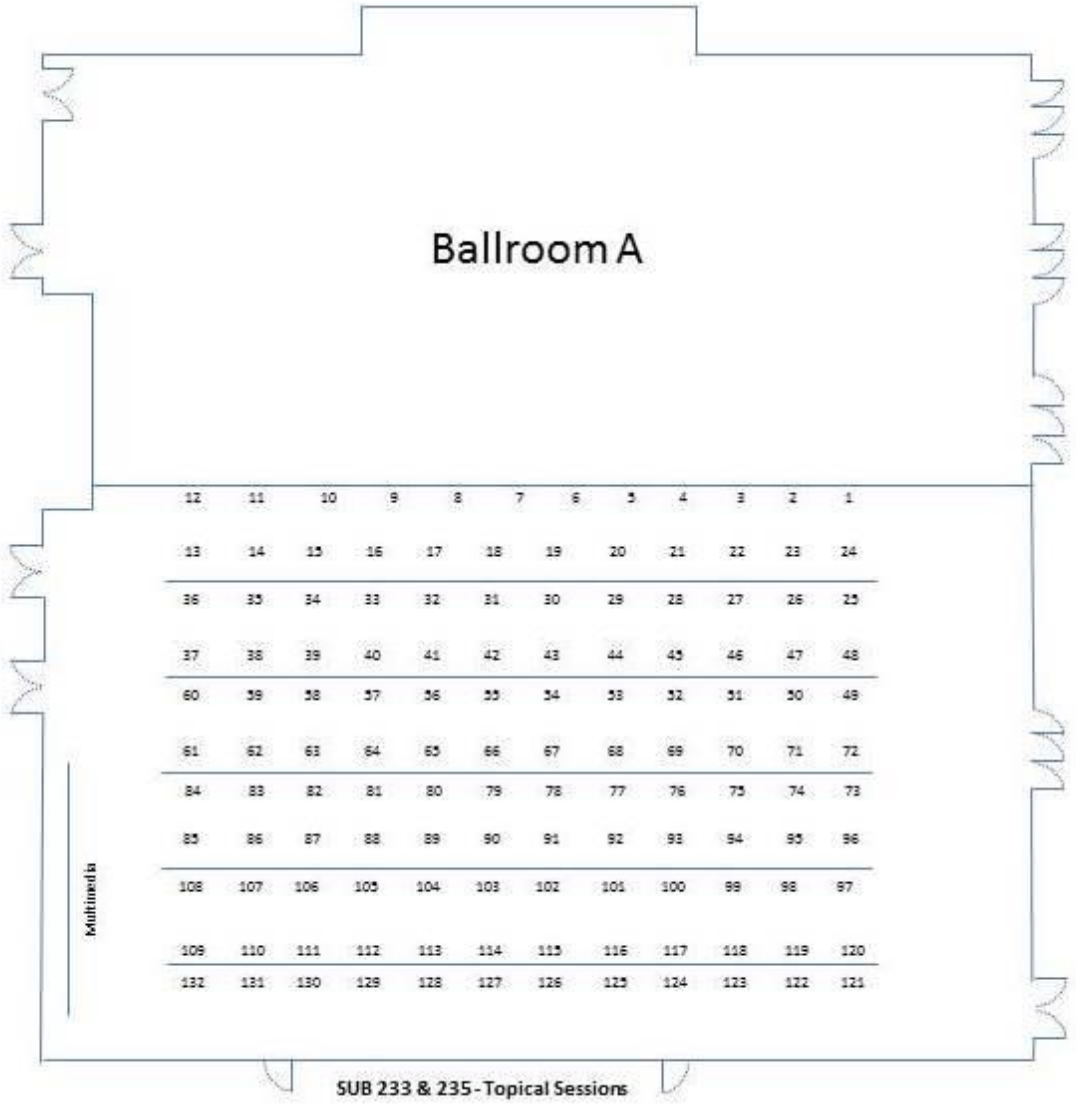
Table of Contents

Conference Map



Panel Discussions – SUB 233

April 9, 2015

New Media: Re-imagining Writing Center Connections 9:00 am – 10:30 am

This panel will discuss and question the relationship between new media and writing centers, and, more specifically, how our Writing Center at Montana State University is affected by these new forms of communication. We will define new media as communication through technology that connects writers in the academic writing community and beyond, and explore how our interactions with new media challenge us to reimagine our goals as a writing center.

Moderator: Jess Carroll, Assistant Director, MSU Writing Center
Research Mentor: Dr. Michelle Miley, Director, MSU Writing Center

Undergraduate Panel Members:

- **Kerry Byrnes:** English, Writing Center Peer Tutor
- **Kelsey Weyerbacher:** English and Photography, Writing Center Peer Tutor
- **Brooke Hampton:** Cell Biology & Neuroscience, Writing Center Peer Tutor

From Renaissance London to Infinite Space: On William Shakespeare and Thomas Middleton 11:00 am – 12:30 pm

Our panel will focus on the plays of William Shakespeare and Thomas Middleton in both early modern and contemporary settings. We aim to devote critical attention to different aspects of early modern drama in order to showcase the value of early modern drama as an experience, a critical topic, and an agent for social change.

Moderator: Gretchen Minton, Faculty Member, English

Undergraduate Panel Members:

- **Zach Stenberg:** English Literature
- **Chase Templet:** English Literature
- **John Woodgerd:** English Literature

Sustaining/Revitalizing Indigenous Knowledge to Advance Science Learning in Contrasting USA and Russia Mountain Systems 1:00 pm – 2:30 pm

This session will focus on student led activities related to a National Science Foundation Grant project. Students and faculty who participated in an international research expedition during summer 2014 will share findings from their research projects to explore a unified interdisciplinary theme of advancing informal science learning through connections to sustaining/revitalizing Indigenous knowledges.

Moderators: Christine Rogers Stanton, Faculty Member, Education
Dawn Falcon, Undergraduate Student, Liberal Studies/Environmental Studies

Undergraduate Panel Members:

- **Sierra Alexander:** Liberal Studies/Environmental Studies
- **Michelle Chapel:** Land Resources
- **Dawn Falcon:** Liberal Studies/Environmental Studies
- **Avery Old Coyote:** Conservation Biology/Ecology

Graduate Panel Members:

- **Michael Running Wolf:** Computer Science

Faculty Panel Members:

- **Shane Doyle:** Native American Studies
- **Cliff Montagne:** Director, BioRegions International

Oral Presentations – SUB 235

April 9, 2015

McNair Scholars Program — 11:00 am- 12:30 pm

The essence of the McNair Scholars Program (MSP) at MSU is to successfully combine faculty mentoring, undergraduate research, and academic support services for students who are preparing themselves for success in graduate school and whose families have not traditionally participated in post-secondary education. One important preparatory aspect of the program is to provide opportunities for scholars to share their research and creative projects at regional & national conferences such as today. The collection of projects previews the diversity of interests, as students in the MSP range from art history to engineering.

11:00 – Josh Gosney, Chemical & Biological Engineering (Faculty Mentor – Dr. Jeffrey Heys)
Numerical Prediction of Microbubble Attachment in Biological Flows

11:15 – Melissa Emery, Chemistry & Biochemistry (Faculty Mentor – Dr. Charles McLaughlin)
Chemistry Student Perceptions Toward TEAL: Gender and Achievement

11:30 – Sydney Jaramillo, English (Faculty Mentor – Dr. Dave Swingle)
Preserving a Museum's Own History: Digitizing the Video Archives of the Museum of the Rockies

11:45 – Katie DesLauries – Health & Human Development (Faculty Mentor – Dr. Dawn Tarabochia)
Grandparents Raising Grandchildren: Perceptions on healthy eating, access and affordability of healthy foods

12:00 – Amanda Williams – Art History (Faculty Mentor – Dr. Dave Swingle)
Jacques-Louis David: Classical Forms and Iconography from Greece, Rome, and France

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 molecular biology to teacher education to public health.

Moderator: Tamra Heberling, Graduate Student, Mathematical Sciences

1:00 – Shari Samuels (Faculty Mentor – Beth Burroughs)
The Evolution of Prospective Elementary Teachers' Competencies

1:15 – Katharine Banner (Faculty Mentor – Megan Higgs)
Model Averaging: I know you are, but what am I?

1:30 – Diana Scepens (Faculty Mentor – Tomas Gedeon)
Optimization of Metabolic Pathway

1:45 – Kevin Ferris (Faculty Mentor – Jim Robison-Cox)
Examining the Spread of Ebola in Western Africa

2:00 – Tan Vinh Tran (Faculty Mentor – Mark Greenwood)
Choosing The Number of Clusters in Monothetic Clustering

2:15 - Michael Broome (Faculty Mentor – Tianyu Zhang)
A Two Species Competition and Mutation Model within a Biofilm

2015 Student Research Celebration
April 9, 2015

MORNING POSTER PRESENTATIONS

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

Student, Mentor, Project	Poster #	Abstract Page #
Kirkwood Donavin: Agricultural Economics & Economics Mentor: Sarah Janzen -- Agricultural Economics & Economics *The Welfare Impacts of Engineers Without Borders in Western Kenya*	1	33
Neil Liotta, Kirkwood Donavin, Kelly Hendrix, Jake Ebersole, Alexander Paterson: Chemical & Biological Engineering, Agricultural Economics & Economics, Civil Engineering, Business Mentor: Sarah Janzen -- Agricultural Economics & Economics *Assessment of Health Outcomes from Engineers Without Borders' Water and Sanitation Projects in Khwisero, Kenya*	1	62
Kevin Zolman: Cell Biology & Neuroscience Mentor: Susy Kohout -- Cell Biology & Neuroscience *Determination of the Role of the C2 domain of Voltage Sensing Phosphatase*	3	102
Evan Atchley: Chemistry & Biochemistry Mentor: John Peters -- Chemistry & Biochemistry *Investigating the Substrate Specificity of the 2-KPCC Carboxylation Reaction*	4	72
Rebecca Danforth: Chemistry & Biochemistry Mentor: Bern Kohler -- Chemistry & Biochemistry *Elucidation of The Photofenton Reaction Mechanism Using Ultrafast Transient Absorption Spectroscopy*	5	33
Nathan Blaseg: Microbiology Mentor: Joshua Obar -- Microbiology & Immunology *Examination of the Leukotriene and Inflammasome Pathways During Invasive Pulmonary Aspergillosis*	6	74
Joshua Carter: Microbiology Mentor: Blake Wiedenheft -- Microbiology & Immunology *Modeling the Dynamics of Target Binding in a Type I-E System*	7	77
AnneMarie Criddle: Microbiology Mentor: Matthew Taylor -- Microbiology & Immunology *Using Co-Infection of Fluorescent Herpes to Characterize Viral Exclusion*	8	79
Jessica Proctor: Architecture Mentor: Chris Livingston, Bradford Watson, Henry Sorenson -- Architecture *Exploring Responses to Marks Left on a Dwelling by Human Inhabitation*	9	26
Chelsie Shults: Architecture Mentor: Maire O'Neil -- Architecture *Design for Human Performance*	10	26
Reese Christensen: Architecture Mentor: Fatih Rifki -- Architecture *The Space Between Buildings*	11	44

Student, Mentor, Project	Poster #	Abstract Page #
Mike Trenk, Adam Koziol, Connor Danelson, Hunter Lapp: Computer Science Mentor: Clemente Izurieta -- Computer Science *Development of Dashboard Management and Monitoring System Technologies in the Software Factory*	12	69
Caleb Killian: Architecture Mentor: Selena Ahmed, Fatih Rifki -- Health & Human Development, Architecture *Reconciling Agrarian and Urbanist Ideals Towards Sustainability*	13	45
Marley Robb: Architecture Mentor: Elisa Renouard -- Architecture *AGUDDIM: PROPOSAL FOR A COMPREHENSIVE ANALYSIS OF PLACE*	14	46
Andrew Marshall: Art Mentor: Joshua DeWeese -- Art *Accessibility Through Furnace Design- Multi-use and Multi-fuel*	15	45
Mason Weber, Coltran Hophan-Nichols: Computer Science, Mentor: Clem Izurieta -- Computer Science *Mobile Application for Equation Recognition and Manipulation*	16	70
Jacob Christenson, Kraig McKernan: Computer Science, Mentor: Clemente Izurieta -- Computer Science *Context Dictionary*	17	55
Brigit Noon: Chemistry & Biochemistry Mentor: Brian Bothner -- Chemistry & Biochemistry *Real-Time Metabolomics*	18	91
Katherine Budeski: Chemistry & Biochemistry Mentor: Brian Bothner -- Chemistry & Biochemistry *Complex Metabolite Analysis in Milk Using Bovine Serum Albumin as a Molecular Sensor*	19	76
Madison Martin: Microbiology Mentor: Michelle Flenniken, Brian Bothner -- Plant Sciences & Plant Pathology, Chemistry & Biochemistry *Metabolic Signatures of Pathogen and Pesticide Stress in Honey Bees*	20	87
Alexandra Thornton: Agroecology Mentor: Fabian Menalled -- Land Resources & Environmental Sciences *Impact of nitrogen availability and time of inoculation on Pyrenophora semeniperda effectiveness as a biocontrol agent of Bromus tectorum*	22	42
Melissa Emery: Chemistry & Biochemistry Mentor: Charles McLaughlin -- Chemistry & Biochemistry *Chemistry Student Perceptions Toward TEAL: Gender and Achievement*	23	79
Maggie O'Donnell: Agricultural Economics & Economics Mentor: Jason Pearcy -- Agricultural Economics & Economics *Addressing the Validity of Using The Test of Understanding in College Economics to Measure Student Learning*	24	91
Shawna Pratt: Center for Biofilm Engineering Mentor: Connie Chang -- Chemical & Biological Engineering *Development and Applications of Double Emulsion Microfluidics Techniques*	25	66
Spencer Bruce: Chemical & Biological Engineering Mentor: Stephanie Wettstein -- Chemical & Biological Engineering *Small pore zeolites for biomass upgrading*	26	29
Quinn Andrews: Chemical & Biological Engineering Mentor: Paul Gannon, Phil Himmer -- Chemical & Biological Engineering, Electrical & Computer Engineering *Investigation on Corrosion Behavior of Magnesium Alloys*	27	52

Student, Mentor, Project	Poster #	Abstract Page #
Katie DesLauriers: Health & Human Development Mentor: Dawn Tarabochia -- Health & Human Development *Grandparents Raising Grandchildren: Perceptions on healthy eating, access and affordability of healthy foods*	28	48
Tracy Echert: Health & Human Development Mentor: Lynn Owens -- Health & Human Development *Motivation for Physical Activity*	29	48
Sandy Filesteel: Nursing Mentor: Elizabeth Kinion -- Nursing *An approach to Integrate American Indian Cultural Strengths with Clinical Best Practice to Prevent Early Childhood Caries on American Indian Reservations*	30	103
Jamie Ritter: Cell Biology & Neuroscience Mentor: Darcy Hunter -- Gallatin WIC Program *Early Childhood Nutrition*	31	95
Dani Bergey: Cell Biology & Neuroscience Mentor: Frances Lefcort -- Cell Biology & Neuroscience *p53-mediated regulation of neuronal number in Ikbkap-deficient mice*	32	73
Jenna Pinto: Cell Biology & Neuroscience Mentor: John Peters -- Chemistry & Biochemistry *Oxidative Stress Protection in Clostridium Perfringens*	33	93
Anna Scott: Chemistry & Biochemistry Mentor: Joan Broderick -- Chemistry & Biochemistry *Mechanistic Studies of Hydrogen Abstraction in the Radical SAM Enzyme HydG*	34	96
Steven Rehbein: Chemistry & Biochemistry Mentor: Thomas Livinghouse -- Chemistry & Biochemistry *Development and Synthetic Application of Metalloamination of Zn(II)*	35	94
Andrew Helming, Amanda Leckband: Chemistry & Biochemistry, Animal Science Mentor: Edward Dratz -- Chemistry & Biochemistry *Study and Isolation of Nontoxic, Plasmid-Curing Agents*	36	83
Merve Gokce, Elif Yagci: Chemical & Biological Engineering Mentor: James Wilking -- Center for Biofilm Engineering *Extending Colloidal Templating Techniques with New Colloidal Materials*	37	56
Cassia Wagner: Chemistry & Biochemistry Mentor: Mark Young -- Plant Sciences & Plant Pathology *Cryo-electron microscopy and bioinformatic annotation of an archaeal virus reveals a novel viral family*	38	100
Martha Welander: Chemistry & Biochemistry Mentor: Bern Kohler -- Chemistry & Biochemistry *Photochemistry of Flavin Adenine Dinucleotide*	39	101
Magdalena Russell: Cell Biology & Neuroscience Mentor: Frances Lefcort -- Cell Biology & Neuroscience *Neuroprotective effects of BGP-15 on IKAP deficient dorsal root ganglia neurons: increasing lifespan of a Familial Dysautonomia model*	40	96
Paul Puettmann: Cell Biology & Neuroscience Mentor: Roger Bradley -- Cell Biology & Neuroscience *NFPC Is required for proper secretion of Wnts during Neural Crest specification in Xenopus*	41	94
Karissa Floerchinger: Cell Biology & Neuroscience Mentor: Jamie Sherman -- Plant Sciences & Plant Pathology *Confirming QTLs for seed size and yield*	42	80

Student, Mentor, Project	Poster #	Abstract Page #
Kirra Paulus: Biotechnology Mentor: Blake Wiedenheft, MC Rollins -- Microbiology & Immunology *The Subcomponent Interactions of the CSY Complex*	43	92
Robyn Gibbons: Health & Human Development Mentor: J. Mitch Vaterlaus -- Health & Human Development *The Experience of Seeking Emergency Food Relief in the Gallatin Valley*	44	48
Kaitlyn Okrusch: Health & Human Development Mentor: Seth Walk, Arthur Blum, Joel Weinstock -- Microbiology & Immunology, Tufts Medical Institute *Investigating the Role of the GI Tract Microbiome in a Murine-Parasite Model of Inflammatory Bowel Disease*	45	50
Emily Berglund: Chemical & Biological Engineering Mentor: James Wilking -- Chemical & Biological Engineering *Force measurements of pluripotent stem cell differentiation in the development of viable three dimensional structures of large intestine organoids*	46	53
Emily Bermel: Chemical & Biological Engineering Mentor: Christine Foreman -- Chemical & Biological Engineering *The Effects of UV Light on Biofilm Formation and Pigment Production of Antarctic Janthinobacterium sp. Strain CG23_2 and a non-pigmented mutant*	47	53
Orrin Boese: Chemical & Biological Engineering Mentor: Wataru Nakagawa -- Electrical & Computer Engineering *Optimization of Electron Beam Lithography for Nano-optical Devices*	48	54
Jacob Hoffman: Land Resources & Environmental Sciences Mentor: Anthony Hartshorn -- Land Resources & Environmental Sciences *The Smell of Gold: Quantifying the Ammonia Off-gassed from an Ore Processing Facility*	49	40
Jennifer Woodcock-Medicine Horse: American Studies Mentor: Robert Rydell, William Wyckoff, Henrietta Mann -- History & Philosophy, Earth Sciences, Native American Studies *Green Museums Waking up the World: Indigenous and mainstream approaches to exploring sustainability*	50	36
Alexandra Hinchcliff: English Mentor: Allison Wynhoff Olsen, Ada Giusti -- English, Modern Languages & Literatures *The different methodologies between adult and adolescent education with an emphasis in culture*	51	83
Mike Roddewig: Electrical & Computer Engineering Mentor: Joseph Shaw -- Electrical & Computer Engineering *Detection of Lake Trout and Plankton in Yellowstone Lake with a Low-Cost, Miniature Airborne Lidar*	52	31
Laura M. Dahl: Electrical & Computer Engineering Mentor: Joseph Shaw -- Electrical & Computer Engineering *Modeled visible-to-SWIR spectrum of skylight polarization*	53	29
Marshall Boyland: Physics Mentor: Hugo Schmidt, Yves Idzerda -- Physics *Impedance Spectroscopy of Thin Films*	54	75
Melissa (Rashelle) Herrygers: Animal & Range Sciences Mentor: James Berardinelli, Robert Garrott -- Animal & Range Sciences, Ecology *Metabolites, Metabolic Hormones, and Hematological Variables in Bighorn Sheep (Ovis canadensis) at the End of Breeding Season and the First Trimester of Pregnancy*	55	24

Student, Mentor, Project	Poster #	Abstract Page #
Katharine Perz: Animal & Range Sciences Mentor: Jennifer Thomson -- Animal & Range Sciences *Blood Parameters and Respiratory Quotients of Lambs Selected for Divergent Residual Feed Intake*	56	25
Spencer Dahl: Chemical & Biological Engineering Mentor: Rich Macur, Ellen Lauchnor -- Center for Biofilm Engineering, Civil Engineering *Degradation of Recalcitrant Compounds In Waste Water Using Fungal Strain GS24*	57	55
Jayesha Jayaratne: Chemical & Biological Engineering Mentor: Jennifer Brown -- Chemical & Biological Engineering *Rheological Characterization of worm-like micelle solutions with varied surfactant and counter-ion concentrations*	58	60
Amy Fox: Chemical & Biological Engineering Mentor: Connie Chang -- Center for Biofilm Engineering *Cells In Gels: A Microfluidics Study of Alginate Droplets*	59	55
Eric Troyer: Chemical & Biological Engineering Mentor: Ellen Lauchnor, Adrienne Phillips, Robin Gerlach -- Civil Engineering, Chemical & Biological Engineering *Method to Measure Biomass Entrapped During Microbial Induced Calcium Carbonate Precipitation*	60	69
Heather Begger: Plant Sciences & Plant Pathology Mentor: Jennifer Britton -- Plant Sciences & Plant Pathology *Pollinator Garden at Montana State University Horticulture Farm*	61	39
Shelley Haug: Chemical & Biological Engineering Mentor: Joseph Seymour -- Chemical & Biological Engineering *Self-Diffusion Coefficient Model Development for HPMCAS Polymer/Acetone Binary Mixtures and Polymer Concentration Regime Analysis using Nuclear Magnetic Resonance and Rheology*	62	58
Connor Hoffmann: Chemical & Biological Engineering Mentor: Blake Wiedenheft, Ryan Jackson, MaryClare Rollins -- Microbiology & Immunology *Understanding and Engineering CRISPR RNA-Guided Nucleases*	63	58
Kilean Lucas: Chemical & Biological Engineering Mentor: Recep Avci -- Physics *Influence of Material Defects in the Microbially Influenced Corrosion of 1018 Steel in Fuel/Seawater Systems*	64	62
Jeremiah Jansen: Animal & Range Sciences Mentor: Mike Giroux, Janice Bowman -- Plant Sciences & Plant Pathology, Animal & Range Sciences *Investigating effect of barley grain hardness on ruminal digestion in cattle*	65	40
Smith Wells: Animal & Range Sciences Mentor: Stuart Challender -- Earth Sciences *LONG-TERM CHANGES IN RIPARIAN AREAS FOLLOWING BEAVER REINTRODUCTION IN THE ABSAROKA-BEARTOOTH WILDERNESS*	66	43
Conor Hagan: Physics Mentor: Sachiko Tsuruta -- Physics *Thermal Evolution of Low Mass X-ray Binaries*	67	82
Gabriel Kletter: Physics Mentor: David Klumpar -- Physics *Nozzle Variations and Paraffin Wax Mechanics in Hybrid Fueled Rocket Engines*	68	87

Student, Mentor, Project	Poster #	Abstract Page #
Jonathan Murtaugh: Physics, Philosophy Mentor: Sara Waller -- History & Philosophy *The Social Predator Consortium*	69	90
Robert Watson: Modern Languages & Literatures Mentor: Ada Giusti -- Modern Languages & Literatures *Preservation of Berber Culture with French Theatre*	70	100
Maurisa Bell: History & Philosophy Mentor: David Swingle -- Museum of the Rockies *Cowboys and Indians: A Perpetual Conflict*	71	73
Chance Noffsinger: Land Resources & Environmental Sciences Mentor: Lisa Rew -- Land Resources & Environmental Sciences *Quantifying the response of an invasive annual and native perennial grass to different climate and carbon dioxide scenarios: will a changing climate favor Bromus tectorum over Psuedorogenaria spicata?*	72	41
Danielle Hanger: Psychology Mentor: Hutchison Keith -- Psychology *Working Memory Capacity and Deception*	73	82
Holly Howe: Psychology Mentor: Rebecca Brooker -- Psychology *Cognitive Control: Physical Responses of At Risk Adults Due to High Allostatic Load*	74	84
Alyssa Sferrazza, Chazlyn Miller: Health & Human Development, Psychology Mentor: Monica Skewes -- Psychology *The Sexual Experiences, Substance Use, Mental Health, and Academic Performance among University Students: Toward the Development of a Social Norms Intervention*	75	51
Chazlyn Miller, Alyssa Sferrazza: Psychology, Health & Human Development Mentor: Monica Skewes -- Psychology *The Sexual Experiences, Substance Use, Mental Health and Academic Performance among Montana State University Students: Toward the Development of a Social Norms Intervention*	75	89
Randi Phelps: Psychology Mentor: Rebecca Brooker -- Psychology *Composites of neural markers of prediction of risk for anxiety symptoms*	76	92
Lauren Broes: Earth Sciences Mentor: Dave Mogk -- Earth Sciences *Geochemical and Petrographic Study of the Late Precambrian Lahood Formation, Bridger Mountains, Montana*	77	76
Mary Frances Ambrose: Ecology Mentor: Laura Burkle -- Ecology *Post-wildfire Vegetation Diversity in the Rocky Mountain Ecoregion*	78	71
Anita Ratcliff: Civil Engineering Mentor: Yiyi Wang -- Civil Engineering *A Study of Public Transit in Rural and Small Urban Communities*	79	67
S.P. Dudley: Material Science Mentor: Jerry Downey -- Graduate Departments and Degrees *Rare Earth Element Research and the use of Composite Materials*	80	37
Lenore Page: Mechanical & Industrial Engineering Mentor: Maria Velazquez, David Claudio -- Mechanical & Industrial Engineering *Ecological Validity is Used but Not Defined in Transportation Safety Research*	81	30
Taylor Oeschger: Chemical & Biological Engineering Mentor: Joseph Seymour -- Chemical & Biological Engineering *Techniques for Heterogeneous Gelation of Alginate Solutions*	82	64

Student, Mentor, Project	Poster #	Abstract Page #
Thomas Lund: Chemical & Biological Engineering Mentor: Jennifer Brown -- Chemical & Biological Engineering *Non-Newtonian Fluid Flow in Porous Media*	83	62
Emma Garcia: Chemical & Biological Engineering Mentor: Michelle Flenniken -- Plant Sciences & Plant Pathology *The Impacts of Viral and Agrochemical Stresses on Honey Bee Health*	84	56
Stephen Pedersen: Chemical & Biological Engineering Mentor: John Priscu -- Land Resources & Environmental Sciences *Analysis of Long Term Photosynthetically Active Radiation Data from McMurdo Dry Valley Lakes to Identify Turbidity Stratification Patterns*	85	66
Gage Sowell: Chemical & Biological Engineering Mentor: Rich Macur -- Center for Biofilm Engineering *Determination of optimal aeration rate and shear stress conditions for maximizing growth and lipid production by an extremophilic fungus*	86	69
Shu Ying Wee: Chemical & Biological Engineering Mentor: Christine Foreman -- Chemical & Biological Engineering *Chemotaxis of Antarctic and Arctic Microbial Life toward Various Carbon Sources Using a Microfluidic Capillary Motility Method*	87	70
Andrew Bender: Mechanical & Industrial Engineering Mentor: Sarah Codd, Joseph Seymour -- Mechanical & Industrial Engineering, Chemical & Biological Engineering *Characteristics of two-phase flow in porous media at low capillary numbers*	88	52
Chris ODonnell: Mechanical & Industrial Engineering Mentor: Daniel Miller, Ladean McKittrick, Ed Adams -- Civil Engineering *How Variable Snow Microstructure Affects Gas Diffusion Rates*	89	64
Sara Amish: Ecology Mentor: Jia Hu -- Ecology *Germination Success Rates: Testing the success of an ecosystem to recover post disturbance*	90	72
Aaron Blaser: Ecology Mentor: Thomas McMahon, Jerry DiMarco -- Ecology, Physics *Examination of the Fukushima Radiation Presence in the Pacific Marine Ecosystem*	91	74
Jacob Gardner, Helen Dailey: Earth Sciences, Organismal Biology Mentor: Dale Greenwalt, Colin Shaw -- Smithsonian Institution Research Collaborator, Earth Sciences *Smithsonian Paleobiology Internships: Fossil Insects and Fish from the Kishenehn Formation, Montana*	92	81
Monica Rodriguez: Earth Sciences Mentor: Cody Warner -- Sociology and Anthropology *Community-based resources in Montana:Locations and neighborhood features*	93	95
Alana Vosen: Psychology Mentor: Keith Hutchinson -- Psychology *False Memory in Older Adults*	94	99
Elizabeth Corey: Sociology and Anthropology Mentor: Cindi Spinelli -- Gallatin City-County Health Department *Risk of Vaccine Preventable Diseases in Gallatin Valley Schools*	95	78
Molly Taylor: Sociology and Anthropology Mentor: Jack Fisher -- Sociology and Anthropology *Horsing Around: The Skeletal Analysis of an Excavated Horse*	96	98

Student, Mentor, Project	Poster #	Abstract Page #
Deann Snyder: Microbiology & Immunology Mentor: Mark Jutila, Jodi Hedges -- Microbiology & Immunology *Consumption of plant-derived agonists that enhance NK cell activity is beneficial in infection- and DSSinduced colitis*	97	35
Jennifer Burns: Microbiology & Immunology Mentor: Valerie Copie -- Chemistry & Biochemistry *Barley Senescence and the HvGR-RBP1 Protein*	98	39
Arielle Potter: Microbiology & Immunology Mentor: Seth Walk, Susan Broadaway -- Microbiology & Immunology *Novel Escherichia Lineages and the Campus Waterfowl Environment*	99	93
Amanda Richards: Microbiology & Immunology Mentor: Michael Franklin -- Microbiology & Immunology *Flourescent staining and imaging of the Pseudomonas aeruginosa PAO1 biofilm matrix material*	100	94
Fred Vollmer: Agricultural Economics & Economics Mentor: Eric Hyyppa, Scott Sterling -- Montana PBS *Creating an iOS App to Showcase Montana's Music*	Multi-media A	99
Rory Running: Art Mentor: Sara Mast, Michelle Flenniken -- Art, Plant Sciences & Plant Pathology *The Effects of the Modern Environment on the Current State of the Honey Bee*	Multi-media B	46

2015 Student Research Celebration
April 9, 2015

AFTERNOON POSTER PRESENTATIONS

SUB Ballrooms B, C, and D
1:30 pm – 4:30 pm

Student, Mentor, Project	Poster #	Abstract Page #
Neil Liotta, Kirkwood Donavin, Kelly Hendrix, Jake Ebersole, Alexander Paterson: Chemical & Biological Engineering, Agricultural Economics & Economics, Civil Engineering, Business Mentor: Sarah Janzen -- Agricultural Economics & Economics *Assessment of Health Outcomes from Engineers Without Borders' Water and Sanitation Projects in Khwisero, Kenya*	1	62
Peter Billman: Ecology Mentor: Matt Lavin -- Plant Sciences & Plant Pathology *Microsatellite Analysis of the Biogeographical and Phylogenetic Relationships Within Aquilegia flavescens (Yellow Columbine)*	3	74
Alysa Yoder: Earth Sciences Mentor: David Mogk -- Earth Sciences *Characterization of the Chamberlain Formation, Belt Supergroup*	4	101
Will van Gelder: Earth Sciences Mentor: Mark Skidmore -- Earth Sciences *Clay Mineralogy of Subglacial Lake Whillans Sediments*	5	99
Dillon Osleger: Earth Sciences Mentor: Dixon Jean -- Earth Sciences *Bathymetric mapping and Geophysical investigation of Rocky Mountain Alpine Lakes*	6	91
Briana Jones: Electrical & Computer Engineering Mentor: Kevin Repasky -- Electrical & Computer Engineering *Development of a singly-resonant OPO for carbon cycle science*	7	30
Connor Julien: Electrical & Computer Engineering Mentor: Brock LaMeres -- Electrical & Computer Engineering *Design and Space Flight Testing of a Radiation Tolerant, FPGA-based, Reconfigurable Computer System on the International Space Station*	8	60
Jerad Hoy: Computer Science Mentor: Ben Poulter -- Ecology *Developing a Web Application to Visualize Greenhouse Gas Emissions Reductions*	9	59
Kenneth Patrick: Computer Science Mentor: Clem Izurieta -- Computer Science *Dynamic Online Course Contrast (DOCC)*	10	65
Daniel Salinas: Computer Science Mentor: Brendan Mumey -- Computer Science *Flux Calculations Based on Metabolomic Data for Human Chondrocyte Central Energy Metabolism in Response to Applied Compression*	11	31
Dominic Friedlein, Zachary Fisher: Computer Science, Mentor: Clemente Izurieta -- Computer Science *THEBarcodeScanner*	12	56

Student, Mentor, Project	Poster #	Abstract Page #
Priyanka Kudalkar: Land Resources & Environmental Sciences Mentor: John Priscu, Cathy Cripps, Gary Strobel -- Land Resources & Environmental Sciences, Plant Sciences & Plant Pathology *STRUCTURE AND FUNCTION OF FUNGI IN ANTARCTIC LAKE ICE*	13	25
Joseph Rizzi, Samuel Leuthold: Land Resources & Environmental Sciences, Mentor: Tony Hartshorn -- Land Resources & Environmental Sciences *Effects of artificially warmed soils on carbon residency time*	14	41
Hannah Estabrooks: Plant Sciences & Plant Pathology Mentor: Mike Giroux, Alanna Oiestad -- Plant Sciences & Plant Pathology *Increasing Plant Productivity via Starch Biosynthetic Specific Transcription Factors*	15	24
Ji Kent Kwah: Plant Sciences & Plant Pathology Mentor: Valerie Copie -- Chemistry & Biochemistry *Structural and functional investigations of the Linker-NEAT 2 Domain of IsdB on Staphylococcus aureus*	16	40
Nickolas Lapp: Electrical & Computer Engineering Mentor: Joseph Shaw -- Electrical & Computer Engineering *Aurora Alert Notification System for Optical Aurora Detector*	17	61
Benjamin Moon: Electrical & Computer Engineering Mentor: Wataru Nakagawa -- Electrical & Computer Engineering *Characterization of Optical Nanostructures using Optimized Measurement System with Phase and Polarization Capability*	18	64
Shanna Lewis: Environmental Studies (Montana State University Billings) Mentor: Susan Gilbertz, Jamie McEvoy, Matthew Anderson -- Environmental Studies (MSU Billings), MSU Bozeman, Eastern Washington University *Complications in Field Research: Database Integrity*	19	111
Holley Flora: Earth Sciences Mentor: James Hicks -- Education *Developing an Identification Guide for Microfossils in the Hell Creek Formation*	20	80
Miriah Reynolds: Animal & Range Sciences Mentor: Bret Olson -- Animal & Range Sciences *Are metabolic rates of beef cattle correlated with feeding level?*	21	41
Isaac Stafstrom: Animal & Range Sciences Mentor: Tony Hartshorn, Patrick Hatfield -- Land Resources & Environmental Sciences, Animal & Range Sciences *Test of grazing effects on soil physical and chemical processes*	22	42
Zane Huttinga: Mathematical Sciences Mentor: Tomas Gedeon -- Mathematical Sciences *Admissible Linear Extensions of Function Values in Continuous Time Boolean Networks*	23	85
Riley Shearer: Agricultural Economics & Economics Mentor: Mark Anderson -- Agricultural Economics & Economics *Raw Milk and Infant Health*	24	42
Evan J. Burnett: Architecture Mentor: Christopher Livingston, Barry Newton, Maire O'Neill -- Architecture *Towards a Restroom Architecture: Existential Understanding from the Toilet Room*	25	26
Jehremy Felig: Broadfield Science & Education (Montana State University Billings) Mentor: Lynn George, Joy Goffena -- Biological & Physical Sciences *Does codon bias contribute to Familial Dysautonomia?*	26	106

Student, Mentor, Project	Poster #	Abstract Page #
Ian Cavigli: Cell Biology & Neuroscience Mentor: Michelle Flenniken -- Plant Sciences & Plant Pathology *Longitudinal Monitoring of Honey Bee Health and Pathogen Prevalence in Migratory Commercial Beekeeping Operations*	27	77
Addie Melvin: Chemical & Biological Engineering Mentor: Joseph Shaw -- Electrical & Computer Engineering *Measuring Atmospheric Aerosol Optical Absorption*	28	63
John Pankratz: Chemical & Biological Engineering Mentor: Jennifer Brown -- Chemical & Biological Engineering *Rheo-NMR Characterization of Wormlike Micelle Solutions*	29	65
Varsha Rao: Chemical & Biological Engineering Mentor: Sarah Codd, Joseph Seymour -- Mechanical & Industrial Engineering, Chemical & Biological Engineering *Heterogeneous Gelation of Bacterial Alginate strains FRD1 and FRD1153*	30	66
Ty Show: Mechanical & Industrial Engineering Mentor: Laura Stanley -- Mechanical & Industrial Engineering *Peer-to-Peer Effects Amongst Teen Drivers On the Blackfeet Indian Reservation*	31	68
John Ryter: Mechanical & Industrial Engineering Mentor: Roberta Amendola, Paul Gannon -- Mechanical & Industrial Engineering, Chemical & Biological Engineering *Investigating the Influence of Secondary Phases on the Dual Atmosphere Corrosion of Ferritic Stainless Steel 441*	32	68
Aubrie Golden: Mechanical & Industrial Engineering Mentor: Erick Johnson -- Mechanical & Industrial Engineering *Validation of a Cross-Flow Water Turbine*	33	57
Sydney Jaramillo: English Mentor: Dave Swingle -- History & Philosophy *Preserving a Museum's Own History: Digitizing the Video Archives of the Museum of the Rockies*	34	85
Jonathan Yauk: University Studies Mentor: Hua Li -- Modern Languages & Literatures *Evolution and The Underlying Ideals of China*	35	104
Korey Flynn: Modern Languages & Literatures Mentor: Ada Giusti -- Modern Languages & Literatures *The Representation of Indigenous Moroccans in Regional Moroccan Museums*	36	81
Cassidy Medicine Horse: American Studies Mentor: Matthew Herman, Danielle Hidalgo, Julie Wiesler -- Native American Studies, Sociology and Anthropology, Psychology *Displacing Biogendercentricity: Twenty-First Century Transgender Visibility as a Product of Mid Twentieth Century Political Trans-Emergence*	37	34
Janet Hanson: Education Mentor: Art Bangert, William Ruff -- Education *Mindset Research - A Comparison of Predictors on Teacher/Administrator Perceptions of School Mindset and School Change*	38	28
Sarah Mailhiot: Mechanical & Industrial Engineering Mentor: Ronald June -- Mechanical & Industrial Engineering *In vitro Degradation and In Vivo Deterioration Analysis of a Bioluminescent Cartilage Reporter Mouse Model*	39	30

Student, Mentor, Project	Poster #	Abstract Page #
Kevin Izard: Mechanical & Industrial Engineering Mentor: Sarah Codd -- Mechanical & Industrial Engineering *Flow Condition of Two-Phase Flow in Porous Media*	40	59
Ahmed Imtiaz: Mechanical & Industrial Engineering Mentor: Laura Stanley -- Mechanical & Industrial Engineering *An Eye Scanning Approach of Exploring the Experience Level at Which Novice Drivers Exhibit Hazard Perception Skill As Good As Their Experienced Counterparts*	41	29
Taylor Reese: Chemical & Biological Engineering Mentor: James Wilking -- Center for Biofilm Engineering *Active Microrheology on Pseudomonas Aeruginosa*	42	67
Colleen Rooney: Chemical & Biological Engineering Mentor: Mark Young -- Plant Sciences & Plant Pathology *Analysis of peptide based targeting of a pathogenetic bacteria within a biofilm*	43	67
Griffin Ruehl: Chemical & Biological Engineering Mentor: Stephanie Wettstein -- Chemical & Biological Engineering *Green Solvents for Biomass Solubilization*	44	68
Phyu Pannu Khin: Cell Biology & Neuroscience Mentor: Christa Merzdorf, Jennifer Forecki -- Cell Biology & Neuroscience *The Role of ZIC1 in Cranial Suture Formation*	45	86
Rosana Molina: Cell Biology & Neuroscience, Ecology Mentor: Edward Schmidt -- Microbiology & Immunology *Histopathology of Mouse Liver Lacking Major Redox Enzymes*	46	90
Kasey Welles: Architecture Mentor: Fatih Rifki -- Architecture *The Autonomous Automobile and Urban Morphology: How implementation of the autonomous car might change the form and structure of the city*	47	27
Taylor Cornwell: Architecture Mentor: Alexis Pike -- Film & Photography *An American*	48	44
John Allemeier: Physics Mentor: Hugo Schmidt -- Physics *Impedance Spectroscopy for Fuel Cell Material Analysis*	49	71
Joseph Bretz: Physics Mentor: Nico Yunes, Kent Yagi -- Physics *Four-Hair Relations for Differentially Rotating Neutron Stars*	50	75
Jessie Hardin: Nursing Mentor: Amber Wagner -- Bozeman Community Health Partners *Reaching Undiagnosed Hypertension patients: Barriers and Results*	51	103
Beth Augare: Early Childhood & Elementary Education (Blackfeet Community College) Mentor: Theresa Pepion, Dee Hoyt -- Health & Education *Infants and Toddlers, Ages 0 – 3, will have enhanced brain development when they learn through senses; vision, touch, smell, taste and hearing words*	52	105
Tinaya Monroe: Health & Human Performance (Blackfeet Community College) Mentor: Theresa Pepion, Dee Hoyt -- Health & Education *Can Genetic Disease be Prevented by a Living Healthy Lifestyle?*	53	111
Elizabeth Narigon: Health & Human Development Mentor: Carmen Byker -- Health & Human Development *Strategies to Promote Dietary Adherence of USDA Nutrition Standards in High School Lunchrooms Across Montana*	54	50

Student, Mentor, Project	Poster #	Abstract Page #
Tyler Boucher: Health & Human Performance (Montana State University Billings) Mentor: Kathe Gabel -- Health & Human Performance *The Effect of Beetroot Crystals on the Oxygen saturation, Blood Lactate, Blood Pressure, Heart Rate and Perceived Exertion in Healthy, Collegiate Students During Intense Exercise*	55	105
Carly Grimm: Health & Human Development Mentor: Florence Dunkel -- Plant Sciences & Plant Pathology *Participatory Diagramming to Eliminate Malnutrition in Sanambele*	56	49
Liana Bates: Chemical & Biological Engineering Mentor: Ryan Anderson -- Chemical & Biological Engineering *Thermal Energy Storage using Star-CCM+*	57	52
Ashley Berninghaus: Chemical & Biological Engineering Mentor: Brent Peyton, Robin Gerlach -- Chemical & Biological Engineering *Renewable Biogas Production from Algal Biomass using Anaerobic Digestate Cultures Acquired from Municipal Wastewater with Varying Carbon Substrates*	58	54
Nikita Cardenas: Chemical & Biological Engineering Mentor: Ryan Anderson -- Chemical & Biological Engineering *Pore Scale Modeling of Fluid Flow and Heat Transfer Through a Packed Bed*	59	54
Julia Goldberg: Chemical & Biological Engineering Mentor: Garth James, Elinor Pulcini, Kelly Kirker -- Center for Biofilm *Analysis of Gene Expression of Pseudomonas aeruginosa Post Exposure to Atmospheric Plasma Using RNA Sequencing*	60	57
Hasan Karadurmus: Chemical & Biological Engineering Mentor: Jovanka Voyich -- Microbiology & Immunology *Rise of the Superbugs: A Survey of the Challenge of Drug Resistance*	61	60
Katherine Kent: Chemical & Biological Engineering Mentor: Jennifer Brown -- Chemical & Biological Engineering *Rheo-NMR Studies of Polymer-Particle Dispersions with Silicon Dioxide Nanoparticles*	62	61
McLain Leonard: Chemical & Biological Engineering Mentor: Roberta Amendola, Hugo Schmidt -- Mechanical & Industrial Engineering, Physics *Non-planar, BZY Electrolyte Fabrication for Liquid Lithium Proton-conducting Fuel Cell*	63	61
Michelle Meagher: Chemical & Biological Engineering Mentor: Brent Peyton, Dana Skorupa -- Chemical & Biological Engineering, Center for Biofilm Engineering *Phylogenetic Analysis of Novel Thermophilic Archaea and Bacteria from an Alkaline Spring in Yellowstone National Park*	64	63
Mary Owen: Health & Human Performance (Montana State University Billings) Mentor: Kathe Gabel -- Health & Human Performance *Evaluation of health behaviors and fitness levels of children enrolled in the Active 6 program at the Billings YMCA*	65	112
Julia Hayes: Health & Human Development Mentor: Lynn Owens -- Health & Human Development *Mental Toughness and Coping Strategies in Collegiate Skiers*	66	49
Justin Provance: Health & Human Development Mentor: Lynn Owens -- Health & Human Development *Impact of the Coach-Athlete Relationship on Athlete Performance & Effort*	67	50
Dusti Boyce: Health & Human Performance/Allied Health (Blackfeet Community College) Mentor: Theresa Pepion, Dee Hoyt -- Health & Education *Marijuana Use During Pregnancy may cause ADHD in Youth*	68	105

Student, Mentor, Project	Poster #	Abstract Page #
Kendra Teague: Health & Human Development Mentor: Selena Ahmed, Carmen Byker -- Health & Human Development *Understanding Opportunities and Challenges Associated with Indigenous Food Systems at the Fort Peck Indian Reservation Towards Healthy Communities*	69	51
Bruce Chappell: Physics Mentor: Recep Avci -- Physics *Corrosion of CuNi alloy in a suboxic and sulfidogenic marine environment*	70	78
Devin Hansen: Physics Mentor: Nicolas Yunes -- Physics *Slowly-Rotating Black Hole Solutions in Dynamical Chern-Simons Gravity with an ADS Background*	71	82
Jeffrey Kuntz: Physics Mentor: Dana Longcope -- Physics *Numerical Analysis of Anomalous Solar Flares*	72	87
Mohammed Refai: Chemistry & Biochemistry Mentor: Brian Bothner -- Chemistry & Biochemistry *Proteomics of an archaeal host response to viral infection*	73	34
Ryan Bachofer: Chemistry & Biochemistry Mentor: Martin Teintze -- Chemistry & Biochemistry *Mechanisms of Action and Resistance: An Investigation of the Interactions between a Novel Antibacterial (THAM-3φG) and MRSA*	74	72
Laura Fisch: Chemistry & Biochemistry Mentor: Deborah Keil -- Microbiology & Immunology *Evaluating Epigenetic Alterations Associated with Immunotoxicity following Complex Metal Exposures*	75	80
Trace Hobbs: Chemistry & Biochemistry Mentor: Robin Gerlach -- Center for Biofilm Engineering *Investigation of the Relationship between Biofilm and Mineral Formation in a Clinically Relevant Model Flow System of the Kidney*	76	84
Andrew Kavran: Chemistry & Biochemistry Mentor: Edward Dratz -- Chemistry & Biochemistry *Activating Wnt signaling in Induced Pluripotent Stem Cells by fatty acid supplementation*	77	86
Jordan Maxwell: Physics Mentor: Dave Klumpar -- Physics *Calibration of Cube-Satellite Ranging Module*	78	88
Jonathon Mortenson, Sonja Benton: Physics, Mentor: Sachiko Tsuruta -- Physics *Population III stars as possible progenitors of ultra-long gamma-ray bursts*	79	90
Kaitlin Poole: Physics Mentor: Rufus Cone, Charles Thiel -- Physics *Laser Spectroscopy of Semi-transparent Rare-Earth-Doped Materials*	80	93
Cody Brown: Physics Mentor: Neil Cornish -- Physics *Differences Between Averaged and Exact Equations for Spin Procession of Binary Systems*	81	76
Cody Kipp: Science (Blackfeet Community College) Mentor: Jim Kipp, Kim Paul, Betty Matthews -- Research Coordinators *Understanding the Correlation between Stress-Hormone Levels and the Susceptibility to Chronic Disease among Members of a Native American Community*	82	110

Student, Mentor, Project	Poster #	Abstract Page #
Shane Johnson: Science (Blackfeet Community College) Mentor: Jim Kipp, Kim Paul, Betty Matthews -- Research Coordinators, *Abstract*	83	109
Chyana Johnson, Samantha Biegler: Science (Blackfeet Community College), Mentor: Jim Kipp, Kim Paul, Betty Matthews -- Research Coordinators *Abstract*	84	109
Scott Ollinger, Dane Main: Science (Blackfeet Community College), Mentor: Jim Kipp, Kim Paul, Betty Matthews -- Research Coordinators *Abstract*	85	112
Misty Goings Laplant: Science (Blackfeet Community College) Mentor: Jim Kipp, Kim Paul, Betty Matthews -- Research Coordinators *Abstract*	86	110
Colbi Kipp: Science (Blackfeet Community College) Mentor: Jim Kipp, Kim Paul, Betty Matthews -- Research Coordinators *Abstract*	87	110
Roy Smart, Jackson Remington: Physics, Mentor: Charles Kankelborg -- Physics *MOSES Flight Software Design and Development*	88	97
Brandon Thiesen: Physics Mentor: Hugo Schmidt -- Physics *Effects of Temperature Variation on the Impedance Spectra of Doped Perovskite Ceramics*	89	98
Josh Thornton: Physics Mentor: Randy Babbitt -- Physics *Upgrading Tapered Amplifer Chips*	90	98
Sarah Miller: Chemistry & Biochemistry Mentor: Trevor Rainey -- Chemistry & Biochemistry *Acutumine Synthesis*	91	89
Samantha Reap: Chemistry & Biochemistry Mentor: Mary Cloninger -- Chemistry & Biochemistry *Lactose-Functionalized Dendrimers Influence Galectin-3 Meditated Cancer Cell Migration*	92	94
Alex Sherman: Chemistry & Biochemistry Mentor: Rob Walker -- Chemistry & Biochemistry *Analysis of Secondary Amine 7-(methylamino-4-trifluoromethyl) Coumarin*	93	97
Jessica Wambeke: Chemistry & Biochemistry Mentor: Robert Walker, Melissa McIntyre -- Chemistry & Biochemistry *Characterizing materials for high temperature energy conversion*	94	100
Rochelle Johnson: Clinical Laboratory Science (Montana State University Billings) Mentor: Kurt Toenjes -- Biology *BH3I-1 derivatives inhibit the filamentous growth of the CEA10 strain of Aspergillus fumigatus*	95	108
Michael Calhoun: Biochemistry (Montana Tech) Mentor: Katie Hailer -- Chemistry *Human Exposure Assessment Down-Wind of an Active Open-Pit Copper and Molybdenum Mine in Butte, MT, USA*	96	106
Victoria Haugen, Rebekah Threefingers: Associate of Arts (Chief Dull Knife College), Mentor: Dianna Hooker, Dan Pleier -- Math and Information Technology *West Nile Virus Summer Research 2014*	97	107

Student, Mentor, Project	Poster #	Abstract Page #
Vincent Siragusa: Biological Sciences (Montana Tech) Mentor: Amy Kuenzi -- Biological Sciences *Examining the relationship between movement and Sin Nombre Virus infection in the North American Deer Mouse (Peromyscus maniculatus)*	98	114
Matthew Rist: Community Health (Blackfeet Community College) Mentor: Theresa Pepion, Dee Hoyt -- Health & Education *When the Inner Environment is Neutralized with Kangan Water (hexagonal shaped water molecules): Muscle Cells have the Power to Ward Off Cancer Growth*	99	113
Avery Hanson: Biology (Montana State University Billings) Mentor: Matt Queen, Kurt Toenjes -- Biology *Molecular Mechanics of the Fungal Morphogenesis Inhibitor, BH3i-1*	100	107
Tessa Herbert: Biology (Montana State University Billings) Mentor: Crystal Richards -- Biology *Growth and Survival of Helicobacter pylori in a Dental Biofilm Reactor*	101	107
Kaari Hultgren: Biology (Montana State University Billings) Mentor: Kurt Toenjes -- Biology *Analysis of BH3I-1 derivatives inhibition of C. rugosa and C. parapsilosis*	102	108
Luke Brandenberger: Microbiology Mentor: Ed Schmidt -- Microbiology & Immunology *Gene Expression Analysis on Mice Lacking All Classical Reductase Pathways*	103	75
Kendra Hertweck: Microbiology Mentor: Michael Giroux -- Plant Sciences & Plant Pathology *Impact of new Rht Alleles upon Plant Height*	104	83
Katrina Jackson: Microbiology Mentor: David Ward -- Land Resources & Environmental Sciences *Survey of the Microbial Taxa and Chemical Properties of Mammoth Terraces Hot Springs in Yellowstone National Park*	105	85
Trisheena Kills Pretty Enemy: Microbiology Mentor: Seth Walk, Susan Broadaway -- Microbiology & Immunology *Molecular epidemiology of Clostridium difficile in Bozeman, MT*	106	86
Shereena Old Elk: Mentor: -- *Abstract*	107	-
Sky Gabel, Anne Wylie: Biology, Psychology (Rocky Mountain College), Mentor: Cristi Hunnes, Amanda Crandall, Ambrin Masood, Faraz Masood, Gerlinda Morrison, Sara Young -- Biology, Biochemistry, Allied Health, Psychology *Education of Crow Middle School Youth about the Physical and Emotional Impacts of Substance Abuse*	108	106
Vanessa McNeil: Psychology (Montana State University Billings) Mentor: Sarah Keller, Caroline Graham Austin, Elizabeth Ciemins -- Communication & Theater (MSU Billings), Business (MSU Bozeman), Billings Clinic *Stigma, Stress, and Cowboy-ing Up: A Qualitative Evaluation of Attitudes & Beliefs about Suicide in Montana*	109	38
Kathryn McNamee: Microbiology & Immunology Mentor: Blake Wiedenheft -- Microbiology & Immunology *Signaling the CRISPR Alarm*	110	88
Mallory Spencer: Microbiology & Immunology Mentor: Deborah Keil -- Microbiology & Immunology *Oxidative Stress and Lung Histopathology Following Sub-Acute Exposure to Natural Dust From Nellis Dunes Recreational Area*	111	35

Student, Mentor, Project	Poster #	Abstract Page #
Michael Coryell: Microbiology & Immunology Mentor: Seth Walk -- Microbiology & Immunology *Gut microbiota protect host from exposure to ingested arsenic*	112	32
Will McGuinness: Microbiology Mentor: Jovanka Voyich-Kane -- Microbiology & Immunology *Analysis of Staphylococcal Virulence Factor Transcription By The SaeR/S Gene Regulatory System In Human Neutrophil Evasion*	113	88
Kaitlyn See: Microbiology Mentor: Christa Merzdorf -- Cell Biology & Neuroscience *The Role of aqp3b in Convergent Extension in Xenopus Embryos.*	114	97
Cody Minor: Mathematical Sciences Mentor: Ron June -- Mechanical & Industrial Engineering *A Stoichiometric Matrix Model of the Biochemical Network of Central Energy Metabolism in Human Cells for Understanding Chondrocyte Mechanotransduction*	115	89
Tino Woodburn: Material Science Mentor: Rufus Cone, Charles Thiel -- Physics *Using Birefringence to Orient Biaxial Crystals for Photonic Applications*	116	37
Kyle Payne: Biology and Chemistry (Montana State University Billings) Mentor: Rhonda Dillman -- Biological & Physical Sciences *Fluorination of BH3i-1 for use in Anti-fungal Research*	117	112
Aubree Honcoop: Biology and Chemistry (Montana State University Billings) Mentor: Tom Lewis, Angela Glassing – Biochemistry *In-vitro Reconstitution of Sulfite Reductase from Pseudomonas aeruginosa*	118	108
Blanca B. Perez: Biology (Montana State University Billings) Mentor: Matt Queen -- Biology *Chemical characterization of Pyridine-2, 6-bis (thiocarboxylic acid) and its first row transition metal complexes*	119	113
MyLinda Lovell: Biology (Montana State University Billings) Mentor: Kurt Toenjes -- Biology *BH3I-1 derivatives inhibit the filamentous growth of the AF293 strain of Aspergillus fumigatus*	120	111
Heather Ridley, Madi Zahorik, Derrick Krueger, Chad Dalman, Phillip Levy: Business Mentor: Omar Shehryar -- Business *Bozeman Student Affordable Housing 2015*	121	47
Ariel Zemlicka: Agricultural Economics & Economics Mentor: Caroline Graham Austin -- Business *Examining the Role of Fashion Bloggers in the Fashion Industry*	123	101
Timothy Bernard: Psychology Mentor: Matthew Vess -- Psychology *Companion Animal Effects On Mortality Concerns*	124	73
Erica Dunn: Psychology Mentor: Ian Handley -- Psychology *Does the tendency to correct against expectation biases reduce the stereotype threat effect?*	125	79
Jaime Gilden: Psychology Mentor: Colleen Moore -- Psychology *Trust and Uncertainty in Risk Perceptions of Asbestos Contamination in Libby, Montana*	126	81
Erik Rupert: Economics Mentor: Kristen Juliar -- *Montana Area Health Education Center & Office of Rural Health* *Abstract*	127	-

Student, Mentor, Project	Poster #	Abstract Page #
Katherine Chambers: Modern Languages & Literatures Mentor: Molly Todd -- History & Philosophy *Refugee Issues for Educators*	Multi-media A	78
Julia Martin: Film & Photography Mentor: Alexis Pike -- Film & Photography *Altered Realities*	Multi-media B	45
MUSE 383: Assessment in Music Education, Danel Chausse, Cassandra Dickerson, Joseph Dresen, Logan Henke, Alexis Hogart, Hannah Lane, Miranda LeBrun, Susan McCartney, Rachel Wambeke: Music, Mentor: Kristin Harney -- Music *Rehearsing Research: A Collaborative Exploration of the Arts Without Boundaries Program*	Multi-media C	44

2015 STUDENT RESEARCH CELEBRATION

GRADUATE ABSTRACTS

Sorted by Student Major

COLLEGE OF AGRICULTURE

Hannah Estabrooks: Plant Sciences & Plant Pathology
Mentor: Mike Giroux, Alanna Oiestad -- Plant Sciences & Plant Pathology
Increasing Plant Productivity via Starch Biosynthetic Specific Transcription Factors

Starch is an important contributor to plant growth as excess photosynthate is stored in leaves as starch during the day to be remobilized at night to support plant growth, and it is the principal constituent of cereal seeds causing it to greatly influence crop yields. Leaf starch is regulated in part by ADP-glucose pyrophosphorylase (AGPase), the rate limiting step of starch biosynthesis. Transgenic rice with increased leaf AGP activity and plant biomass was subjected to RNA-sequencing. The results indicate that the AGP transgene which increased leaf starch also caused the upregulation of several transcription factors (TFs). The current study examines the potential of increasing starch biosynthesis in leaves via leaf-specific upregulation of selected TFs responsive to leaf starch levels. A single WRKY TF was chosen and used to create transgenic rice with leaf specific TF overexpression. The preliminary results indicate that overexpression of the WRKY TF significantly increases leaf starch. This study will examine whole plant growth, photosynthesis, and gene expression in lines homozygous positive or negative for the presence of the transcription factor. We hypothesize that starch biosynthesis and plant biomass will be increased to a greater extent than with AGP overexpression alone because the TF should result in broad upregulation of carbohydrate metabolism. Ultimately this project hopes to increase knowledge of the biological factors limiting plant growth associated with leaf starch biosynthesis, identify key TFs mediating the process, and increase plant productivity and agronomic yield.

Melissa (Rashelle) Herrygers: Animal & Range Sciences
Mentor: James Berardinelli, Robert Garrott -- Animal & Range Sciences, Ecology
Metabolites, Metabolic Hormones, and Hematological Variables in Bighorn Sheep (Ovis canadensis) at the End of Breeding Season and the First Trimester of Pregnancy

Objectives were to evaluate the relationships among energy-related metabolites, hormones, and hematological variables in bighorn ewes at the end of the breeding season and 1st trimester of pregnancy. Ewes 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 for pregnancy) for JWY and NEY herds. Previously, we reported that estrous cyclicity and pregnancy rates (PR) differed ($P < 0.05$) among herds. However, PR were not associated with variations in glucose and non-esterified fatty acid concentrations among herds. In the present study, sera was assayed for insulin (I), thyroxine (T4), triiodothyronine (T3), β-OH-butyrate (βOHB), blood urea nitrogen (BUN), and total protein (TP). Concentrations of I, T3, T4, and T3:T4 did not differ ($P > 0.05$) among herds or between pregnant (P) and non-pregnant (NP) ewes. Whereas, BUN and TP concentrations differed ($P < 0.05$) among herds and between P and NP ewes. On the other hand, βOHB concentrations differed ($P < .05$) only among herds and not between P and NP ewes. The differences in BUN among herds and P and NP ewes was due to a four-fold difference between ewes in TM compared to ewes in JWY. Interestingly, high BUN concentrations in the TM ewes appeared to be related to low PR compared to high PR in JWY ewes. Differences in TP concentrations among herds and P and NP ewes was due primarily to high TP in JWY ewes compared to low concentrations of TH ewes; this difference may be related to a higher PR of JWY ewes than

in the TH ewes. In conclusion, differences in metabolic and hematological factors among herds of bighorn sheep may be related to PR.

Acknowledgements: Carson Butler (MSU Graduate Student) - Ecology

Priyanka Kudalkar: Land Resources & Environmental Sciences
Mentor: John Priscu, Cathy Cripps, Gary Strobel -- Land Resources & Environmental Sciences, Plant Sciences & Plant Pathology

STRUCTURE AND FUNCTION OF FUNGI IN ANTARCTIC LAKE ICE

The permanently ice covered lakes of Antarctica harbor a diverse group of microbes that live in unique liquid water habitats. These Dry Valley lakes have a long geological history and the lake ice hosts microbial communities that are unique to this environment. My research focuses on the functional role of fungi in the permanent ice covers of lakes in the McMurdo Dry Valleys. Fungi form a substantial part of this microbial community that greatly influences the dynamics of the icy ecosystem. Laboratory cultures obtained from ice cores taken from selected lakes were tested for growth characteristics under various temperature and nutrient regimes. Partial ITS- DNA sequencing was used to screen for functional genes and to identify novel fungal types unique to this region of Antarctica. Our results show that axenic cultures were successfully obtained from the permanent ice cover of the lake ice. Temperature experiments revealed that these organisms were psychrotolerant and grew most rapidly at 20°C. In addition, the isolated organisms possess antifungal activity that has not been previously reported from fungi isolated from Antarctic lake ice. Results from the study will be the first to address the structure and function of fungi in these subzero habitats and the potential for eukaryotic life to exist in icy worlds beyond Earth.

Katharine Perz: Animal & Range Sciences
Mentor: Jennifer Thomson -- Animal & Range Sciences

Blood Parameters and Respiratory Quotients of Lambs Selected for Divergent Residual Feed Intake

The purpose of this study was to evaluate differences in blood cell parameters and respiratory quotients (RQ) in lambs selected for divergent residual feed intake. Mixed-breed wether lambs (n = 65), approximately 4-months-old, were placed on trial in September of 2014. Following a 47-day feeding trial, residual feed intakes (RFI), an efficiency measurement based upon the difference in expected feed intake and actual feed intake, were calculated. Wethers with an RFI of one standard deviation greater (HIGH; less efficient; n = 6) or lower (LOW; more efficient; n = 6) than the mean RFI of the 65 wethers were used for this study. Systemic blood samples (8 mL) were collected via jugular venipuncture from each wether on December 5, 2014. Sixteen blood cell parameters of a complete blood count were evaluated for each wether. Respiratory quotient for each wether was measured with a Field Metabolic System (Sable Systems International, Las Vegas, NV) attached to a portable, air-tight chamber. Each wether was confined within the chamber on December 3, 2014 for approximately 45 minutes. A computerized (Expedata) pull-mode spirometer was connected to the chamber to measure CO_2 production (VCO_2,L/min) and O_2 consumption (VO_2, L/min); RQ= VCO_2/VO_2. Blood cell parameters were not affected ($P > 0.05$) by RFI classification. RQ did not differ ($P > 0.05$) between HIGH and LOW lambs. Mean RQ of HIGH and LOW lambs were 0.76 and 0.67, respectively. Selection for RFI does not appear to influence blood cell parameters or RQ in growing sheep.

Acknowledgements: Mike Whitmore (MSU Undergrad Student) - Animal & Range Sciences, James Berardinelli (MSU Faculty Member) - Animal & Range Sciences, Bret Olson (MSU Faculty Member) - Animal & Range Sciences

COLLEGE OF ARTS & ARCHITECTURE

Evan J. Burnett: Architecture
Mentor: Christopher Livingston, Barry Newton, Maire O'Neill -- Architecture
Towards a Restroom Architecture: Existential Understanding from the Toilet Room

This research interrogates how people occupy the toilet room - a modern space essential to functions of our human being. At the essence of the analysis is exploring the mundane; the everyday life-world in which we exist. A discussion of the Western relationship to the toilet as a fixture, and a statement of the overall philosophical position on architecture frame the boundaries of the inquiry. Through qualitative historical and contemporary interpretations of the gender segregated development and occupation of toilet spaces, along with quantifiable analysis of such factors like cost and usage, the research creates a base-level description of the typical toilet room. From the base-level description the research then provides examples through architectural design of "improved" toilet room conditions. The work then delves into reinterpreting the physical qualities of toilet spaces in relation to the socio-cultural occupation through the design of a safety roadside rest area along 1-10 in Southern California, in addition to the collection of first-person occupation narratives. From the initial interrogation, it was determined that toilet rooms can be considered an architecture of devices, separate from the architecture they exist within, and controlled by formula and economical function rather than by design ethics. These initial findings indicate the need to reevaluate toilet room design to better accommodate the overall human experience. The research may then influence broader discussions surrounding the value of architectural design as a discipline, gender-equity relationships, contemporary morality within capitalistic societies, and so forth.

Jessica Proctor: Architecture
Mentor: Chris Livingston, Bradford Watson, Henry Sorenson -- Architecture
Exploring Responses to Marks Left on a Dwelling by Human Inhabitation

As technology allows society to become increasingly mobile in the physical and ideological sense, the physical spaces which once were familiar and coated with the narrative of one family or regional archetype begin to collect the marks of inhabitation from many inhabitants. These marks, which I have called Residues for the purpose of this study, are attached to dwellings in a way that the narratives no longer are. This study is investigating what residues stripped of their stories have to offer. It asks how a contemporary nomad views an unfamiliar space, how residues influence the rituals of occupancy. The study considers three topics; the classical nomad's experience of place and how modern experience compares, what defines a residue, and what rituals are associated with residue. Field work was conducted to document the residues of seven residential dwellings possessing high occupant turnover. From these topics and fieldwork studies, a theory has been generated which will guide the design of seven installations or interventions of residues pulled randomly from the above documentation that carry negative connotations in today's society. The hope is that this study will provoke thought about how marks left by inhabitation contribute over time to the distinctiveness of a property and how this distinctiveness becomes valuable in a society in which building standards create stock architecture.

Chelsie Shults: Architecture
Mentor: Maire O'Neil -- Architecture
Design for Human Performance

This research identifies many of the myths and perceptions surrounding Universal Design. In the United States at any given time, it is reasonable to expect that 1 out of 10 people have limited mobility due to a temporary or a permanent physical condition. Bearing in mind that everyone is going to have limitations to some degree during their lifetime, Universal Design should become integral to the design process. Socio-cultural issues are driving the demand in today's society. The economic conditions of the twenty first century have led to a multi-generational living movement which begs for design that is sensitive to diversity. This nation also faces a baby boomer generation of approximately 76 million aging Americans, who have long term mobility concerns. Design

professionals need to be aware of inclusive design strategies as this generation will be living longer, more productive lives aided by the advancements in medical science. As we move forward, these realities will affect the built environment not only in terms of the life of the building, but more importantly the life of the user. This research stresses the importance of demographics in architectural education and socio-cultural topics which demand engaged empathetic designers. It emphasizes the need to shift accessibility issues from an add-on compliance issue to an integral part of the design process. Design students and professionals are positioned to generate a paradigm shift which views environmental design as something that provides for all. And in turn, we find ourselves more capable than ever before.

Kasey Welles: Architecture
Mentor: Fatih Rifki -- Architecture

The Autonomous Automobile and Urban Morphology: How implementation of the autonomous car might change the form and structure of the city

Advances in transportation technologies have had an immense impact on the morphology of the built environment from the 1700's to today. Historic analyses suggest that these changes are exemplified in the shape, functionality, and appearance of urban areas. The three major forms of habitation pertinent to this topic and their associated mode of transportation would be the walking city, the transit city, and the automobile city. Society is now poised for the next potential advance in transportation technology, the autonomous automobile, which may be the most substantial change in transportation since the adoption of the modern automobile in the late 1800's. Understanding historical trends in transportation technologies may help reveal how implementation of the autonomous car might advance current trends in habitation or revolutionize habitation and urbanization. This study posits that transportation advances and their relationship to changes in urban morphology can be recognized through historical research. Keying into urban morphological characteristics and how they have changed with major transportation advances, case studies are utilized to substantiate the historical research findings and provide a foundation for developing scenarios for the urban morphological response to the implementation of the autonomous automobile. Two highly contrasting scenarios are developed recognizing that the highly polarized scenarios help to better understand some of the implications the widespread use of this technology may have on the built environment. Understanding how the adoption of the autonomous automobile might affect the urban environment may help reveal the potential risks and opportunities associated with this advancement as well as how to implement this technology in an advantages way.

COLLEGE OF EDUCATION, HEALTH & HUMAN DEVELOPMENT

Janet Hanson: Education
Mentor: Art Bangert, William Ruff -- Education

Mindset Research - A Comparison of Predictors on Teacher/Administrator Perceptions of School Mindset and School Change

This study used an exploratory quantitative approach, including Likert style surveys, to explore the motivational concept of school Mindset in a convenience sampling of four public middle schools and high schools in rural Montana. The research question addressed in this study was "*Is there a relationship between principal openness to change, faculty openness to change, individual work locus of control, and school Mindset?"* The variables used were selected from the Setting/Operating/Monitoring/Achievement (SOMA) Model, that combines literature on the Mindset theories with Carver and Scheier's (1982, 1998) self-control theory (Vygotskii, 1962; Hong, Chiu, Dweck, Lin & Wan, 1999) and from the Open Systems organizational model (Tarter & Hoy, 2004). Multiple regression analysis was used to determine the relationships between principal openness to change, (POC), faculty openness to change (FOC), individual work locus of control (Wloc) and school Mindset. Results from this exploratory study found that principal openness to change, faculty openness to change, and individual work locus of control, explained .69 percent of the variance in school Mindset. Finally, the implications of this study suggested that principals have a significant influence on schoolwide perceptions of a growth mindset culture. In addition, results further suggest that principal leadership behaviors can influence teacher beliefs about their capacity to model behaviors that promote student growth and learning.

COLLEGE OF ENGINEERING

Spencer Bruce: Chemical & Biological Engineering
Mentor: Stephanie Wettstein -- Chemical & Biological Engineering
Small pore zeolites for biomass upgrading

Furfural derived from lignocellulosic biomass is a valuable platform molecule in the production of renewable liquid fuels and chemicals. With increasing 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 global economic and environmental impact. Small pore zeolites were evaluated for use in the dehydration of xylose and biomass to furfural in a monophasic system of 90/10 γ-valerolactone (GVL)/water. High furfural yields were achieved from both xylose (40%) and switchgrass (70%) over SAPO-34 and SAPO-56 in the GVL/water solvent system. Moderate yields of furfural were achieved from xylose in GVL/water with no catalyst; however, zero furfural yield was achieved from switchgrass with no catalyst, indicating that a catalyst is necessary to deconstruct and convert the biomass. Acid site leaching studies with SAPO-34 showed no leaching of acid sites, indicating true heterogeneous catalysis. Additionally, SAPO-34 could be recycled for multiple reactions with minimal regeneration steps and only a modest drop in furfural yield.

Laura M. Dahl: Electrical & Computer Engineering
Mentor: Joseph Shaw -- Electrical & Computer Engineering
Modeled visible-to-SWIR spectrum of skylight polarization

A successive orders of scattering (S0S) radiative transfer model can estimate the degree of polarization (DoP) in the clear-sky. We previously published results showing polarization depending strongly on atmospheric and surface properties that vary with wavelength. Those results showed that skylight polarization can trend upward or downward, or even have unusual spectral discontinuities that arise because of sharp features in the underlying surface reflectance. In the previous model, actual measurements of surface properties from locations around the world were used, however, the results were limited to wavelengths below 1 µm from a lack in available satellite data at longer wavelengths. Actual measurements of atmospheric properties were also limited to 1.64 µm. To continue with this work, we studied skylight polarization extending from 400 nm to 2500 nm (SWIR) using atmospheric extrapolation and by using a ground-based spectrometer for surface reflectance measurements. Along with extending our model spectrum, we wish to know the polarization dependence on surface or atmospheric properties. For instance, what happens when there is no surface reflection? The basic optical physics of the skylight polarization process and example results of the skylight polarization spectra will be presented.

Ahmed Imtiaz: Mechanical & Industrial Engineering
Mentor: Laura Stanley -- Mechanical & Industrial Engineering
An Eye Scanning Approach of Exploring the Experience Level at Which Novice Drivers Exhibit Hazard Perception Skill As Good As Their Experienced Counterparts

Hazard perception is a key skill needed to drive a vehicle safely. Literature has shown that this skill improves with experience. Little is known regarding the time window in which novice drivers start exhibiting essential hazard perception skills as efficiently as their experienced counterparts do. This research seeks to address this unknown through the use of a semi-naturalistic driving study employing eye tracking technologies and by examining the roadway eye scanning pattern differences among driver groups consisting of drivers with less than 1, 2,3,4,5 and over 10 years of driving experiences. A total of 60 participants, 12 in each group, were recruited for the study and asked to drive through two predetermined potentially hazardous scenarios. An observation time window, beginning at the first moment the potential hazard scenario came into view up to the moment it had passed, was extracted from the recorded eye movement videos. Then eye fixation and gaze duration on the regions of interest will be extracted using MAPPS software. Necessary statistical analyses will be then performed to compare the recorded fixation duration and gaze frequencies of drivers' groups to address the research question.

Briana Jones: Electrical & Computer Engineering
Mentor: Kevin Repasky -- Electrical & Computer Engineering
Development of a singly-resonant OPO for carbon cycle science

The human impact on the global carbon cycle is a complex scientific question that is affecting the health of the environment by changing the balance between incoming and outgoing radiation as well as by affecting other geochemical cycles such as the nitrogen and water cycles. The need for improved understanding of the global carbon cycle has led to a U.S. Carbon Cycle Science Plan that aims to coordinate carbon cycle science research to determine how the carbon cycle is being modified, what the consequences of these modifications are, and how best to mitigate and adapt to the changes in the carbon cycle and climate. A differential absorption lidar (DIAL) is proposed for spatially mapping both carbon dioxide (CO_2) and methane (CH_4) concentrations. Modeling indicates that for measurements with less than 2% error relative to ambient levels of atmospheric CO_2 or CH_4, a laser transmitter will need to produce over 3 mJ of pulse energy with a pulse repetition rate of 1 kHz at either 1.571 µm or 1.645 µm where CO_2 and CH_4 have appropriate absorption features for DIAL measurements. The goal of this work is to evaluate the potential for a novel singly-resonant optical parametric oscillator (OPO) for the DIAL laser transmitter. The OPO will be based on large aperture periodically-poled magnesium-oxide-doped lithium niobate (PPMgO:LN) as the nonlinear optic material. Results from initial experimental measurements of Nd:YAG pumped PPMgO:LN optical parametric amplifier (OPA) are presented. These results are used in the SNLO model, a community-based nonlinear optical model developed by Sandia National Laboratory, to show that up to 20% conversion efficiency is achievable for the OPO. This indicates that the OPO will allow the specifications needed for the DIAL instrument to be met.

Acknowledgements: Phil Battle (AdvR Inc.), Matt Bigelow (AdvR Inc.)

Sarah Mailhiot: Mechanical & Industrial Engineering
Mentor: Ronald June -- Mechanical & Industrial Engineering
In vitro Degradation and In Vivo Deterioration Analysis of a Bioluminescent Cartilage Reporter Mouse Model

Articular cartilage is the tissue that covers the end of the bones and serves to reduce friction and transmit load at the joint. Osteoarthritis (OA) is a disease of the joints that is characterized by damage to the articular cartilage. To understand the progression of OA in vivo, many animal models have been used but these models are limited by their ability to study progression of the disease at various time points in a single animal without injury or euthanasia. In this study a model expressing luciferase, the enzyme active in bioluminescence, under the control of CRE recombinase in aggrecan-producing tissues (ie: cartilage) is studied. The objective of this study is to evaluate this model for the ability to express cartilage specific bioluminescence that correlates to the thickness of cartilage. The goal is to relate loss of bioluminescence to loss of cartilage and disease. This was tested using live imaging in the presence of a substrate, luciferin. Various OA models were tested: ex vivo enzyme digestion to degrade the tissue and reduce tissue volume, treadmill running to induce OA, and age. The results show that a decrease in bioluminescence is linearly correlated to time post treadmill running and hours of enzyme degradation. Further, the results show that a decrease in bioluminescence correlates to standard OA grading scales and histology. There was also a decrease in bioluminescence between 2 and 5 months of age. This data shows that the transgenic mouse model can be utilized for in vivo monitoring of OA progression. This model allows for longitudinal monitoring and a reduction of animals needed for OA research.

Acknowledgements: Justin Prigge (MSU Postdoc/Research Scientist) – Microbiology & Immunology, Edward Schmidt (MSU Faculty Member) – Microbiology & Immunology

Lenore Page: Mechanical & Industrial Engineering
Mentor: Maria Velazquez, David Claudio -- Mechanical & Industrial Engineering
Ecological Validity is Used but Not Defined in Transportation Safety Research

In transportation safety the term ecological validity is used to describe or establish the validation of research equipment. A review of driving literature produced varying definitions of ecological validity; it lacks a clear definition. Some researchers use ecological validity to refer to the reliability of a cue to be a predictor of behavior.

Others use ecological validity to relate the degree that a unit of analysis is defined in real life by people or natural features. A similar but slightly different definition is the extent to which an experimental situation matches real life. Ecological validity has also been described in terms of outcomes; yet again, it has also been related to the extent which a task resembles the demands of everyday life. In summary, the variety of definitions suggests that ecological validity is the experiment's physical setting, task, specific cues, or perceived context. Those definitions are already defined in terms of face validity, content validity, discriminant validity, and criterion-related validity. This work addresses the multiple meanings of ecological validity as it relates to the framework of validation theory. It is the assertion of this research that ecological validity is not a validity that can be directly tested. The multiple definitions support the reasoning that ecological components are part of a theoretical hypothesis or method, not validation theory. It is also proposed that if ecological validity exists, it is actually comprised of various validity categories which need to achieve specific levels of performance or behavior.

Mike Roddewig: Electrical & Computer Engineering
Mentor: Joseph Shaw -- Electrical & Computer Engineering
Detection of Lake Trout and Plankton in Yellowstone Lake with a Low-Cost, Miniature Airborne Lidar

In this work we demonstrate a novel, low-cost, miniature airborne lidar primarily for use in marine fisheries research. We show its application to management of invasive lake trout (*Salvelinus namaycush*) in Yellowstone Lake, mapping and identification of submerged plankton layers, and a comparison of linear and circular polarization under conditions of high turbidity. Preliminary results from Yellowstone Lake, Flathead Lake, and Lake Como are presented and discussed, as well as cloud data. Finally, plans for future work and study are detailed.

Acknowledgements: Nathan Pust (MSU Postdoc/Research Scientist) - Electrical & Computer Engineering

Daniel Salinas: Computer Science
Mentor: Brendan Mumey -- Computer Science
Flux Calculations Based on Metabolomic Data for Human Chondrocyte Central Energy Metabolism in Response to Applied Compression

To investigate the response of joint cells to exercise, SW1353 chondrocytes (articular cartilage cells) were grown in stiff agarose and exposed to sinusoidal compression for thirty minutes. Cell samples were taken at times 0, 15, and 30 minutes to quantify changes in internal metabolism over time. Metabolic analysis was done by measuring concentrations of internal and external metabolites via liquid-chromatography mass spectrometry. To gain further insight from metabolic flux measurements, the data was applied to a model of cell metabolism as a network of reactions. The model includes pathways for glycolysis, the TCA cycle, a pentose phosphate shunt, the electron transport chain and two anaplerotic reactions. The linear system consisting of the network's stoichiometric matrix with metabolic fluxes was solved using the Moore-Penrose pseudoinverse. Calculated reaction fluxes were different for the control and experimental groups, and varied over time as well. The flux vectors were compared with vectors which maximize the production of aggrecan, and collagen. These vectors showed high glycolytic activity, also present in the flux calculated for the 15-30 minute interval of the experimental group, suggesting compression promotes their production.

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COLLEGE OF LETTERS & SCIENCE

Katharine Banner: Mathematical Sciences
Mentor: Megan Higgs -- Mathematical Sciences
Model Averaging of Regression Coefficients: Considerations and Practical Guidelines

Methods accounting for model uncertainty in regression problems have received a lot of recent attention. Bayesian Model Averaging (BMA) is often used to average posterior distributions of regression coefficients over a set of plausible regression models. This method implicitly assumes the same parameters exist in multiple models. However, in the context of regression, coefficients of particular explanatory variables appearing in multiple models do not necessarily hold equivalent interpretations across those models. The meaning of a model averaged regression coefficient is then completely dependent on the context of the problem as well as the estimated posterior model probabilities, making explanatory inference difficult. Perpetuating this problem in practice is the accessibility to easily implementable software for model averaging without diagnostic tools or guidelines for assessing its appropriateness. This gap between methods and practice can leave well-intentioned researchers with unclear inferences. We propose a set of considerations including explicit notation and two graphical diagnostic tools to aid researchers in making informed decisions when considering BMA.

Michael Broome: Mathematical Sciences
Mentor: Tianyu Zhang
A Two Species Competition and Mutation Model within a Biofilm

A progression of models for microbes existing inside a biofilm are studied. A two species model with competition for shared resources is presented, and mutation from one species to another is discussed as a deterministic process, and future work in the introduction of stochasticity is considered.

Michael Coryell: Microbiology & Immunology
Mentor: Seth Walk -- Microbiology & Immunology
Gut microbiota protect host from exposure to ingested arsenic

Arsenic is a naturally occurring toxic metalloid element to which prolonged exposure in humans can lead to keratosis, hyperpigmentation, lung and cardiovascular disease and multiple forms of cancer. Worldwide an estimated 150 million people are exposed to levels of arsenic in drinking water which exceed the safety guidelines of the World Health Organization. However, chronically exposed individuals show high variability in symptoms, even among similarly exposed individuals. Host specific factors like genetic variability, body weight, and diet only partially account for this observed variability. The toxicity, mobility, and, bioavailability of arsenic are all highly variable based on oxidation state and presence of organic or inorganic functional groups. In ecosystems where it occurs naturally arsenic can exist in a variety of organic and inorganic chemical compounds. In these environments, biochemical transformations of arsenic are primarily driven by microbial processes. Some microbes also have the ability to incorporate arsenic into their cellular biomass. The GIT microbiome of mammals confers numerous important functional benefits to the host organism, many of which are not well understood or characterized. It has also been shown that altering gut microbial communities of mice can change the profile of arsenic transformations that take place in these communities. This research suggests that the GIT microbiome functions to protect the host from ingested arsenic. We have demonstrated that germ-free mice and mice with antibiotic-disrupted GIT microbiomes accumulate more arsenic in host tissues when compared with similarly exposed mice with conventional GIT microbial communities.

Acknowledgements: Abdullah Alowaifeer (MSU Graduate Student) - Land Resources & Environmental Sciences, Mark McAlpine (Research Associate) - Microbiology, Tim McDermott (MSU Faculty Member) - Land Resources & Environmental Sciences

Rebecca Danforth: Chemistry & Biochemistry
Mentor: Bern Kohler -- Chemistry & Biochemistry
Elucidation of The Photofenton Reaction Mechanism Using Ultrafast Transient Absorption Spectroscopy

In the photo-Fenton reaction, a water molecule in the coordination sphere of an iron(III) ion is decomposed into a hydroxyl radical and iron(III) is reduced to iron(II) under the action of UV light. The mechanism behind this reaction are investigated using ultrafast transient absorption spectroscopy. In the experiments, a 266 nm laser pulse excites the sample after which a second laser pulse probes the population in either the excited or ground state of the system. By delaying the probe pulse, data can be collected as the ground state either recovers or the excited state decays on the picosecond time scale. Biexpontial decays were observed. The longer decay component which ranges from 200 ps -40 ns depends on pH can yields a straight line when fitting $1/[H^+]$ vs. τ. This is assigned to non-geminate recombination of the photogenerated iron (II) and H^+ and $OH^\bullet$. The short time component, of approximately 3-15 ps is tentatively assigned to geminate recombination.

Kirkwood Donavin: Agricultural Economics & Economics
Mentor: Sarah Janzen -- Agricultural Economics & Economics
The Welfare Impacts of Engineers Without Borders in Western Kenya

Diarrheal disease accounts for many deaths around the world every year, especially amongst children. The student-led chapter of Engineers Without Borders at Montana State University (EWB-MSU) seeks to address this problem by providing bore-hole wells and latrines to primary schools in Khwisero, Kenya. Amongst other goals, these engineering projects seek to improve the safety of drinking water at the school, thereby reducing diarrheal disease, increasing school attendance and improving overall well-being in these communities. After ten years in Khwisero, it is yet unknown whether EWB-MSU is achieving these goals. Data was collected from 776 households in Khwisero, half of which have children at primary schools with EWB-MSU projects, and the other half with children at future project schools. Instrumental variable and propensity score matching models analyze EWB-MSU's impact on health outcomes, while fixed effect analysis is used to investigate the impact on educational and time-use outcomes. No impact is detected on health or education from these projects but households with children at EWB-MSU well project schools spend about a minute less time traveling to their primary water source compared with other groups indicating these households are using EWB-MSU wells. Follow up data collection should be conducted that measures health and education outcomes in order to test this conclusion. EWB-MSU may more effectively improve welfare by focusing on well projects because latrines do not have a clear positive impact on student health or education outcomes.

Kevin Ferris: Mathematical Sciences
Mentor: Jim Robison-Cox -- Mathematical Sciences
Examining the Spread of Ebola in Western Africa

This past summer, the ebola outbreak in Western Africa took the world by storm. Cases were first reported in Guinea in March, 2014. By the end of 2014, there were almost 25,000 suspected cases in Western Africa. This project explores how the disease progressed in counties throughout Western Africa using publicly available data on ebola cases and deaths. Interactive visualizations are used to show how the outbreak spread over time, and Google Maps are used to plot these changes on the familiar map of Africa.

Tamra Heberling: Mathematical Sciences
Mentor: Lisa Davis, Tomas Gedeon -- Mathematical Sciences
Incorporating Torque into Transcription Modeling

DNA transcription is the first step of gene expression, and stochastic models can be used to describe this process mathematically. Recent discoveries show that when an RNA polymerase transcribes a strand of DNA, it applies a torsional force onto that strand. With multiple polymerases transcribing a strand at one time, the torque applied

from one polymerase affects the velocity of neighboring polymerases. Using a formula based on torsion of elastic rods, we were able to incorporate torque into our stochastic model.

Acknowledgements: Marty Morgan (MSU Undergrad Student) - Mathematical Sciences, Jakub Gedeon (MSU Undergrad Student) - Computer Science

Cassidy Medicine Horse: American Studies
Mentor: Matthew Herman, Danielle Hidalgo, Julie Wiesler -- Native American Studies, Sociology and Anthropology, Psychology
Displacing Biogendercentricity: Twenty-First Century Transgender Visibility as a Product of Mid Twentieth Century Political Trans-Emergence

The years spanning the mid-twentieth century to the second decade of the twenty-first century encompassed social and cultural ideological shifts in America's reaction to transgender identity, reflecting an evolutionary amendment in the journalistic content and subsequent interpretation of normativity. The inclusion of multivariate identity as part of the human condition is characterized by the 2010 Presidential appointment of the first transgender woman as a senior official in the U.S. Commerce Department. In *Displacing Biogendercentricity: Twenty-First Century Transgender Visibility as a Product of Mid Twentieth Century Political Trans-Emergence*, I ask how the rare occurrence of publicly declared "Transgender" identity emerged in post WWII America and came to occupy its present acknowledged position in cultural thought, and argue that the current state of transgender visibility originated in the conservative atmosphere of 1950's McCarthyism. Further, that the era's occurrences were formative of a "transgender other" and thus removed gender-variance from the American lexicon. Through archival records I demonstrate that the subsequent decade was representative of evolutionary thought that challenged the basic premises of restrictive gender bimodality. In tracing these discursive intersections, I propose that contemporary transgender visibility owes its heritage to the "questioning era" of the 1960's that shed a critical light on the states' lacks of authority to restrict guarantees of equality based on the expectations of birth gender. Finally, I propose that the interpretation of social or religious doctrines do not supersede the rights of a transgender individual to enter a public space, or participate in public or private life.

Mohammed Refai: Chemistry & Biochemistry
Mentor: Brian Bothner -- Chemistry & Biochemistry
Proteomics of an archaeal host response to viral infection

The biology of virus-host interactions in hyperthermophilic archaea remains largely undescribed due to the challenge of culturing the host cells and viruses. Little is known about archaeal viruses or how they interact with their hosts, compared to viruses of bacteria and eukaryotes. The unusual genomic and morphological characteristics of these viruses present an opportunity to learn about archaeal biology and makes archaeal virus-host system of particular interest. Previous results have shown rapid and dramatic changes in transcriptional regulation of *Sulfolobus islandicus* after viral infection by *Sulfolobus islandicus* rod-shaped virus 2 (SIRV2). Here we report the first proteomics-based experiments this system. Protein samples were collected at 1, 3, 5 hours after infection. 2-D Gel based techniques were used to assess global changes in the proteome. Lable-free shotgun proteomics was also performed. These experiments allowed identification of hot proteins that showed significant changes in abundance during infection and showed that the expression of viral proteins had a distinct temporal pattern. Post translational modifications were observed on the viral proteins.

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Shari Samuels: Mathematical Sciences
Mentor: Beth Burroughs -- Mathematical Sciences
The Evolution of Prospective Elementary Teachers' Competencies

This presentation will explore the research process and preliminary results that arose from following prospective elementary teachers as they moved through the first two of three mathematics content courses. Data was

collected relevant to their procedural knowledge (basic algebra skills), mathematical knowledge for teaching, and attitudes toward mathematics. A closer examination of a few students was made with regard to problem solving and constructing viable mathematical arguments, two of the new Common Core Standards for Mathematical Practice. This presentation will include a brief discussion of relevant research, the methodologies used for this research project, and preliminary results from the data.

Diana Schepens: Mathematical Sciences
Mentor: Tomas Gedeon -- Mathematical Sciences
Optimization of Metabolic Pathway

In microbiology, cell functions are often optimized for maximal fitness, given the constraints of available resources and cell state. We examine a particular instance of this optimization problem, where a microorganism invests carbon in the production of both substrates and enzymes used in a metabolic pathway to promote maximal growth. Using the method of Lagrange multipliers we find minimal carbon investment for a given flux in a metabolic pathway, as well as the dual problem of maximizing flux for a given carbon investment. We discuss the implications of these results to the behavior of microbial communities.

Acknowledgements: Ross Carlson (MSU Faculty Member) - Chemical & Biological Engineering, Jeffery Heys (MSU Faculty Member) - Chemical & Biological Engineering, Ashley Beck (MSU Graduate Student) - Chemical & Biological Engineering

Deann Snyder: Microbiology & Immunology
Mentor: Mark Jutila, Jodi Hedges -- Microbiology & Immunology
Consumption of plant-derived agonists that enhance NK cell activity is beneficial in infection- and DSSinduced colitis

Inflammatory bowel disease (IBD) is characterized by chronic, relapsing inflammation for which there is no known cure and limited treatment and preventative options. Plant products in many nutritional supplements have been shown by multiple groups to be protective in IBD. We have identified polysaccharides from Acai berries (Acai PS) and polyphenols from apple peels (APP) that specifically stimulate γδ T cells, as well as NK cell and monocyte populations. The effects are similar in some respects to responses induced by patterns derived from the microbiota. Mice fed Acai PS, but not APP, had increased IL-12 expression in spleens, MLN and serum compared to water fed mice and displayed no adverse inflammatory effects in response to the fed supplements. Ingestion of both APP and Acai PS protected from dextran sulfate sodium (DSS)-induced colitis. Acai PS-, but not APP- fed mice with colitis had increased expression of NKG2A, an NK cell receptor implicated in protection from DSS-induced colitis. Acai PS also protected against *Salmonella Typhimurium*-induced enterocolitis. Novel oral innate agonists Acai PS and APP protect against colitis, but perhaps through distinct mechanisms. Augmented immune signaling is likely to contribute to maintenance of the epithelial barrier and underlying immunity. Considering the paucity of therapeutic and prophylactic options, these plant derived agonists may represent novel therapeutic options for patients with IBD.

Acknowledgements: Amanda Robison (MSU Research Associate) - Microbiology & Immunology, Emily Kimmel (MSU Research Associate) - Microbiology & Immunology

Mallory Spencer: Microbiology & Immunology
Mentor: Deborah Keil -- Microbiology & Immunology
Oxidative Stress and Lung Histopathology Following Sub-Acute Exposure to Natural Dust From Nellis Dunes Recreational Area

Exposure to particulate matter containing heavy metals can induce adverse health effects through industrial exposures; however, little data exist on effects associated with natural exposures. We evaluated markers of oxidative stress and lung histopathology following sub-acute exposure to metals containing dust collected from a natural setting used heavily for ORV recreation. Adult female B6C3F1 mice were exposed to dust collected from seven surface types at the Nellis Dunes Recreation Area. Dust representative of each surface type was prepared with a median diameter of ≤4.5μm, suspended in PBS, and given by to oropharyngeal aspiration at 0.01 100 mg of

dust/kg body weight. Four exposures a week apart over 28 days mimicked a month of weekend exposures. Lungs for histopathology and blood for evaluation of oxidative stress markers were collected 24 hours after the final exposure. These data were compared to similar measures collected from mice exposed to titanium dioxide (TiO_2), a particle devoid of a complex metal mixture. No single surface type consistently induced markers of oxidative stress. Two highest concentrations of dust from one surface type increased two markers of oxidative stress; results of other surface types were inconsistent. These observations were relatively consistent with TiO_2; a significant change at the highest exposure was observed in one measure of oxidative stress. All surface types induced some level of lung inflammation, typically at highest doses. These results indicate that exposure to these natural, mineral dusts, concomitant with our exposure scenario, while are unlikely to considerably increase the risk of oxidative damage systemically, may induce local effects of lung inflammation in exposed individuals.

Acknowledgements: Jamie DeWitt (East Carolina University), Brenda Buck (UNLV), Dirk Goossens (UNLV)

Tan Tran: Mathematical Sciences
Mentor: Mark Greenwood -- Mathematical Sciences
Choosing the number of clusters in monothetic clustering

Monothetic clustering is a divisive clustering method based on recursive bipartitions of the data set by choosing splitting rules from all candidate variables. Like other clustering methods, the choice of the number of clusters is important. Connections between monothetic clustering and decision trees motivate the consideration of pruning methods as aids in selecting the number of clusters. We apply different cross-validation techniques to find the number of clusters that optimize prediction error and compare that approach to permutation-based hypothesis tests at each bi-splitting step, retaining splits with "small" p-values. A simulation study is performed to evaluate the performance of the methods.

Jennifer Woodcock-Medicine Horse: American Studies
Mentor: Robert Rydell, William Wyckoff, Henrietta Mann -- History & Philosophy, Earth Sciences, Native American Studies
Green Museums Waking up the World: Indigenous and mainstream approaches to exploring sustainability

Mainstream and Indigenous museums are ideally situated, geographically and socially, to educate the public about climate change, and inspire and mentor their constituent youth to craft the imaginative solutions required to maintain a habitable planet. Indigenous communities have, through the trial and error of millennia, developed functional and philosophical approaches to living successfully in their particular environments; these adaptive strategies, often dismissed as archaic in the industrial age, clearly have a great deal to offer world cultures as a whole. A careful study of Indigenous museums will discern how these cultural paradigms may be presented accurately and respectfully, information of great value to Mainstream museums seeking fresh ways of engaging their public, while analysis of progressive mainstream museums offers current best practices in communicating with the mainstream public. This research creates an opportunity to ascertain the most affective and effective arguments and strategies for museums to pursue to better educate the public about pressing environmental concerns. The primary research question - investigating the best practices of mainstream and indigenous museums regarding climate change and sustainability infrastructure and pedagogy - is addressed through four chapters framed within a theoretical and methodological set of concepts focusing on both the dissertation research itself, as well as efficacious museum practices.

S.P. Dudley: Material Science
Mentor: Jerry Downey – Materials Engineering (Montana Tech)
Rare Earth Element Research and the use of Composite Materials

Experimental and industrially produced polystyrene and silica resins are tested for recovery capabilities of Rare Earth Elements (REE). Testing regimes being used are typical of resin analysis. Inductively Coupled Plasma-AES results indicate that preferential separation and recovery is possible in the adjusted pH range of 2 to 10, solution conditions, and resin type. Testing conditions are resulting in structure modification of the composite resin as indicated by X-Ray Diffraction, Differential Scanning Calorimetry, Scanning Electron Microscopy, Mercury Porisometry, and density analysis. Resin modification indicates both surface and internal structure alteration outside of reported standard behavior of resins. Structural changes have ramification for both Rare Earth Recovery RER and traditional resin operations. Analysis shows that the resin uptake of REE can be manipulated for concentration. Further analysis with SEM work indicates that widespread surface and interior modification is taking place as resins load with REE. This modification is leading to pore rupture and particle breakage. Further investigation is being performed to determine the mode of breakage.

Tino Woodburn: Material Science
Mentor: Rufus Cone, Charles Thiel -- Physics
Using Birefringence to Orient Biaxial Crystals for Photonic Applications

We describe a simple optical technique for visually determining the crystallographic orientation of biaxial monoclinic crystals used in a wide range of emerging photonic technologies. Precise knowledge of the orientation of the underlying crystallographic structure of each individual crystal sample is required due to the highly anisotropic interaction with light and the external electric and magnetic fields employed in many of these applications. Usually this requires direct measurements on the atomic structure using techniques such as electron or x-ray diffraction that require specialized, expensive apparatus, impeding the ability to quickly determine the orientation of a sample. To significantly simplify the orientation of these crystals for optical applications, we present a procedure applicable to birefringent materials that employs polarized light to uniquely identify the underlying crystal axes. Using a simple device that consists of a white light and two linear polarizers, we describe how to unambiguously determine the absolute orientation of the crystal through identification of the material's optical axes and the wavelength-dependent orientation of the optical indicatrix. This technique is demonstrated for yttrium orthosilicate, Y_2SiO_5 (YSO), a crystal employed in a wide range of photonics research including quantum information processing, optical computing, slow light, and optical clocks.

MONTANA INBRE NETWORK STATEWIDE SYMPOSIUM PRESENTERS

Vanessa McNeil: Psychology (Montana State University Billings)
Mentor: Sarah Keller, Caroline Graham Austin, Elizabeth Ciemins -- Communication & Theater (MSU Billings), Business (MSU Bozeman), Billings Clinic
Stigma, Stress, and Cowboy-ing Up: A Qualitative Evaluation of Attitudes & Beliefs about Suicide in Montana

"Let's Talk" is a community-based media project for suicide prevention. This intervention model is "grassroots" insofar as the model recruits members (from the same population as the audience) to write and perform an original play about suicide and depression. The research question: Does exposure to a play about suicide prevention correlate with increased self-efficacy, response-efficacy, perceived severity/susceptibility of suicide and/or behavioral intentions for help-seeking? The actors participated in two focus groups: One prior to writing the play, and a follow-up after completing ~10 performances. Graduate students transcribed and coded, based on defined variables. Prior to participation in the project, actors, all of whom had experience with suicide, felt minimal confidence in their self-efficacy to obtain help. The actors' self-reported increases in confidence and self-efficacy afterwards were so powerful, many have changed their academic pursuits, incorporating this experience into their daily lives with the goal of helping others.

Acknowledgements: Danielle Arnoux (MSU Billings Graduate Student) - MPA, Kristin Neva (MSU Billings Graduate Student) - MSPR

2015 STUDENT RESEARCH CELEBRATION

UNDERGRADUATE ABSTRACTS

Sorted by Student Major

COLLEGE OF AGRICULTURE

Heather Begger: Plant Sciences & Plant Pathology
Mentor: Jennifer Britton -- Plant Sciences & Plant Pathology
Pollinator Garden at Montana State University Horticulture Farm

Dwindling pollinator populations are alarming bee keepers, crop growers, and researchers (Pennsylvania State University College of Agriculture Sciences, 2007). Impacts on food resources for humans will primarily be affected because much of what we eat is a result of the pollination process. A secondary effect is that meat may be in shorter supply if forage plants are not pollinated. The goal of the Pollinator Garden Project at the Montana State University Horticulture Farm is to create a well-managed, thriving habitat for pollinators allowing for research experiences. Educational opportunities will be available for MSU students and the community. Methods of investigation included research of plant hardiness, benefit to pollinators, and bloom times that fill the growing season. A site analysis has revealed restrictions and opportunities of the area. Stakeholders were interviewed in order to understand their vision and goals. The layout of the garden was influenced by creating meaningful experiences for visitors of the garden. A design plan and construction documents have been drawn and approved. Proper building methods will be analyzed and the project will be implemented beginning in the spring of 2015. In the future, a review of the project will be conducted by undergraduate students to assess the post-occupancy achieved and lessons learned. The anticipated results are; that the garden will be attractive, a successful habitat for pollinators, a place for pollinator research opportunities, and that students and the community who visit will understand the importance of pollinators.

Jennifer Burns: Microbiology & Immunology
Mentor: Valerie Copie -- Chemistry & Biochemistry
Barley Senescence and the HvGR-RBP1 Protein

Leaf senescence is an important phase in a plant's development. During this stage, nutrients from the senescing leaves are relocated into the plant's reproducing seeds. This process is very complex, and is tightly regulated by many factors. These factors orchestrate the timing and efficiency of leaf senescence, which in turn determines the plant's nutrient content, yield, and growth. One such control factor is a glycine-rich RNA binding protein found in barley (HvGR-RBP1). The transcript of this protein has been discovered to be highly up-regulated in early (as compared to late) senescing barley plants, which is typically a result of cold-related stress. Structural and functional analysis of the HvGR-RBP1 protein have been undertaken to determine its role in the senescence pathway and as a potential RNA chaperone. NMR analysis reveals a multidomain protein consisting of a well folded N-terminus RNA Recognition Motif and a disordered, glycine-rich C-terminus. RNA binding studies using a variety protein constructs show that the entire protein is required for binding target RNA, and that this binding appears to be non-specific. Growth and cold-shock treatment studies demonstrate varying protein expression levels in response to plant life cycle and cold-related stress. We therefore conclude that HvGR-RBP1 binds RNA non-specifically using both N and C terminals, and that it functions in plant responses not only to cold-related stress, but to environmental stress in general.

Acknowledgements: Brian Tripet (MSU Postdoc/Research Scientist) - Chemistry & Biochemistry

Jacob Hoffman: Land Resources & Environmental Sciences
Mentor: Anthony Hartshorn -- Land Resources & Environmental Sciences
The Smell of Gold: Quantifying the Ammonia Off-gassed from an Ore Processing Facility

Ammonia (NH_3) gas is one bi-product of cyanide destruction procedures associated with processing of microscopic gold. How much NH_3 is emitted by Golden Sunlight Mine's ore processing facility (near Whitehall, MT), and how much of that NH_3 ends up distributed across ecosystems downwind and downstream of the facility? We predict approximately 1,000 tons of NH_3 is released annually. This estimate is based on annual gold production, average amounts of cyanide used for gold extraction, and average amounts of additional nitrogen contributed by cyanide destruction methods. Challenges have arisen with monitoring techniques and locations. Water from downwind Boulder River has been tested for nitrate (NO_3^-) and ammonium (NH_4^+). If NH_3 from Golden Sunlight Mine is present in abundance, we expect to find a peak value of nitrogen directly east of the mine (distributed by westerly winds) compared to historic upstream readings. It may be difficult, however, to distinguish a nitrogen signal from Golden Sunlight Mine amidst nitrogen signals associated with natural ecosystem functions.

Jeremiah Jansen: Animal & Range Sciences
Mentor: Mike Giroux, Janice Bowman -- Plant Sciences & Plant Pathology, Animal & Range Sciences
Investigating effect of barley grain hardness on ruminal digestion in cattle

Starch is the primary nutrient in ruminant diets used to promote weight gain. The site of starch digestion alters the nature of digestive end products (VFA in the rumen vs. glucose in the small intestine) and the efficiency of use. Cereal grain endosperm texture influences the rate and extent of starch degradation in ruminants with harder grains being slower to digest. Barley grain texture is regulated by the starch surface protein complex friabilin that consists primarily of the hordoindoline proteins(HIN) A, B1 and B2. Softer kernel texture in barley is a result of the presence of all HIN genes in active form and bound to starch granules. The objective of this study was to investigate the effect of varying barley HIN content on the rate of starch digestion in the rumen of beef cattle. We have created BC2F5 derived lines of barley in which lines vary for the presence of hordoindoline B2 (Hinb-2). Lines lacking Hinb-2 were 16 units harder and thus should yield larger particles after milling and thus may be slower to digest. However, the presence of hordoindolines on the surface of starch may slow the rate of digestion. My experiment involve two components. First, I have milled softer and hard barley to both coarse and fine particle sizes to determine the impact of grain hardness on particle size. Second, I will measure dry matter digestibility (DMD) to determine how quickly starch from both hard and softer barley is digested. Differences in milling treatments are expected to have little impact on the rate of DMD and starch digestibility, and greater effects will be the result of increased HIN content. Hordoindolines are expected to aid in the protection of starch molecules from microbial digestion in the rumen reducing DMD and promoting greater feed efficiency.

Acknowledgements: Andrew Hogg (MSU Postdoc/Research Scientist) - Plant Sciences & Plant Pathology, Jack Martin (MSU Faculty Member) - Plant Sciences & Plant Pathology, Petrea Hofer (MSU Postdoc/Research Scientist) - Plant Sciences & Plant Pathology

Ji Kent Kwah: Plant Sciences & Plant Pathology
Mentor: Valerie Copie -- Chemistry & Biochemistry
Structural and functional investigations of the Linker-NEAT 2 Domain of IsdB on Staphylococcus aureus

Staphylococcus aureus is a bacterial pathogen that causes skin and soft tissue infections in humans. Crucial to its survival and growth is its ability to scavenge the essential metal ion iron in the form of hemin from human hemoglobin. To this end *S. aureus* utilizes two closely related surface bound iron surface determinant (Isd) proteins IsdB and IsdH. These receptors bind hemoglobin, rapidly extract hemin and transfer it to the other down-stream Isd proteins in the cascade. Structurally, both IsdB and IsdH contain a conserved three domain core comprised of two NEAr iron Transporter (NEAT) domains connected by an alpha-helical linker domain. The core structure of IsdH has been solved both by X-ray crystallography and solution NMR techniques, however, only the two NEAT domain of IsdB are known. Since subtle yet significant differences in activity exist between IsdB and IsdH, in this study we have utilized 3D nuclear magnetic resonance (NMR) spectroscopy to investigate the solution structure of the linker-NEAT 2 domain. These data were acquired, analyzed and assigned using NMR data processing software

NMRPipe and SPARKY. Chemical shift differences caused by the presence of the N-terminal residues of the linker region in the absence (apo) and presence (holo) of heme on the NEAT2 domain have been determined. A mapping of these shifts onto the Neat2 structure reveals both a location and strength of the linker-NEAT2 connectivity.

Chance Noffsinger: Land Resources & Environmental Sciences
Mentor: Lisa Rew -- Land Resources & Environmental Sciences
Quantifying the response of an invasive annual and native perennial grass to different climate and carbon dioxide scenarios: will a changing climate favor Bromus tectorum over Psuedorogenaria spicata?

This experiment was designed to quantify the response of an invasive annual and native perennial grass to different climate and carbon dioxide scenarios. Test species, *B. tectorum* and *P. spicata*, where grown using a De Wit replacement series experimental design with five levels of density (0:100, 25:75, 50:50, 75:25, 100:0). Two treatment levels include: temperature(+/-) and atmospheric CO_2 (+/-). One hypothesis is that *B. tectorum* growth rate and productivity will respond positively to increased temperature and CO_2 availability, but *P. spicata* will not, providing *B. tectorum* a competitive advantage. Under enriched CO_2 condition *B. tectorum* is expected to have this competitive advantage compared to *P. spicata* because increases in temperature and CO_2 availability treatments may increase plant water use efficiency (Smith et al., 2000). These results will help to improve predictions and gain understanding of a changing climates effect on the invasive potential of *B. tectorum* within Montana.

Miriah Reynolds: Animal & Range Sciences
Mentor: Bret Olson -- Animal & Range Sciences
Are metabolic rates of beef cattle correlated with feeding level?

Most beef cattle in Montana are fed hay for 3 to 5 months during winter. Many ranchers assume that their cattle will lose excessive weight if not fed hay. Feeding hay is the major variable cost in their operation. Our objective was to determine if metabolic rates of beef cattle are correlated with step-wise adjustments in feeding level. Previous research suggests that cattle grazing winter range lower their metabolic rates similar to wildlife. Heart rate closely tracks step-wise decreases and increases in feeding level in reindeer and red deer. Our trial was conducted at the Bozeman Agricultural Research and Teaching (BART) Farm from late February until early April 2015. Six head of young, non-pregnant, non-lactating Black Angus cattle were placed in individual pens for 12 days to determine their desired feeding level. For our trial, three of the six cows were kept at full feed (100%;'control'). The other three cows received a step-wise decrease and then increase in their feeding level in four day increments (100%->70%->30%->70%->100%). Metabolic rates were measured with a respirometer (CO_2 and O_2 analyzer) and a portable metabolic chamber. Metabolic rates of all cows were measured on the morning following each four day feeding increment. We expect that metabolic rates are correlated with feeding level in our cows, as heart rates are in reindeer and red deer. If metabolic rates are correlated with feeding level, then ranchers may be unnecessarily maintaining elevated metabolic rates at high expense.

Joseph Rizzi, Samuel Leuthold: Land Resources & Environmental Sciences
Mentor: Tony Hartshorn -- Land Resources & Environmental Sciences
Effects of artificially warmed soils on carbon residency time

Out-of-control carbon emissions are a major environmental issue, and the general population is beginning to understand the risk they pose to our collective future (IPCC 2013). This project aims to combine soil carbon dioxide (CO_2) flux measurements (dimensions: g C m^-2 y^-1) and soil carbon estimates (dimensions: g C m^-3) to explore whether artificially warmed soils are associated with decreased soil carbon residence times, which would indicate a potential positive feedback to rising atmospheric CO_2 levels (Woodwell and McKenzie 1995). This study operates under the hypothesis that increased soil temperatures will lead to increased root and microbial respiration, and therefore a higher turnover rate of soil carbon, which translates to shorter soil carbon residence times.

Riley Shearer: Agricultural Economics & Economics
Mentor: Mark Anderson -- Agricultural Economics & Economics
Raw Milk and Infant Health

Raw milk has been known to contain disease-causing pathogens such as tuberculosis and listeriosis. For this reason, the widespread adoption of pasteurization in the 1920's has been hailed as one of the most successful public health interventions in the history of the United States. . Recently, there has been increased debate on the nutritional value of pasteurized milk compared to unpasteurized milk as well as the real risk of consuming unpasteurized milk. Using data on raw milk producers across counties and over time from four states, we analyze the relationship between the availability of unpasteurized milk and infant and fetal health outcomes. This work has important implications for public policy as an increasing number of bills to either constrict or increase the supply of unpasteurized milk are being considered across the country.

Isaac Stafstrom: Animal & Range Sciences
Mentor: Tony Hartshorn, Patrick Hatfield -- Land Resources & Environmental Sciences, Animal & Range Sciences
Test of grazing effects on soil physical and chemical processes

This research project explores the effects of cover crop termination methods on physical soil properties, quantifying how three different treatments - mechanical tillage, chemical treatment, and sheep grazing - affect physical soil properties. It tests the hypothesis that grazing animals at an optimal stocking density can improve soil health through aeration and organic matter integration. Samples will be collected from the experimental plots at the Fort Ellis Research Farm at incremental depths throughout the cover crop and grazing season (approximately April to August); measurements of dry bulk density and soil organic matter will be used to characterize treatment effects on soil health. This project is sponsored by Dr. Anthony Hartshorn (Land Resources and Environmental Science), and contributes to Dr. Patrick Hatfield's (Animal and Range Sciences) investigation into the effects of incorporating animals into farm systems. This investigation is supplemented by a spring project tracking the highly compacted soils, frozen ground, and variable O-horizons associated with confined animal feeding operations. In this project, thermal imagery and soil temperature sensors are used to characterize the effects of animal traffic on soil densities, heat flux, and thermal properties.

Alexandra Thornton: Agroecology
Mentor: Fabian Menalled -- Land Resources & Environmental Sciences
Impact of nitrogen availability and time of inoculation on Pyrenophora semeniperda effectiveness as a biocontrol agent of Bromus tectorum

Bromus tectorum is an invasive winter annual grass that proliferates in rangelands and croplands across the western United States. Although herbicides provide partial *B. tectorum* control, herbicide resistance issues and non-target impacts hinder their adoption. Further, herbicides fail to impact *B. tectorum's* seedbank, leaving thousands of propagules untouched. Therefore, there is growing interest in developing integrated management practices. *Pyrenophora semeniperda* is a soil-borne fungal pathogen native to the western United States that attacks *B. tectorum's* seedbank, and can be used as a tool for integrated weed management programs in different systems, such as farms and rangelands. The soil residence time of *P. semeniperda* is unknown and to date no studies have investigated how its biocontrol capabilities interact with nitrogen availability. This research aims at improving our understanding of how biological and environmental stressors impact *P. semeniperda* as a *B. tectorum* biocontrol agent. This greenhouse research will follow a randomized block design with seven different seeding dates of *B. tectorum*, two nitrogen levels (high N environment, low N environment), and two *P. semeniperda* levels (inoculated, non-inoculated).

Smith Wells: Animal & Range Sciences
Mentor: Stuart Challender -- Earth Sciences
LONG-TERM CHANGES IN RIPARIAN AREAS FOLLOWING BEAVER REINTRODUCTION IN THE ABSAROKA-BEARTOOTH WILDERNESS

After populations were near extinction in the mid-1900s, beaver were reintroduced into the Absaroka-Beartooth Wilderness (AB) from 1986 to 1999. These reintroductions returned an indigenous species to the area that is capable of significantly altering riparian ecological processes. Preliminary data analysis has indicated a positive response of willow to the reintroduction, as seen by greater proportions of willow cover within study meadows in 2011 compared to 1981. This study aimed at quantifying willow canopy cover over time in order to create a narrative of the long history of willow-wildlife interactions in the AB. Staying consistent with previous methods, aerial photographs from a 1991 to 1994 time period and from 2005 were visually interpreted to quantify percent willow cover within the AB study meadows. Results show how changes in percent willow cover coincide with ecological events in the AB including: beaver reintroduction in 1986, moose population declines around 1990, and when beaver reached carrying capacity in 2000. The beaver reintroductions have provided Forest Service biologists a unique opportunity to assess long-term effects of the species on riparian areas without human influence and have increased habitat managers' support for beaver reintroduction as a tool for riparian recovery. Study findings will add another element of habitat analysis to the results of pending publications and previous research by the Forest Service, which will reinforce their findings, conclusions, and future management models.

COLLEGE OF ARTS & ARCHITECTURE

Reese Christensen: Architecture
Mentor: Fatih Rifki -- Architecture
The Space Between Buildings

The purpose of this research project is twofold: First, to analyze some of the most successful urban spaces and explore what makes them so successful. The goal is to identify the basic design strategies in the urban environment that elevate them to prominence. The second purpose is to explore how existing and future buildings that form the urban spaces inform and influence urban space. The sites located in Amsterdam, London, Rome, Venice, and Tangier were chosen based on their different climactic, cultural, and historical contexts, and visited. A qualitative comparative evaluation was than conducted using Christopher Alexander's *A Pattern Language*. This resulted in five patterns that are found to be common between all ten sites and as well as three patterns that are unique to each site. In the next phase of the research, the ten sites were analyzed according to the principles delineated in *Urban Microclimates: Designing the Spaces between Buildings* to explore further the quantitative characteristics of each site. The findings are illustrated a set of ten drawings, one for each site to highlight the overlapping patterns and principles. These are then presented as guidelines that can be used by students of urbanism and urban designers in new contexts both as analysis tools and means.

Taylor Cornwell: Architecture
Mentor: Alexis Pike -- Film & Photography
An American

"The Americans" is arguably one of the most influential photo books ever published. The book documents what the Swiss-born photographer, Robert Frank, witnessed while visiting America. Frank's work was bold and innovative, challenging many traditions in photography. It is from this book that I have drawn inspiration for my own project. As an outsider with no preconceptions of the places I am going, my project is photographed from the same perspective as Frank. The intent of the project is discovering who the rest of the world is, and beginning to understand and record this alternative way of life. To do so, I have taken a close look at the people. It is not the buildings and monuments that define a place; it's not the history or the economy; it's not the geography or the climate. It's the people. When one is able to discover even a little bit of the truth inside a person, they are able to see the true definition of the place. Each of us has individualities and characteristics, attitudes and quirks that define who we are. And all of these defining elements are evidence of a way of life that is a result from living in a place. In order to discover the place, I have to discover the people. My intent is just that. It's a people project.

MUSE 383: Assessment in Music Education, Daniel Chausse, Casandra Dickerson, Joseph Dresen, Logan Henke, Alexis Hogart, Hannah Lane, Miranda LeBrun, Susan McCartney, Rachel Wambeke - Music
Music Mentor: Kristin Harney -- Music
Rehearsing Research: A Collaborative Exploration of the Arts Without Boundaries Program

All undergraduates at Montana State University are required to generate a scholarly project and participate in a research/creative experience. We participated in a semester-long project designed to introduce us (second year, pre-service music education students) to the tools we will need to successfully design, carry out, and complete research during our senior year. Nine students who were enrolled in MUSE 383, Foundations of Assessment, participated in the study. Outside of class, each participant also served as a mentor teacher providing free after school music lessons to fifth through eighth grade students through a local non-profit, Arts Without Boundaries. As a way to explore a variety of research strategies in a safe, supportive environment, students engaged in a collaborative research study exploring the Arts Without Boundaries program. We created research questions, created and administered a survey, coded qualitative data, performed simple statistical analyses of quantitative data, created tables and graphs, and drew conclusions. Individually, each student developed a literature review, made observations, kept a journal, interviewed a student, and transcribed the interview. Products from individual

tasks were all brought back to the large group for discussion and analysis. Although the focus of the study was on the rehearsal of research, rather than on the generation of a specific research product, our conclusions point toward increases in efficacy and effectiveness regarding our private teaching over the course of the semester, as well as increases in the achievement of our private lesson students that might be attributed to participation in the Arts Without Boundaries program.

Caleb Killian: Architecture
Mentor: Selena Ahmed, Fatih Rifki -- Health & Human Development, Architecture
Reconciling Agrarian and Urbanist Ideals Towards Sustainability

Architecture and agriculture, the two fields trusted with our most basic needs, are both chasing a sustainable future with unparalleled fervor. Green building technologies, the resilient city, slow/ local food movements, empowering farming strategies all run on the idea that we can have a future that is holistically and revolutionary more inhabitable than we have now. The irony, however, is that these two fields- that are so intrinsically linked through our natural humanity- are creating this future through dichotomous strategies. There must be some reconciliation- some relationship- between these two disciplines that each hold equal shares in the nurturing and culturing of human (and non-human) life. How can those who are responsible for the future built environment begin to consider agrarian principles when they design where we live? What does sustainable development begin to look like in the countryside? How does the urbanist model begin to understand the production of, access to, and relationship with soil and food? What motivates our design of the future- for both the architect and the farmer? The objective of my proposed research is to reconcile the architectural pursuit of sustainability through urbanism with agrarian principles. My project's primary research concern revolves around how farmers view urbanism as a large-scale sustainable strategy, and how architects and urban planners understand rural aspirations and pastoral life in their ideas of development.

Andrew Marshall: Art
Mentor: Joshua DeWeese -- Art
Accessibility Through Furnace Design- Multi-use and Multi-fuel

This research proposes to investigate the potential for a forced air multi-use and multi-fuel furnace design with the goal of increasing the accessibility to the fire-based arts through novel design, education, and DIY strategies for others to follow. The intention of the proposed experimental furnace is that it will be able to efficiently combust wood, coal, natural gas, propane, and waste oil while reaching temperatures up to 2400 degrees Fahrenheit. The desired applications would be for ceramics, blacksmithing, and glass blowing. The target demographic would be those individuals or organizations that are denied access to the fire-based arts due to the relatively high initial investment and rising fuel costs. This demographic would include professional artists and crafts people, small schools, community art centers, and more marginalized groups dealing with insubstantial infrastructure such as in the 3rd world or as part of disaster relief. This research can pave the way for trade based education and industry in all demographics as well as providing means for sustainable commerce and industry.

Julia Martin: Film & Photography
Mentor: Alexis Pike -- Film & Photography
Altered Realities

This project is a photographic study on altered reality using the wet plate collodion process. This explores a dreamlike state with bizarre and obscure occurrences. These occurrences, however, are subtle, so that it is obvious looking at the image that there is something wrong, but it is not necessarily apparent what it is. Wet plate collodion, a historic process, is undergoing a revival amongst contemporary photographers. It is an alternative process in which a glass plate is covered with a light-sensitive solution and then exposed. In an age of viewing images on screens, a material image on a substantial surface such as glass becomes a precious object. This process creates a strange feeling in itself, with intense eyes, strange tones, and imperfections in each image that create distortion, which will become part of the image due to my concept. This project is helping to keep the historical process of wet plate collodion alive, yet is contemporary and modern.

Marley Robb: Architecture
Mentor: Elisa Renouard -- Architecture
AGUDDIM: PROPOSAL FOR A COMPREHENSIVE ANALYSIS OF PLACE

To collect and compose a volume of information on the cultural and architectural heritage of these distinct people as a way of valorizing the historical fabric of the place. This will be a comprehensive urban analysis that will seek to document not just the physical character of the village but also the ways in which traditions and ways of life have shaped, and continue to shape, this place. This documentation will work as a departure point for conversation and course of action towards the historical preservation and restoration of Aguddim, Morocco. My goal is to research the culture in Aguddim, to document what is valued by the people, and what is found to be unique in this location. Understanding these things will help ensure that efforts being done to restore this place can be undertaken in a manner that best suits the area.

Rory Running: Art
Mentor: Sara Mast, Michelle Flenniken -- Art, Plant Sciences & Plant Pathology
The Effects of the Modern Environment on the Current State of the Honey Bee

The specific objective of this project is to give the public a better understanding of the honeybees role in the world, their methods of communication and the environmental threats they currently face. This will be done by translating scientific research on the possible reasons for the sharp increase of colony losses into a visual art exhibition of conceptual mixed media charcoal drawings, encaustic paintings and two observational beehives as well as a memorial stupa sculptural piece. I will use my art to explore and investigate the potential reasons for honeybee colonies dying at such high rates since 2006 as well as exploring the honeybees complex network of communication. The final show will be multi-faceted in terms of the art mediums incorporated including functional structures, 2D drawings, and paintings depicting communication within a hive, their ability to survive as a collective whole and the environmental threats they currently face.

Amanda Williams: Art
Mentor: Dave Swingle – Museum of the Rockies
Jacques-Louis David: Classical Forms and Iconography from Greece, Rome, and France

Jacques-Louis David, perhaps the most notable artist of the eighteenth and early nineteenth centuries, perfected neoclassical painting and specialized in historical scenes. Often he looked back to classical Greece and Rome for subject matter, as well as stylistic inspiration. Depending upon the mood that David wanted to portray, he chose to utilize different cultural forms for reference. I have compared two paintings in which these visual languages are easily discernable, *Andromache Mourning Hector*, painted in 1783, as well as *Paris and Helen*, painted in 1788.

COLLEGE OF BUSINESS

Heather Ridley, Madi Zahorik, Derrick Krueger, Chad Dalman, Phillip Levy: Business
Mentor: Omar Shehryar -- Business
Bozeman Student Affordable Housing 2015

Research suggests that housing is critical for meeting a student's basic needs, as well as being a platform for improving educational outcomes. As the population of Bozeman has risen, so has the demand for housing, particularly from low-income university students. This research seeks to answer the question of whether or not there is a lack of affordable housing in Bozeman. With the population of Gallatin County rising 32% from 2000-2012, and Montana State University seeing record-breaking high enrollment in eight of the past nine years, this is an important question to answer. Through our primary and secondary research, we aim to discuss, determine, and answer the following questions: how students are financing their housing, how Bozeman rental prices compare to other college towns in Montana and Idaho, what Montana State students are able to afford in regards to housing, and the current market and price trends in Bozeman. The primary research for this project will come from analyzing the results of the survey that will be submitted to the student body after spring break. Secondary research includes online database records and interviews with MSU staff, realty agents, and city officials. As the primary research is still in progress, results and conclusions will be available prior to the research fair.

COLLEGE OF EDUCATION, HEALTH & HUMAN DEVELOPMENT

Katie DesLauriers: Health & Human Development
Mentor: Dawn Tarabochia -- Health & Human Development
Grandparents Raising Grandchildren: Perceptions on healthy eating, access and affordability of healthy foods

Over the past ten years the US has seen an increase of grandparents raising their grandchildren. According to US Census Data there are more than 2.2 million grandparents who identify as the main caregiver for grandchildren (US Census, 2000). In most cases of grandparents raising grandchildren the development of the grandparent's new role is brought about by crisis. Often the crisis stems from the parents, which may be the result of death, incarceration, drugs, teenage pregnancy, and other factors. It is currently estimated that 6,000 grandparents living in Montana are raising their grandchildren. As a rural state, Montana is faced with many challenges regarding the availability and sustainability of services including nutritious food options. The purpose of this study was to explore grandparent nutritional knowledge and the availability and affordability of nutritious foods for grandparents raising grandchildren. This study was an exploratory, mixed methods study. A 25-question survey was developed to assess the nutritional knowledge of grandparents raising grandchildren and to ascertain the availability and affordability of nutritious foods. Frequencies and content analysis was used to analyze the survey data. The results of this study showed that of the participants surveyed, grandparents appear to have basic nutritional knowledge. The results also indicated that nutritious foods were available to most grandparents; however, many grandparents reported that nutritious foods were not affordable.

Tracy Echert: Health & Human Development
Mentor: Lynn Owens -- Health & Human Development
Motivation for Physical Activity

There are two main types of motivation in exercise psychology: intrinsic and extrinsic. Intrinsic motivation comes from an internal source, whereas extrinsic comes from an external source. In the college population, these motivators come in a variety of ways. Many college students are former high school athletes, but no longer participate in sports. In addition, college campuses tend to have a more diverse population of students, some of which may also have had a high school athletic career. The study focused on the relationship between these factors and how they motivate students to remain active. Specific research questions included how motivation is sustained, the influence of an athletic background, if geography or cultural differences are a factor, and if either intrinsic or extrinsic rewards are more influential. The participants, chosen through a convenience sample, consisted of 51 students from several different universities. Data analysis utilized both descriptive stats for quantitative results and text analysis for qualitative. Several themes were highlighted, all indicating that most students strongly agree with the fact that physical activity is important, and yet, only 32.65% regularly act on this belief. The top motivators included the enjoyment of exercise, more positive feelings about oneself, and stress relief, indicating that intrinsic motivators are more rewarding and sustainable, leading to lifelong fitness. The results also suggest that an athletic background influences lifelong activity and that athletic involvement differs cross-culturally.

Robyn Gibbons: Health & Human Development
Mentor: J. Mitch Vaterlaus -- Health & Human Development
The Experience of Seeking Emergency Food Relief in the Gallatin Valley

Food banks were developed for emergency food relief, and their rapid increase since the 1980s shows the response of communities in redistributing surplus or charitable foods to those who are in need. Little is presently known about the primary reasons that individuals seek out emergency food relief beyond the experience of limited financial resources identified in previous quantitative research. This qualitative study was developed to explore the reported primary purposes of emergency food relief usage as a short-term or long-term resource in a rural

community. Semi-structured in-depth interviews were conducted with ten individuals (5 females and 5 males) who had previously received services from an emergency food relief program in a rural county. This presentation reports preliminary findings derived from qualitative analysis of the collected interviews

Carly Grimm: Health & Human Development
Mentor: Florence Dunkel
Participatory Diagramming to Eliminate Malnutrition in Sanambele

The Bambara village of Sanambele lies southeast of Bamako in Mali. Through partnerships between Montana State University, the University of St. Thomas, the University of California- Davis, Chief Dull Knife College, l'Institut d'Economie Rurale, l'Institut Polytechnique Rural de Formation et de Recherche Appliquée de Katibougou, University of California- Riverside, and Virginia Tech, the villagers have spent the past nine years finding holistic solutions to issues that they have determined to be the most devastating to village life. One of the issues defined is Kwashiorkor – protein deficiency that impedes the growth and development of children between weaning and 5 years of age. Research in past years has determined that enough sources of protein grow and exist in the village to eliminate Kwashiorkor, but social and logistical hurdles persist. Of the ten essential amino acids, two (tryptophan and lysine) have been found to be limiting Sanambelean children's diets (Fraser and Dunkel 2012). Following conversations with elders in Sanambele and locals of nearby villages, the food sources discussed were assessed for protein content, amino acid breakdown, and micronutrient content. Based on the amino acid findings, a poster representing the food sources with the densest tryptophan content was sent to the village to be used as an educational component of the resolution of Kwashiorkor in Sanambele.

Julia Hayes: Health & Human Development
Mentor: Lynn Owens -- Health & Human Development
Mental Toughness and Coping Strategies in Collegiate Skiers

Pain is a mental construct that is seen as a warning signal to avoid injury. Athletes are able to overcome the mental roadblock of pain with many different coping strategies. Research has shown that pain coping mechanisms can help athletes to avoid the negative effect of pain on performance (Thelwell, Weston, Greenlees, 2005). Ignoring pain can be used to change pain perception. Pain tolerance has also been shown to increase with mental training during exercise, suggesting that specific coping mechanisms can have a strong impact on an athlete's ability to maintain a high performance level during competition (Thelwell, 2005). The purpose of this research is to distinguish between different coping mechanisms and the role they have in maintaining a high performance level in colligate skiers, specifically between perceived mentally tough and non-mentally tough athletes, and between gender and discipline. The participants of this study included 16 competitive, collegiate Nordic and alpine ski racers (11 women, 5 men) on the Montana State University Ski Team. The subjects were chosen from a convenience sample, and limited by time constraints. Data gathered for this study was conducted by the administration of three surveys. Two of these estimated the athletes' total mental toughness. The other was a series of 11 questions using a Likert scale and free response, asking about different coping styles used when under stress or fatigue during competition, and mental toughness. The data was first analyzed quantitatively using descriptive statistics, and qualitatively by text analysis, triangulation, and constant comparison to find a general understanding of each participant's mental toughness and coping styles. Data was then compared between gender and discipline. Individual case studies were developed to understand how each person handled stress mentally, and what they did to reduce stress during higher performance. Trends in the data were found when examining the most stressful aspect of skiing and specific coping mechanisms used to handle stress, and what actually works mentally and physically. Results from this study reveal that mental toughness does not factor into high performance levels quite as much as coping strategies. Mental toughness does play a part in particular coping mechanisms (Nicholls, 2007), but from this sample size, there was no clear association between a high mental toughness and better results. However, coping styles did contribute to better performances among colligate skiers suggesting that coping styles have a more prominent role in obtaining a high performance.

Elizabeth Narigon: Health & Human Development
Mentor: Carmen Byker -- Health & Human Development
Strategies to Promote Dietary Adherence of USDA Nutrition Standards in High School Lunchrooms Across Montana

As a senior studying food and nutrition, I have a great interest in the assessment of school nutrition and foodservice practices. This research involves the analysis of plate waste and nutritional intake within five high school lunchrooms across Montana. This study allows my team made up of four healthcare professionals and myself to analyze current nutritional statuses among students in the high school setting. The scope of this research involves a three-day pre and post-plate waste assessment in each lunchroom to investigate the overall patterns and amounts of plate waste accumulated. In the pre-assessment, our team collected trays from each student and recorded specified food choices and the amount of food wasted per tray. In between pre and post-waste assessments, our team utilized the Cornell-based Smarter Lunchroom Redesign curriculum to implement changes focused on the layout of the lunchroom, the lunch line, and the appearance of food. By examining the pre-waste assessments in comparison to post-waste assessments, we will assess the effectiveness of lunchroom changes and the influence on students' nutritional intake. The data is compiled in excel documents with corresponding statistics to reflect patterns of food choices. The final results after our post-waste assessment will help determine the influence that the lunchroom changes has on this data. Defining changes to improve school nutrition will help foodservice workers plan for optimal lunchroom nutrition. Our goal in this study is to provide a platform of effective school nutrition outcomes to support the Smarter Lunchroom curriculum for the improvement of school nutrition nationwide.

Kaitlyn Okrusch: Health & Human Development
Mentor: Seth Walk, Arthur Blum, Joel Weinstock -- Microbiology & Immunology, Tufts Medical Institute
Investigating the Role of the GI Tract Microbiome in a Murine-Parasite Model of Inflammatory Bowel Disease

Inflammatory Bowel Disease (IBD) is a progressive autoimmune disease and one of the five most prevalent gastrointestinal (GI) disorders in the United States. IBD symptoms, including severe diarrhea, cramping, and fatigue, are managed with varying degrees of success using medications that dampen the body's immune response to bacteria in the GI tract. There is no cure for IBD and novel treatment strategies are critically needed. This project is investigating the'Hygiene Hypothesis', which states that autoimmune diseases, like IBD, result from the lack of normal exposure to microorganisms. Previous experiments demonstrated that infection with the parasitic helminth, *Heligmosomoides polygyrus*, ameliorates active colitis in immunocompromised (IL-10 knockout) mice. Our current project addresses the role of the microbiome in this model. Different microbiomes with potentially protective effects are established in germ free, IL-10 knockout mice. These mice are subsequently challenged with a drug that promotes severe colitis. Mice with different GI tract microbiomes are monitored for disease and intestinal tissues are evaluated at the end of each experiment to determine whether certain microbiomes are more beneficial than others. Our ultimate goal is to identify members of the murine GI tract microbiome that help ameliorate disease.

Acknowledgements: Mark McAlpine (MSU Faculty Member) - Microbiology & Immunology, Mandi Roe (MSU Graduate Student) - Microbiology & Immunology

Justin Provance: Health & Human Development
Mentor: Lynn Owens -- Health & Human Development
Impact of the Coach-Athlete Relationship on Athlete Performance & Effort

Coaches have a powerful influence on the performance of their athletes. When assessing athletic performance, the athlete is typically the primary focus, with less consideration given directly to the dynamic relationship between the coach and athlete, (Barić & Bucik, 2009; Sagar & Jowett, 2012; Stewart & Owens, 2011). The purpose of this study is to further understand the impact of the coach-athlete relationship on overall athlete performance in youth sports, from the perception of the athlete. Specific research questions include: How do coach-athlete relationships impact athlete performance and effort? How much influence do coaches have on their players? A mixed-method survey was employed for this convenience sample of 114 participants. Data was analyzed through summaries and

averages via the Survey Monkey website. Qualitative data was analyzed using text analysis, triangulation, and constant comparison to develop themes as they emerged from the data. These themes include the coach-athlete relationship's positive and negative impact on 1) Performance, 2) Effort, & 3) Likeability. Results suggest that the dynamic relationship between coaches and their athletes has a profound impact on athletic *performance*, according to this study. These athletes performed better when they liked their coaches and felt that their coaches liked them—although the results also show that they don't seem to "need" their coaches to like them, or vice versa, in order to perform well. Alternatively, those who did not look for or did not have a significant relationship with a coach looked to their self-motivation and/or competitive nature to fuel their performance and/or effort. Even though performance was a strong indicator of coach-athlete relationships, the overall *effort* was what stood out most prominently—as a theme—to these participants when asked to speak freely about the effects of the coach-athlete relationships. Additionally, respondents overwhelmingly declared that they asserted great effort when trying to meet the *high expectations* of a coach whom they had a good relationship with. Furthermore, a strong majority of those surveyed indicated that a *relatable* coach "brought out the best" in them. Some respondents associated this relatability with their performance, their receptiveness to being "pushed" by their coach, their playing skills, and/or their self-confidence.

Alyssa Sferrazza, Chazlyn Miller: Health & Human Development, Psychology
Mentor: Monica Skewes -- Psychology
The Sexual Experiences, Substance Use, Mental Health, and Academic Performance among University Students: Toward the Development of a Social Norms Intervention

Sexual assault is a widespread public health problem affecting college campuses across the United States, including Montana State University. Alcohol has been implicated as a risk factor in the perpetration and victimization of sexual assault. Experiencing sexual assault can impact academic performance and mental health outcomes. Given the negative health consequences associated with both sexual assault perpetration and victimization, efforts to address and prevent these behaviors are critical to public health. The study will utilize a social norms approach to behavior change positing that peer influences have in important impact on individual behavior. In other words, people behave the same way they believe their peers behave, whether their perceptions of the norm are accurate or not. This study aims to investigate the extent of misperceptions regarding alcohol-related sexual experiences among men at MSU by examining differences between self-reported rates of various sexual experiences and perceptions of how common these experiences are in the participants and their peer groups. Further, the associations between different levels of sexual assault and mental health and academic variables will be examined, and the associations between substance use and history of having experienced sexual assault will be considered. The researcher hopes to identify descriptive norms and perceived norms to develop a future norms correction intervention.

Kendra Teague: Health & Human Development
Mentor: Selena Ahmed, Carmen Byker -- Health & Human Development
Understanding Opportunities and Challenges Associated with Indigenous Food Systems at the Fort Peck Indian Reservation Towards Healthy Communities

The major objective of the proposed study is to develop a Community-Placed Participatory Research project to assess the needs of community members of the Fort Peck Indian Reservation regarding local and traditional food systems and nutrition. Recent works express shared beliefs throughout many Native communities that there is a correlation between the disruptions of traditional food systems and diet-related disease currently impacting Native peoples. Recent studies explore natural and forced shifts that have impacted Indigenous Peoples abilities to re-establish self-sustaining practices regarding agriculture and the implementation of culturally specific nutrition models and education curriculum. Previous works done regarding Indigenous Peoples, local and traditional food systems and resulting nutrition concerns have elucidated the need for community placed and community based works to be done in order to address concerns in Native communities. The development of research and works that address related issues, as well as movement towards self-representation through research and works has been growing within Indigenous communities. This work serves to support those actions in order to address concerns around food systems and nutrition on the Fort Peck Indian Reservation.

COLLEGE OF ENGINEERING

Quinn Andrews: Chemical & Biological Engineering
Mentor: Paul Gannon, Phil Himmer -- Chemical & Biological Engineering, Electrical & Computer Engineering
Investigation on Corrosion Behavior of Magnesium Alloys

The focus of my research project is primarily a fundamental study on magnesium corrosion behavior. Magnesium has the lowest density of all structural metals which contributes to it having one of the highest strength to weight ratios. These key characteristics of magnesium translate into improved performance of engineered materials. The main reason magnesium is not readily used in so many of these industries is because it is one of the most chemically active metals which causes it to have poor corrosion resistance. In order to make magnesium a practical element to work with, our research group is focusing on which metals, and what atomic concentration of these metals, best form an alloy with magnesium that greatly improves the corrosion resistance. We will be studying potential alloys through the use of vapor deposited thin films. By testing a variety of atomic concentrations we will be able to find the critical point where the alloy becomes passive and no longer is hindered due to corrosion. The primary metal we have been alloying with magnesium is titanium. Thus far a wide range of alloy compositions have been deposited and tested, providing intriguing results. This research project will be continued through the rest of the semester and hopefully on through the next year.

Liana Bates: Chemical & Biological Engineering
Mentor: Ryan Anderson -- Chemical & Biological Engineering
Thermal Energy Storage using Star-CCM+

Thermal energy storage is becoming ever more important in the age of renewable energy sources. This project focuses on modeling these thermal energy storage systems using the modeling program Star-CCM+. Star-CCM+ allows for all different types of conditions to be inserted, and will produce a result that mimics one that a real system would produce. The purpose of using Star-CCM+ is to evaluate if these systems are physically possible and what change of parameters would make them better. There are three separate models being simulated; the first is a vessel that has an energy carrier fluid of supercritical CO_2 being run through a porous bed of alumina, the second is a vessel with air being run through a porous bed of alumina, and the third is a vessel with air being run through a porous bed of rocks. Each model has different parameters including temperature, temperature dependent materials, flow rates, geometries, etc. The results of the models indicate a positive outlook for the future of energy storage, as they are able to store and recover heat from the vessels. The next step in this project would be to use these simulations to build the vessels for use in the renewable energy industry. The air-alumina and air-rock vessels already has a physical model in existence but the other simulation is looking to be constructed in the near future.

Andrew Bender: Mechanical & Industrial Engineering
Mentor: Sarah Codd, Joseph Seymour -- Mechanical & Industrial Engineering, Chemical & Biological Engineering
Characteristics of two-phase flow in porous media at low capillary numbers

Both the scientific and industrial communities have become increasingly interested in simultaneous flow of two immiscible fluids in porous media, otherwise known as two-phase flow. Multi-phase flows are commonplaces in the areas of hydrogeology and carbon sequestration where understanding transport of multiple immiscible fluids through the subsurface is critical. Recent work in this field by Sinha et al. examined the effects of capillary forces at low capillary numbers (Ca), where Ca is the ratio of viscous forces to surface tension between fluids. This research used a numerical simulation to show the pressure gradient versus capillary number relationship has a power law scaling exponent of 0.5 at low Ca when a characteristic threshold pressure is used. This project focused on collecting pressure data from two-phase flow in porous media column experiments that illustrated this same power law scaling relationship. Despite the challenges of an ever-changing experimental setup, current data

suggest the pressure gradient relationship is consistent with a power law exponent of 0.5. Further affirming the study by Sinha et al., this work has shown using a threshold pressure is critical to this power law relationship.

Acknowledgements: Matthew Danczyk (MSU Alum), Cody Prather (MSU Graduate Student) - Mechanical & Industrial Engineering

Emily Berglund: Chemical & Biological Engineering
Mentor: James Wilking -- Chemical & Biological Engineering
Force measurements of pluripotent stem cell differentiation in the development of viable three dimensional structures of large intestine organoids

In an attempt to impact the in vitro development of large intestine organoids, forces acting on pluripotent stem cells during differentiation are being studied. Forces on the cells by the medium, as well as forces on the medium by the cells are being studied using traction force microscopy. Research has been conducted on the growth of large intestines in laboratories, and a large source of error is the lack of consistency in the three dimensional structure of the organoid. Some of the organoids form into spheres that lyse, others form into smooth tubes, while some form villi and some don't. Here, the area of interest is how the forces impact these formations. Without the right forces acting on the cells, the large intestine wont have the folds within it necessary to be viable. Without proper folds, it loses the ability to absorb nutrients in the amount required for organoid viability. This research has been done under the guidance of Dr. James Wilking, and in collaboration with Dr. Seth Walk. The first month was dedicated to learning how to use, as well as establish and calibrate the traction force microscopy equipment. The next month will be focused on implanting beads and pluripotent stem cells into the medium. Once this is done, the forces will be measured and the data will be sent to Dr. Allen Ehrlicher to be mathematically modeled. The last month will be dedicated to analyzing the results and simulation data, as well as hypothesizing future force manipulation methods.

Emily Bermel: Chemical & Biological Engineering
Mentor: Christine Foreman -- Chemical & Biological Engineering
The Effects of UV Light on Biofilm Formation and Pigment Production of Antarctic Janthinobacterium sp. Strain CG23_2 and a non-pigmented mutant

Organisms found in Antarctica have been shown to possess a variety of mechanisms to persist under low temperatures, freeze thaw events, and ultraviolet (UV) radiation. Biofilm formation is an adaptation that bacteria have developed to cope with a variety of environmental stressors, and has been well studied in a variety of organisms from differing environments. Although stress responses are receiving increased attention, relatively little is known about the responses of Antarctic bacterial isolates to UV stress, and even less is known about biofilm production in Antarctic organisms. 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 selected for this study, *Janthinobacterium* sp. strain CG23_2 (CG23_2), was isolated from the Cotton Glacier supraglacial stream in Antarctica and is a violacein pigmented, gram negative bacterium. A pigment-less mutant was generated using a chemical treatment of 1-methyl-3-nitro-1-nitrosoguanidine. Both the wild type and mutant strain of CG23_2 were individually grown in CDC bioreactors under continuous UV radiation for 72 hours. In addition to UV exposure both wild type and mutant CG23_2 were subjected to a combination of hydrogen peroxide and UV treatments, to study the response of the organisms to oxidative stress. Dark controls were run in parallel with all treatments. All samples were collected from the reactors after 72 hours, and were analyzed for cell abundance, protein, carbohydrate and pigment content. Confocal laser scanning microscopy (CLSM) was used to image biofilm formation, structure, and cell localization throughout the course of the reactor runs. For wild type CG23_2, CLSM showed that there are differences in biofilm structure and cell localization and viability for the UV treatments compared to the structure-less dark control. Thus, both biofilm formation and pigment production could allow organisms to survive in these extreme environments.

Ashley Berninghaus: Chemical & Biological Engineering
Mentor: Brent Peyton, Robin Gerlach -- Chemical & Biological Engineering
Renewable Biogas Production from Algal Biomass using Anaerobic Digestate Cultures Acquired from Municipal Wastewater with Varying Carbon Substrates

The global population is growing rapidly, increasing the demand for energy, especially for fossil fuel production. This has created an increased interest in alternative sources of energy that show potential to be carbon neutral as well as economically comparable to current fossil fuel sources. Biogas is a mixture of gases produced by the breakdown of organic matter through an anaerobic process. Growth of algae for biodiesel production is an advancing technology and conversion of waste algal biomass using anaerobic digestion is an attractive process to treat waste, control pollution, and produce energy. Anaerobic digestate acquired from the Bozeman Water Reclamation Facility was used to anaerobically digest lyophilized algal biomass to produce biogas through various modes of methanogenesis. Lyophilized biomass of a cyanobacteria as well as low-lipid and high-lipid *Chlorella* species were utilized as carbon substrates and their rates of methane production compared. Methane production was determined using a gas chromatograph. The high lipid algae allowed for larger amounts of methane to be produced, while the low lipid *Chlorella* species produced the lowest amount. Calorimetry has been used to determine the energy contents of each biomass type and these values will be compared to the energy created via methane production. These results show potential for the use of microalgae biomass as an alternative substrate for methane production, a promising technology which may help treat waste while producing energy.

Acknowledgements: Katie Davis (MSU Graduate Student) - Chemical and Biological Engineering, Todd Pedersen (MSU Graduate Student) - Chemical and Biological Engineering, Center for Biofilm Engineering

Orrin Boese: Chemical & Biological Engineering
Mentor: Wataru Nakagawa -- Electrical & Computer Engineering
Optimization of Electron Beam Lithography for Nano-optical Devices

Nanostructured polarizers in a large array could be used in conjunction with a camera to take polarization-resolved images, which have applications in medical imaging, industrial diagnostics, or environmental monitoring. The successful fabrication of nanostructured polarizer arrays is strongly dependent on a high resolution pattern writing technique, specifically electron beam lithography. In this project, the electron beam lithography process for fabricating nano-optical devices was characterized and performance limits were determined. A step-wise decrease in feature sizes at different exposures in poly(methyl methacrylate) revealed a minimum reproducible feature dimension of 60 nm. Rectangular gratings were produced reliably at a period of 198 nm with a 70 nm line-width for individual lines. The process was calibrated to account for pattern size changes due to exposure dosage, resulting in high accuracy when fabricating new pattern dimensions. The accuracy of the FE-SEM stage motion was found to vary on average 2.35 µm and 1.71 µm in the'x' and'y' directions, respectively, per 50 µm of movement between adjacent patterns. The FE-SEM stage is therefore not suitable for 'stitching' patterns together when the optical properties of the final device are strongly dependent on exact feature dimensions. Alignment marks were investigated in a two-level fabrication process in order to improve the placement of features without involving additional high-end equipment. The two-level alignment procedure has its drawbacks in process complexity and pattern fidelity near the alignment marks, so there is a tradeoff between more precise placement and economical device fabrication.

Nikita Cardenas: Chemical & Biological Engineering
Mentor: Ryan Anderson -- Chemical & Biological Engineering
Pore Scale Modeling of Fluid Flow and Heat Transfer Through a Packed Bed

The scope of this research is to develop a COMSOL model to generate velocity and temperature profiles inside a packed bed. Packed beds are used in many chemical engineering unit operations and it is useful to know the exact mechanisms of flow and heat inside to understand the limitations of packed beds. Correlations that relate to packed beds are based on macro scale mechanics and are not very accurate. This model is designed to generate micro scale velocity and temperature profiles. This model will be coupled with research done in another MSU lab

that can experimentally measure temperature and velocity profiles inside a packed bed, which can then be compared to this COMSOL model. Once this model is developed, it will be used to develop more accurate correlations for packed beds that are more based on theory rather than empirical data.

Jacob Christenson, Kraig McKernan: Computer Science
Mentor: Clemente Izurieta -- Computer Science
Context Dictionary

When learning a foreign language, memorizing vocabulary is of utmost importance. Unfortunately, there are not many tools available that provide a list of words that users should memorize for a certain subject. Our context dictionary phone application assists users with memorization by displaying a list of words that often appear in a given subject. In order to do this, we created a database containing bilingual dictionaries for the French and Japanese languages. We use a script to search through textbook and story type documents which are in the French or Japanese languages. The script uses an algorithm to track which words appear near a targeted word and assigns a weight to the relationship between the two words. These relationships are considered a context match and are stored in our database. The top weighted context matches for a word are identified and returned to the user when a word is queried. This phone application targets users who are studying the Japanese or French foreign languages. Users of all foreign language skill levels are able to use this application since documents that we are scanning are of varying literature levels.

Spencer Dahl: Chemical & Biological Engineering
Mentor: Rich Macur, Ellen Lauchnor -- Center for Biofilm Engineering, Civil Engineering
Degradation of Recalcitrant Compounds In Waste Water Using Fungal Strain GS24

Fungal Strain GS24 is found in low pH, geothermal areas of Yellowstone National Park and is expected to have applications in water treatment. The primary goal of this project was to evaluate the ability of strain GS24 to degrade recalcitrant aromatic compounds often found in municipal and industrial waste waters. The activated sludge systems commonly used for waste water treatment can degrade many organic compounds, however, there are numerous aromatic compounds that are not efficiently degraded. Bioinformatic analysis of the genome of strain GS24 suggests the ability for degradation of aromatic compounds. Phenol and triclosan are common aromatic ingredients in personal care products and often reside in waste water. Experiments were designed to test the ability of strain GS24 to degrade these compounds. Experiments were conducted in 250 mL baffeled shaker flasks at pH 2.5 at room temperature with varying concentrations of these compounds. Measurements of compound concentration (HPLC analysis) over time revealed that strain GS24 can efficiently degrade these compounds. The positive results observed here support additional testing of other recalcitrant aromatic compounds such as naphthenic acid, an important pollutant associated with oil sands extraction. In summary, fungal strain GS24 has the potential to be used for the removal of aromatic pollutants from municipal and industrial waste waters.

Amy Fox: Chemical & Biological Engineering
Mentor: Connie Chang -- Center for Biofilm Engineering
Cells In Gels: A Microfluidics Study of Alginate Droplets

Droplet- based microfluidics is a rapidly expanding research field that allows experimentation to take place within "micro-reactors," or picoliter-volume drops of fluid. The aim of the "Cells In Gels" project is to use new and existing microfluidics techniques to study the biomineralization activity of individual bacterial cells. The project objective is to investigate if a single bacterium can be isolated within a microscopically tiny gel droplet and then to characterize the biomineralization behavior of that bacterium when exposed to calcium and urea. So far, alginate droplets have been successfully formed within a microfluidic device and bacteria have been encapsulated at various concentrations. The next step will be to expose the bacteria to calcium and urea to observe biomineralization. Further research will likely include a study of biofilm formation within an individual droplet and

also the exploration of other biomineralization processes utilizing varying types of organisms, substrates, and mineral compositions.

Acknowledgements: Logan Schultz (MSU Postdoc/Research Scientist) - Center for Biofilm Engineering

Dominic Friedlein, Zachary Fisher: Computer Science
Mentor: Clemente Izurieta -- Computer Science
THEBarcodeScanner

Modern mobile and hand held devices such as tablets, smart phones and wearable devices have become dynamic and powerful in recent years. Breakthroughs in processing power and development simplicity have spawned millions of applications that have been designed and developed by a wide range of entities. A major focus of these applications is to simplify tasks, and make life more streamlined, by increasing efficiency and reducing complications. However, even with the services these devices provide, there are a limited number of applications that actually pass environmental specific information to services. Mobile devices are quickly overtaking wired, stationary electronics as well as things that we carry around on a daily basis such as cameras, mp3 players, checkbooks, laptops, notebooks, grocery lists, etc. Some individuals even rely solely upon their phones to manage their business. "THEBarcodeScanner" is a consumer oriented Android application used to streamline a user's decision making process. The primary objective of "THEBarcodeScanner" is to provide the end user with all the tools necessary to make a well informed decision; should I buy this? By compiling a number of variables from third party libraries, "THEBarcodeScanner" displays an item's average price, the current price of an item on several large internet based retailers, as well as an items price history. This provides the user with a thorough knowledge base, and saves them from unforeseen price point variables that may cause inflation.

Emma Garcia: Chemical & Biological Engineering
Mentor: Michelle Flenniken -- Plant Sciences & Plant Pathology
The Impacts of Viral and Agrochemical Stresses on Honey Bee Health

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 5 separate agrochemicals in field-relevant doses via their diet. Agrochemicals included 1 fungicide composed of boscalid and pyraclostrobin used to control almond pathogens, 2 neonicotinoid insecticides, 1 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 results suggest that either SINV-GFP copy number does not reflect the sublethal effects of agrochemicals on bee health, or that the amount of agrochemicals ingested by the bees in these studies was not sufficient to detrimentally affect the ability of bees to combat viral infection. A new cohort of samples is being analyzed to corroborate these findings.

Merve Gokce, Elif Yagci: Chemical & Biological Engineering
Mentor: James Wilking -- Center for Biofilm Engineering
Extending Colloidal Templating Techniques with New Colloidal Materials

Most pharmaceutical compounds are taken orally. In order for these compounds to reach the blood stream, they must dissolve; however, many pharmaceutical compounds are very poorly soluble in water and thus dissolve very

slowly in the gastrointestinal fluid. One solution to this problem is to formulate the drug in nanoparticle form; the resulting enhancement in surface area increases the dissolution rate of the pharmaceutical compounds. In one such technology, a colloidal template is used to structure pharmaceutical compounds at the nanoscale and thereby enhance the dissolution rate and bioavailability of pharmaceutical compounds. However, while colloidal templates can be used to structure a wide variety of compounds, the resulting drug-colloid composites are often difficult to break apart and expose the drug. Here, we aim to develop excipients which will enhance composite breakup through crystal growth. Sodium sulfate is a particularly damaging salt to monuments and other porous media: anhydrous sodium sulfate dissolves in water and rapidly converts to a hydrated crystal form. Therefore, we choose this as our primary excipient. Colloidal templates were constructed using silica colloids. Saturated sodium sulfate solutions were added to the pores of the colloidal templates and the resulting filled composites were broken apart. This project provides a new excipient for breaking apart nanoformulations, not only for the pharmaceutical industry but also in many other business areas. This new technique could be used to break rocks in the mining industry, to destroy buildings or manufacture some special shape desirable materials.

Julia Goldberg: Chemical & Biological Engineering
Mentor: Garth James, Elinor Pulcini, Kelly Kirker -- Center for Biofilm Engineering
Analysis of Gene Expression of Pseudomonas aeruginosa Post Exposure to Atmospheric Plasma Using RNA Sequencing

The project performed was a continuation of a research project that has been previously performed in the Center for Biofilm Engineering at Montana State University. That project, performed under the supervision of Garth James, involved using atmospheric plasma as a disinfection method for simulated chronic wounds. The Atmospheric Plasma Disinfection Machine provided by Advanced Plasma Products Inc. has shown successful disinfection (multiple log reduction) in in-vitro models in Phase I research. This project was a part of Phase II research, involving the utilization of these disinfection models for further testing of biological responses. *Pseudomonas aeruginosa* was selected as the pathogen of study due to its problematic nature in the medical field. An understanding of the success of atmospheric plasma on *P. aeruginosa* provides methods to optimize its immediate use as a disinfection treatment. Using RNA sequencing will provide information on the mode of action of this disinfection process. Treated and untreated samples were collected and prepared for transcriptome analysis at each stage of disinfection. Biofilm growth time, treatment time, as well as the RNA extraction method was optimized in order to prepare each sample. Messenger RNA is currently being sequenced using the Illumina MySeq platform. The next step of this project will be analysis of sequenced data using Galaxy, an open source genomics database.

Aubrie Golden: Mechanical & Industrial Engineering
Mentor: Erick Johnson -- Mechanical & Industrial Engineering
Validation of a Cross-Flow Water Turbine

Hydrokinetic power is the least common of the alternative energies and is still in the research and developmental stage. This project aims to contribute to the ongoing research of optimizing cross-flow turbines by improving an existing test fixture and validating the measured results. Optimal design is largely unknown as experts in the field have not reached an agreement on the number of blades, control strategies, or how the turbines should be designed to operate efficiently in complex flow environments, such as in arrays. The goal of this project is to produce a mechanism to test, cross-flow water turbine designs. Improvements to the existing test frame include a partial redesign of the frame and hub, and a new data collection and analysis program, written in MATLAB. The project will proceed in parallel with a graduate student who will perform the bulk of the simulations to validate the data collected from the experiments in my project. In addition, this project will be benefited by an EMEC/ETME Capstone project to construct a flow visualization tool. The primary goal, for the first semester of this design and optimization project, is to expand on my understanding of the computational tools that will be utilized, along with continued testing of the turbine to reveal any issues. Also, there will be a focus on current performance issues with the turbine model. Continuing into the second semester, a data acquisition system and MATLAB will be used to

finish a program that will properly collect large sets of experimental data for analysis. Prototype testing will occur in the Flume of the Civil Engineering Fluid Mechanics Laboratory.

Acknowledgements: Garrett Peebles (MSU Graduate Student) – Mechanical Engineering

Joshua Gosney: Chemical & Biological Engineering
Mentor: Jeffrey Heys -- Chemical & Biological Engineering
Numerical Prediction of Microbubble Attachment in Biological Flows

Biofilm infections pose a major threat to human health and are very difficult to detect. Microbubbles provide an effective and inexpensive method of detection for biofilm-based infections and other diseases such as cancer. The approach studied here examines the potential of targeted microbubbles, with specific antibodies covalently linked to their surfaces for use as ultrasound contrast agents and drug delivery vehicle. This work presents a novel numerical model for determining the forces on microbubble conjugates in the vascular system. A full computational fluid dynamics simulation of biological fluid flow and the resulting forces on attached microbubbles is presented as well as comparisons with simplified analytical models. Both the computational and analytical predictions are compared with the experimental measurements from Takalkar *et al*. and Schmidt *et al*., and these comparisons indicate microbubble attachment can be anticipated when the total hydrodynamic force on the microbubble is less than 100 pN. Through the examination of typical biological flows, microbubble attachment can be expected up to an average velocity of $0.25\ \frac{mm}{s}$ near the microbubble (i.e., a particle Reynolds numbers on the order of .001). The Stokes drag law was shown predict the drag force (the dominant force) on the microbubble within an order of magnitude of the much more complex numerical model. Finally, it was found that the lift force on a microbubble was small relative to the drag force, and that the Saffman equation prediction differed from the numerical model by more than an order of magnitude for the biological flows examined.

Shelley Haug: Chemical & Biological Engineering
Mentor: Joseph Seymour -- Chemical & Biological Engineering
Self-Diffusion Coefficient Model Development for HPMCAS Polymer/Acetone Binary Mixtures and Polymer Concentration Regime Analysis using Nuclear Magnetic Resonance and Rheology

The objective of this spring's research was to further the work of graduate student Nathan Williamson in the analysis of a self-diffusion coefficient model of hydroxypropyl methyl cellulose acetate succinate (HPMCAS) polymer and acetone mixtures obtained using a 250 MHz nuclear magnetic resonance (NMR) spectrometer system with Pulsed Gradient Spin Echo (PGSE) experiments. The proposed mixture regimes and polyelectrolyte polymer behavior will be further explored through rheological analysis of various relevant parameters. The two methodologies of NMR and rheology will be combined to explore how polyelectrolyte polymer dynamics change as a function of weight percent. The existence of dilute, semi-dilute, and concentrated regimes have been hypothesized and will be analyzed in parallel to rheological findings. How the polymer dynamics affect relevant parameters of diffusivity, viscosity, relaxation time, and elastic modulus in relation to the proposed regimes is a novel integration of rheology and NMR. Results so far indicate the overlap concentration occurs between 7 and 9 wt % polymer based on viscosity measurements. This is consistent with the concentration regimes indicated by the previously developed diffusivity regimes.

Acknowledgements: Caroline Lima Salles de Souza (MSU Undergrad Student) – Chemical & Biological Engineering

Connor Hoffmann: Chemical & Biological Engineering
Mentor: Blake Wiedenheft, Ryan Jackson, MaryClare Rollins -- Microbiology & Immunology
Understanding and Engineering CRISPR RNA-Guided Nucleases

Viruses that infect bacteria are the most diverse and abundant biological agents on the planet. Bacteria have developed an adaptive immune response, the CRISPR system, to combat this threat. My proposal seeks to further explicate the mechanisms by which this CRISPR system intercepts and destroys foreign DNA by studying the CASCADE complex. This protein structureinds with foreign DNA, and once attached recruits the Cas3 transacting

nuclease for DNA destruction. Virally encoded anti-CRISPR proteins serve to disrupt this process either by preventing binding to target DNA, or by interfering with the recruitment of Cas3. I have two aims: 1 determine the crystallization conditions of the CASCADE complex when bound to a ssDNA target strand. 2 to resolve a high resolution crystal structure of this complex which will provide insights into the mechanisms of target binding. In preparation for this work I will learn how to produce and purify recombinant proteins through *E. coli* samples and size exclusion chromatography. This project will use high throughput screening techniques and optimization matrices to determine the crystallization conditions of the CASCADE complex. These crystals will then be sent to an off site synchrotron for x-ray crystallography of the complex. Analysis of the gathered data will result in an electron density map of the complex, from which the tertiary structure of the complex can be resolved. The accomplishment of these two aims would serve the medical and biotech communities by providing more foundational knowledge of how the CRISPR system operates. There have been recent advancements in application of CRISPRs to human systems, but these fundamental gaps in knowledge must first be resolved.

Jerad Hoy: Computer Science
Mentor: Ben Poulter -- Ecology
Developing a Web Application to Visualize Greenhouse Gas Emissions Reductions

Greenhouse gases continue to rise around the world and various policies are emerging to try stabilize and reduce concentrations of CO_2 to avoid climate change. For example, the White House Climate Action Plan proposed in 2014 presents a range of strategies to address energy production in the USA and to tackle emissions of CO_2. The purpose of this research project was to develop a web application to both visualize US state greenhouse gas emissions and to show how emissions could be reduced to meet national Climate Action Plan CO_2 reduction goals. The web application uses the statistical programming language R and the web server application framework for R, Shiny. The Environmental Protection Agency database for state-level CO_2 emissions by sector was used as the database for analyzing CO_2 reductions. The application allows users to lower CO_2 emissions state by state from each emissions sector to evaluate different'pathways' to meet the national emissions reduction goal set by President Obama of 26-28% below 2005 levels by 2025. Another application is currently being developed to analyze the methane emissions and environmental impact of fracking in Montana and the Bakken. We hope these tools will be able to inform people about greenhouse gas emissions sources and opportunities for reducing them.

Kevin Izard: Mechanical & Industrial Engineering
Mentor: Sarah Codd -- Mechanical & Industrial Engineering
Flow Condition of Two-Phase Flow in Porous Media

Understanding two-phase flow through a porous media is important in various industries and sciences. One of the more basic problems with this type of flow is trying to predict the structure of the flow by relating flow geometry, velocity and capillary number. Although research and analysis have made some progress towards relating these phenomena, the full characteristics of two-phase flow in a porous medium is not sufficiently understood. The use of Nuclear Magnetic Resonance (NMR) allows for a noninvasive look into characterizing the flow and has previously been applied to understand dynamic flow within a porous media. Previous research has predicted a correlation between the pressure gradient versus capillary number relationship that has recently been verified experimentally using NMR. The pressure gradient (ΔP) is the drop in pressure across the porous media that is being studied, while the capillary number (Ca) is a dimensionless parameter that is a function of the wetting fluid velocity (vw), viscosity (v), and surface tension (σ). Objective: The goal will be to apply 1-D NMR (Nuclear Magnetic Resonance) imaging to various two-phase flow regimes within a porous medium. By observing the varying flow structures, the data collected will provide further insight into the relationship of the capillary number (Ca) of the fluid and the pressure gradient in the column and determine if the flow structure can be predicted for different flow rates.

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Jayesha Jayaratne: Chemical & Biological Engineering
Mentor: Jennifer Brown -- Chemical & Biological Engineering
Rheological Characterization of worm-like micelle solutions with varied surfactant and counter-ion concentrations

The study focused on rheologically characterizing worm-like micelle forming surfactant solutions as a function of surfactant concentration and counter-ion concentration. Surfactants can self-assemble into geometrical forms called micelles, of interest in biomedical fields and the petroleum industry. The aggregates can be induced to form threadlike, or wormlike micelles at certain temperatures, surfactant and counter-ion concentrations. Wormlike micellar solutions can exhibit a non-homogeneous flow at a specific range of shear rates where the shear stress is seen to plateau. The non-homogeneous region is of particular interest as the fluid splits into macroscopic bands where two shear rates coexist under a constant stress called shear banding. The range of shear rates at which shear banding occurs may change based on concentration and temperature of the solutions. The goal of this research was to identify concentrations with shear banding shear rate ranges appropriate for use in Rheo-NMR studies. The surfactant of interest was cetylpyridinium chloride (CPCl) with a counter-ion of sodium salicylate (NaSal), a surfactant widely used in mouthwashes, toothpaste and other antiseptic products. Surfactant concentrations were varied from 4-8% with fixed counter-ion concentrations. 5% had a stress plateau at a low shear rate of 7.5 rad/s and a narrow plateau range. The stress of the 6% solution plateaued at 10 rad/s but existed over a broader shear rate range. 7% had a broad plateau region starting at a high strain of 31.6 rad/s. The stress versus strain curves for 5-7% solutions collapsed onto a single curve when normalized by the plateau modulus and relaxation time, however 4% and 8% concentrations failed to do so.

Connor Julien: Electrical & Computer Engineering
Mentor: Brock LaMeres -- Electrical & Computer Engineering
Design and Space Flight Testing of a Radiation Tolerant, FPGA-based, Reconfigurable Computer System on the International Space Station

Objects in space that are on the edge or outside of the Earth's magnetosphere experience harsh radiation from the sun and other stars in the galaxy. Due to different types of radiation, computers used by astronauts on spacecraft or space stations experience failures from Total Ionizing Dose (TID) and Single Event Effects (SEE) which are both faults caused by ionized particles passing through an integrated circuit component and causing it to malfunction. An FPGA based reconfigurable computer system that has already been developed will be tested on the International Space Station to advance the fight readiness of the technology. Called Artemis (Radiation Tolerate computer Mission on the International Space Station), this computer system required a circuit board to interface to the International Space Station (ISS). The interface circuit board contains the USB connection that will provide power from the ISS to Artemis along with a high speed USB-to-SD card reader to provide data acquisition on an SD card. Once ground testing of the interface circuitry has been completed and the system has been launched to the ISS, data will be acquired and periodically downloaded by an astronaut aboard the station. The data will be electronically sent to Montana State University for analysis to determine how well the radiation tolerant computer system performs in space.

Hasan Karadurmus: Chemical & Biological Engineering
Mentor: Jovanka Voyich – Microbiology & Immunology
Rise of the Superbugs: A Survey of the Challenge of Drug Resistance

Infectious diseases are still one of the most serious threats to the human race claiming 68 % of the deaths in the world (WHO, 2012)[1]. The race against the pathogens of infectious diseases has continued since the discovery of penicillin by Alexander Fleming in the mid- 20th century which led to the development of many antibiotics. Currently, many microorganisms demonstrate resistance to available antibiotics. Moreover, misuse of antibiotics combined with minimal regulations for the usage of antibiotics in food animals have contributed to the existence of multi-drug resistant microorganisms. In this study, we investigate the current status of antibiotic resistance. The study defines resistance mechanisms of pathogens using *Neisseria gonorrhoeae* and *Staphylococcus aureus* as the examples. Additionally, current research efforts to develop new antimicrobials agent are discussed as well as

ideas to help prevent further development of antibiotic resistance. Collectively, this study highlights the growing problem of drug-resistance efforts to control the problem, and explores ideas to develop new methods to combat drug-resistant pathogens.

Katherine Kent: Chemical & Biological Engineering
Mentor: Jennifer Brown -- Chemical & Biological Engineering
Rheo-NMR Studies of Polymer-Particle Dispersions with Silicon Dioxide Nanoparticles

Locust bean gum (LBG) and xanthan gum (XG) are biopolymers with an extensive range of applications due to their low toxicity, affordability and availability. These polymers are of interest both industrially and biologically and have long been used in the food industry as thickeners and stabilizers. More recently, they have become a focus in biomedical research for their potential in drug delivery systems in the pharmaceutical industry. In particular, locust bean gum, xanthan gum, and their combination synergistic gel (LX) solutions can exhibit novel rheological behavior when combined at 1% weight with silicon dioxide nanoparticles (SiO_2), d_p=10-20nm, at varying weight percentages. These polymer-particle dispersions have been shown to have unique rheological properties not seen in the polymer solutions alone. Previous exploration has involved characterizing these solutions through bulk measurements using a rotational rheometer. However, nuclear magnetic resonance techniques applied during rheological measurements, termed Rheo-NMR, can directly measure the velocity field in any direction and provide more detailed information. Rheo-NMR velocity imaging and NMR diffusion experiments were used to explore each polymer's behavior with and without the addition of SiO_2 nanoparticles.

Nickolas Lapp: Electrical & Computer Engineering
Mentor: Joseph Shaw -- Electrical & Computer Engineering
Aurora Alert Notification System for Optical Aurora Detector

The purpose of this project is to add a text messaging alert system to the Aurora Detection Project currently in place at Montana State University. Through a combination of MySQL and Python, a testable, powerful tool is being developed to help share the Aurora with anyone from the public who is interested. The messaging side of this project was functional at the end of December, and upgrades and enhancements to the data collection and messaging system are taking place throughout the Spring semester, culminating in a tool that will help engage the public through observation of the Aurora Borealis.

McLain Leonard: Chemical & Biological Engineering
Mentor: Roberta Amendola, Hugo Schmidt -- Mechanical & Industrial Engineering, Physics
Non-planar, BZY Electrolyte Fabrication for Liquid Lithium Proton-conducting Fuel Cell

A novel H-SOFC (Hydrogen-conducting Solid Oxide Fuel Cell) configuration that features a molten Lithium anode has been envisioned by Dr. Hugo Schmidt. The process to fabricate the cell consists of several stages: ceramic nano-powder synthesis, tape casting, sintering, assembly, and high-temperature impedance spectroscopy. Glycine-nitrate pyrolysis (GNP) was used to synthesize BZY ($Ba(Zr_{0.8}Y_{0.2})O_{3-\delta}$) powder. Tape casting was used to fabricate an electrolyte sheet less than 1 µm in thickness. Bowl-shaped electrolytes were formed during the sintering process. The final cell configuration will use a molten Lithium anode and a solid LSM ($La_{0.8}Sr_{0.2}MnO_3$) cathode. Parameters for GNP, tape casting, and sintering were iteratively optimized throughout the cell fabrication process. Future work will involve the final assembly of the cell followed by Electrochemical Impedance Spectroscopy (EIS) testing to study electrical characteristics.

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Neil Liotta, Kirkwood Donavin, Kelly Hendrix, Jake Ebersole, Alexander Paterson: Chemical & Biological Engineering, Agricultural Economics & Economics, Civil Engineering, Business
Mentor: Sarah Janzen -- Agricultural Economics & Economics
Assessment of Health 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 a number of water and sanitation projects for primary schools in the District of Khwisero, 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 regarding projects with good intentions falling to ruin or not providing the intended effect. The goal of this research project was to analyze the impact of EWB projects on the prevalence of water-borne pathogens. This was done by analyzing health indicators, specifically diarrhea prevalence in communities that benefit from an EWB project relative to those who do not. A household survey and an appropriate sampling strategy were developed and then implemented during the summer of 2014. Fieldwork involved the enumeration of surveys by native Kenyans, followed by data entry and evaluation during the winter of 2015. Summary statistics and a linear regression performed on the collected data show higher diarrhea prevalence in communities that have EWB projects versus those that do not. These results do not indicate a causal relationship between EWB projects and diarrhea prevalence; rather it simply shows that there are more diarrhea cases in communities with projects, likely due to the fact that EWB projects are built in communities that have a greater need for the projects. The results of this research will provide direct feedback to the efficacy of EWB's intentions and guide the implementation of future EWB projects.

Kilean Lucas: Chemical & Biological Engineering
Mentor: Recep Avci -- Physics
Influence of Material Defects in the Microbially Influenced Corrosion of 1018 Steel in Fuel/Seawater Systems

The corrosion of 1018 low carbon steel is a function of many factors including corrosive medium, dissolved oxygen content, bacterial activity and the metallurgical history of the metal. This work focuses on the localized corrosion due to dislocations introduced into metal during its metallurgical preparation. Specifically, the immediate surroundings of manganese sulfide (MnS) inclusions and pearlite grains mark the sites of aggressive corrosion under the influence of microbial activity. Our work is conducted under suboxic/sulfidogenic marine environments in which an anaerobic sulfate reducing bacteria (SRB, *Desulfovibrio indonesiensis*) and an aerobic *Marinobacter sp.* can co-exist. Highly polished 1018 low carbon steel coupons were exposed to the bacteria containing seawater for periods of one month, while being monitored periodically *in situ* by electrochemical measurements. At the conclusion of the experiment, samples were analyzed by multiple microscopic and spectroscopic means to assess the localized corrosion. Results presented in this study support the hypothesis that defects in the metal are potential sites of localized corrosion.

Acknowledgements: Bret Davis (MSU Postdoc/Research Scientist) - Physics

Thomas Lund: Chemical & Biological Engineering
Mentor: Jennifer Brown -- Chemical & Biological Engineering
Non-Newtonian Fluid Flow in Porous Media

The goal of this research is to measure the propagator (the probability distribution of velocities) of non-Newtonian fluids through porous media using nuclear magnetic resonance (NMR) techniques. Surfactants in solution are capable of forming cylindrical or wormlike micelle structures above a critical concentration. When this configuration is adopted, the solution has complex non-Newtonian and viscoelastic rheological properties similar to polymer solutions. Wormlike micelle solutions are used in applications ranging from enhanced hydrocarbon recovery to thickening consumer cosmetic products. It is hoped that through measuring the propagator of these solutions in complex geometries like porous media their behavior can be better understood and predicted. The initial stage was to develop a model porous media system capable of being used in conjunction with the NMR

spectrometer. Due to the nature of NMR measurements, the system must be constructed of non-magnetic materials and free of air which would disrupt the collection of accurate values through the creation of dead spots in the media. The selected system consists of an alternating dual cylinder pump traditionally used in liquid chromatography and a glass chromatography column packed with 240µm polystyrene beads. This column was chosen due to the magnetic properties of the materials of construction as well as its high pressure rating. The pump used in the research required extensive testing and refurbishing to perform as desired. The system has been tested on the benchtop and no leaks were observed. The next step is to take baseline propagator measurements in the NMR spectrometer with a Newtonian fluid (water) and then the wormlike micelle solution studied will be cetyl trimethylammonium p-toluene sulfonate.

Acknowledgements: Elmira Nybo (MSU Graduate Student) - Chemical & Biological Engineering

Michelle Meagher: Chemical & Biological Engineering
Mentor: Brent Peyton, Dana Skorupa -- Chemical & Biological Engineering, Center for Biofilm Engineering
Phylogenetic Analysis of Novel Thermophilic Archaea and Bacteria from an Alkaline Spring in Yellowstone National Park

Communities of microorganisms have relatively recently been found to flourish in environments once thought to be incapable of supporting life. The advent of high throughput DNA sequencing has significantly increased the amount of archaeal and bacterial diversity detected in habitats such as hot springs and deep-sea hydrothermal vents. The vast majority of studies from these geothermal areas, however, have analyzed thermal features with an acidic or circumneutral pH, with few investigating microbial diversity in alkaline hot springs. In this study, the biodiversity of high pH hot springs located in the Heart Lake Geyser Basin in Yellowstone National Park was examined through 16S rRNA gene sequence analysis. Genetic material extracted from sediment slurries was amplified with polymerase chain reaction, and analyzed using next-generation sequencing. Phylogenetic analysis of the 16S rRNA gene sequences classified several novel archaeal and bacterial populations, suggesting numerous novel species are present in these thermoalkaline hot springs. Work conducted here provides insight into prokaryotic life capable of thriving in high pH environments, and opens the door to further detailed physiological and biogeochemical studies of these previously uncharacterized environments.

Addie Melvin: Chemical & Biological Engineering
Mentor: Joseph Shaw -- Electrical & Computer Engineering
Measuring Atmospheric Aerosol Optical Absorption

I will be observing the air quality in Bozeman in reference to black carbon presence in the atmosphere. Black carbon exists in the atmosphere during weak pollution events such as forest fires, car emissions (especially from diesels), and wood stoves burning in the winter. Black carbon is extremely unhealthy for humans to breathe in so it is important for us to track the amount of it in the air in the Bozeman area. Two instruments in Dr. Shaw's lab -- the nephelometer and the Cavity Attenuated Phase Shift (CAPS) extinction monitors -- measure aspects of the particles in the atmosphere. I can find an absorption coefficient of the particles which will give an approximation of the amount of black carbon in the atmosphere using the two instruments. Prior to my addition to the lab, a year's worth of data was collected using these instruments. The two instruments are experiencing technical difficulties currently, so my first step in this project is to fix the machines and validate the nephelometer using a second nephelometer. I will then analyze the data previously collected by calculating an absorption coefficient for that year and analyzing the presence of black carbon. Next, I will collect data during weak pollution events: the burning of wood stoves and diesel engines during the winter months. I will then compare this data to data collected during the spring months, when the air is pristine, to observe the differences in the amounts of black carbon in the air. Overall, this project will be used to determine how well we can predict the absorption coefficient of aerosols in the atmosphere using the nephelometer and CAPS instruments in order to analyze the black carbon content in the air.

Benjamin Moon: Electrical & Computer Engineering
Mentor: Wataru Nakagawa -- Electrical & Computer Engineering
Characterization of Optical Nanostructures using Optimized Measurement System with Phase and Polarization Capability

Optical devices with sub-wavelength nanostructures on silicon have been realized in order to manipulate the polarization state of light. Wavelength dependent polarization effects of such devices have many applications, including integration on MEMS deformable mirrors. Characterizing the properties of these nanostructured optical devices requires accurate measurement of the phase effect caused by the device. To measure this phase effect, an amplitude-splitting interferometer can be used to compare the incident light beam to a reference beam. Using the principle of optical interference, the relative phase effect of the device can then be measured. Research was conducted on a Mach-Zehnder interferometer in order to demonstrate its stability and usefulness for measuring the phase effect of reflective quarter wave plates fabricated by the Nano Optics Lab. Making improvements to the interferometer began with optimizing alignment of all components and updating testing parameters to ensure maximum stability and repeatability of interferometric measurements. Next, the interferometer was characterized extensively to gain an understanding of its overall behavior and stability. Results from this system characterization showed that the interferometer had a sufficient level of stability for conducting phase measurements on a device. This assertion was validated by characterizing a nanostructured optical device with a known phase effect and observing that the interferometer measured a phase shift comparable to the expected phase shift for a quarter wave plate. With these updates to the interferometer, the current test system can support phase-resolved measurements, which will aid in the production of more specialized optical devices.

Chris ODonnell: Mechanical & Industrial Engineering
Mentor: Daniel Miller, Ladean McKittrick, Ed Adams -- Civil Engineering
How Variable Snow Microstructure Affects Gas Diffusion Rates

Our research focuses on both the causes and effects of gas flux through winter snowpack. Initial soil conditions, along with atmospheric influences, can affect gas flux, while this in turn can affect the snowpack's microstructure. In order to measure this gas flux we are developing a system for sampling discrete gas measurements while in subzero conditions. The results of our research will be beneficial in three key ways. First, the results will allow for better rescue responses after avalanches occur, as snow patrollers will have increased knowledge of the amount of time they have to find buried individuals (based on remaining O_2 and the buildup of CO_2), as well as how long it takes these individuals' scents to diffuse to the surface for avalanche rescue dogs to discern. Second, our focus on pre-snowfall soil conditions will allow for more precise and location-specific predictions of avalanche occurrences. Finally, with a better working understanding of the gas flux in the winter snowpack, environmental scientists will be able to better track and predict how snow conditions will affect the subnivean climate (the zone in and underneath the snowpack) and the vegetation and animals that inhabit it. We plan on observing and modeling how $C0_2$ diffuses through the snowpack, and believe that this rate will change over time, as the moving gas will cause changes in the snow microstructure, creating 'channels' that allow it to flow. Thus, we expect the rate of gas diffusion to increase as time goes on. Future research includes altering initial conditions as well as observing the flux for gasses other than CO_2. Additionally, a similar experiment could be conducted outdoors with the use of the same CO_2 sampler that is being used for the current trials.

Acknowledgements: Ben Hills (MSU Undergrad Student) - Civil Engineering

Taylor Oeschger: Chemical & Biological Engineering
Mentor: Joseph Seymour -- Chemical & Biological Engineering
Techniques for Heterogeneous Gelation of Alginate Solutions

Bacterial and algal alginates have many unique properties that are not well understood. Alginate is known to form a physical gel in the presence of divalent cations, such as Ca+2 or Cu+2. During gelation by a heterogeneous reaction process, capillaries are spontaneously formed within the gel matrix. The characteristics of these capillaries are determined by the concentration of alginate and the concentration of divalent cation. Theoretically, liquids can

be flowed through these capillaries and act as a filter to capture ions and remove them from solution. As a result of this, these gels have potential to be used in environmental engineering as filters especially for copper. The shape and size of these capillaries and the transport by flow through them can be quantified using Nuclear Magnetic Resonance. In addition, these alginates have interesting rheological properties that have not been well studied. Using a rheometer, alginates at different concentrations can be examined to determine characteristics such as viscosity, reaction under different forms of stress, and how they respond in varying environments. This project focuses on determining ideal concentrations for capillary formation, designing a flow test, and determining rheological properties of alginate.

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John Pankratz: Chemical & Biological Engineering
Mentor: Jennifer Brown -- Chemical & Biological Engineering
Rheo-NMR Characterization of Wormlike Micelle Solutions

Wormlike micelles formed by cationic surfactants exhibit complex viscoelastic rheological properties. The goal of this project was to utilize Nuclear Magnetic Resonance (NMR) techniques, where a rheological shear cell is contained within an NMR spectrometer, termed Rheo-NMR, to study shear-banding and velocity fluctuations of wormlike micelles under steady state conditions. The solutions analyzed contained the cationic surfactants cetylpyridinium chloride (CPCl) and cetyltrimethyl ammonium bromide (CTAB), two compounds known to form wormlike micelles in solution. These two surfactants have biomedical applications that include their uses as antiseptics in pharmaceuticals, cosmetics, and oral hygiene products. Diffusion coefficients were measured using NMR pulsed gradient spin echo (PGSE) and flow-compensated PGSE methods combined with Rheo-NMR. The hypothesis is that enhanced diffusion will occur on the timescale of the velocity fluctuations in the solutions. A major portion of the project was spent troubleshooting the technique and comparing the acquired results with known literature. Different fluids, including Newtonian and non-Newtonian fluids, were tested to contrast and compare with the results from the wormlike micelle solutions. It was determined that the sample should be prepared with a mixture of deuterium oxide, or heavy water, with regular water in order to avoid experimental artifacts due to a phenomena in NMR called radiation damping. This mixture of water and deuterium was then also tested to ensure that the rheological properties of the micelle were unaltered despite this slight change in the chemistry of its solvent. Future work will include continued study of the enhanced diffusion coefficients as well as velocity profiles for wormlike micelles

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Kenneth Patrick: Computer Science
Mentor: Clem Izurieta -- Computer Science
Dynamic Online Course Contrast (DOCC)

Dynamic Online Course Contrast (DOCC) is a technology to assist in deciding which courses to take when studying abroad. This is a daunting task for a person and figuring out how the desired courses will transfer back to the home university is one of the biggest challenges. This is usually done by searching an unfamiliar website for course descriptions then comparing that description with similar courses on the host university website. DOCC will use web scraping techniques to find desired foreign courses, their home counterparts and will compare the two. Web scraping is a software technique used to extract, or scrape, information from websites. This is accomplished by scanning a website's source HTML file and saving particular portions that the software deems interesting. In this case the interesting information is a given course title and its associated description. Unfortunately, the layout of HTML files on the World Wide Web is not always implemented consistently. Deciphering where to find information is key. DOCC uses two given course names and associated websites, for both foreign and home universities, as start locations. These start locations make it easier to find the desired descriptions. It then starts scanning the website for these descriptions near the course title (in children or sibling HTML nodes) before widening the search.

Stephen Pedersen: Chemical & Biological Engineering
Mentor: John Priscu -- Land Resources & Environmental Sciences
Analysis of Long Term Photosynthetically Active Radiation Data from McMurdo Dry Valley Lakes to Identify Turbidity Stratification Patterns

The current study focused on four perennially ice covered, meromictic, fresh water lakes in the Taylor Valley of the McMurdo Dry Valley region: West and East Lobe Bonney, Fryxell, and Hoare. Data from these lakes have been collected annually for more than 25 years, and are cataloged in the McMurdo Dry Valley Long Term Ecological Research database. The objectives of the current study were to determine whether turbidity stratification patterns could be identified within the four McMurdo Dry Valley Lakes, to look for seasonal and annual changes in those stratification patterns, and to correlate environmental data to identify potential causes of the turbidity. To identify patterns in turbidity, extinction coefficient depth profiles were calculated using photosynthetically active radiation data collected annually during the past 29 years. Averaging the profiles revealed distinct stratification of turbidity layers that were shown to be relatively stable across all recorded years. To examine potential causes of turbidity revealed by the extinction coefficient data, chlorophyll-a profiles were compiled for the same years, and compared to those of the extinction coefficients. Within the photic zones of Lake Hoare and East and West Lobe Bonney, chlorophyll-a was significantly correlated with turbidity. A linear plot of extinction coefficients against time revealed that later season average turbidity is much higher than that of early season turbidity, and that turbidity increases with depth in the photic zones of all lakes. Future research focusing on stream flow data could help identify the causes of the increase in late season turbidity observed in this study.

Shawna Pratt: Center for Biofilm Engineering
Mentor: Connie Chang -- Chemical & Biological Engineering
Development and Applications of Double Emulsion Microfluidics Techniques

Large quantities of mono-disperse, double-emulsion (shelled) drops that range in size from 50 µm to 500 µm in diameter are readily created using microfluidic techniques. These drops have a wide range of applications, including drug delivery, controlled release of chemicals, cosmetics, and high throughput biological assays. To create drops with controlled mono-disperse double emulsion characteristics, the microfluidic device must be carefully designed and calibrated. One of the types of devices capable of producing these drops is the glass capillary microfluidic device. This device is constructed through the careful assembly of glass pipettes that have been pulled to tapered openings 10 µm to 300 µm across. The pipettes are placed within a larger, square capillary in a juxtaposition to promote the flow-focusing and coaxial flow of liquids through the capillaries. After assembly and functionalization, liquids of different solubilities are flowed through the device. The geometry of the device facilitates shear forces of the liquids upon each other, which acts to form either water in oil in water, or oil in water in oil. By manipulating the fluids, drops with large varieties of compositions may be produced. Our aim is to create hydrogel particles and shells with biological compatibility for growing and assaying microbes.

Varsha Rao: Chemical & Biological Engineering
Mentor: Sarah Codd, Joseph Seymour -- Mechanical & Industrial Engineering, Chemical & Biological Engineering
Heterogeneous Gelation of Bacterial Alginate strains FRD1 and FRD1153

As the field of tissue engineering grows, new materials are being considered as potential tissue scaffolds every day. Before any true progress can be made on a scaffold material, its mechanical and chemical properties must first be explored and characterized. Alginate, a polymer that can be isolated from the extracellular matrix of both brown algae and mucoid strains of the bacterium *Pseudomonas aeruginosa*, has the capacity to form a hydrogel with the addition of divalent cations. Varying gelation parameters such as alginate concentration or cation solution composition can drastically change the formation of the gel matrix and induce micro capillary formation. Using magnetic resonance techniques, the capillaries were imaged and the gelation fronts were quantified. This research is focused on measuring and imagining capillary formation in two bacterial alginate strains, FRD1 and FRD1153. The results are compared to previous work with capillary formation in algal alginates.

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Anita Ratcliff: Civil Engineering
Mentor: Yiyi Wang -- Civil Engineering
A Study of Public Transit in Rural and Small Urban Communities

The Streamline is a valuable asset to the Bozeman community. While the Streamline has successfully increased the number of riders and the number of routes throughout the community, important questions remain: why people do and do not choose to ride the Streamline Bus and what improvements could be made to continue increasing ridership? The proposed study pose two hypotheses: (1) people choose to ride the bus because it is convenient not because they do not have access to a different form of transportation and (2) cost-effective approaches exist to increase ridership by understanding the effects of public transportation details on bus ridership while controlling for socio-economic and neighborhood accessibility attributes. The study aimed to discover the influence factors and their effects on the decision to ride or not ride the bus. The study has refined and collected a ridership survey of the Bozeman community and surrounding area and conducted an analysis of the collected data. A better understanding of the decision-making process of trip-makers needs to be supported by a large sample that is representative of the residents in Bozeman and surrounding areas. 496 people were surveyed during the study. The study does not only delve into the reasons people choose the Streamline as a means of transportation, but also provides guidelines for the Streamline to improve their services to the Bozeman and surrounding community.

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Taylor Reese: Chemical & Biological Engineering
Mentor: James Wilking -- Center for Biofilm Engineering
Active Microrheology on Pseudomonas Aeruginosa

Microrheology is a relatively new method for measuring the mechanical integrity of viscoelastic fluids by analyzing the displacement of beads implanted in the material. Standard rheology methods do not provide enough information to fully characterize biofilm mechanics as they take an average value across the entire structure and give no insight into the mechanics of the various phenotypes exhibited by the bacteria in biofilms. Microrheology on the other hand, can be observed at the microscopic scale throughout a biofilm to determine the strength of the biofilm at various points. The purpose of this lab was to develop a map of the mechanics of an alginate producing *Pseudomonas aeruginosa* biofilm, which behaves as a viscoelastic fluid, using active microrheology. In active microrheology, forces are applied to beads using a magnetic field. Alginate producing strains are particularly important to understand in the medical field as they one of the most common microbes to cause infections in cystic fibrosis patients. Experiments were designed to implant magnetic beads into a biofilm and analyze the resistance to movement caused by the polymer matrix surrounding the beads as a magnetic field was applied.

Colleen Rooney: Chemical & Biological Engineering
Mentor: Mark Young -- Plant Sciences & Plant Pathology
Analysis of peptide based targeting of a pathogenetic bacteria within a biofilm

The Young lab has been developing a system to selectively target and kill the pathogen *Aggregatibacter actinomycetemcomitans* within an oral biofilm model. I had designed a GFP construct that could be used to express peptide candidates. Due to a tube mislabeled as pET30, cloning attempts have been unsuccessful up to this point. It was confirmed this plasmid was not pET30 by a restriction digest, and now the vector OGS3015 SIGMA has been ordered and a promising peptide sequence will be cloned into the plasmid using PCR stitching. I will then use this construct to assay peptide directed Aa targeting specificity, affinity, and cellular localization within a biofilm model.

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Griffin Ruehl: Chemical & Biological Engineering
Mentor: Stephanie Wettstein -- Chemical & Biological Engineering
Green Solvents for Biomass Solubilization

Biomass provides a viable alternative to petroleum as a carbon chemical and fuel source, and novel pretreatment processes offer the opportunity to solubilize biomass, which reduces separation costs and allows for heterogeneous catalysts to be used for upgrading. These solvents are ideally low-cost, safe, and environmentally friendly. This research project focuses on using reaction mechanics and intermolecular forces (via the Hansen Solubility Parameters) to understand the solvent-biomass interaction and evaluate novel solvents and solvent mixtures to enhance biomass solubility.

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John Ryter: Mechanical & Industrial Engineering
Mentor: Roberta Amendola, Paul Gannon -- Mechanical & Industrial Engineering, Chemical & Biological Engineering
Investigating the Influence of Secondary Phases on the Dual Atmosphere Corrosion of Ferritic Stainless Steel 441

Solid Oxide Fuel Cells (SOFCs) are devices that produce electricity by oxidizing a fuel, typically hydrogen, and could be a viable means of mass power production due to their high efficiency and low emissions. Individual fuel cells must be stacked in series using interconnects (ICs) in order to produce enough power to be a viable source of energy. Recent advancements have allowed IC components to be composed of ferritic stainless steels (FSSs), decreasing costs. However, because the IC is exposed to hydrogen, air, and high temperatures simultaneously, the IC can experience accelerated corrosion leading to SOFC efficiency reductions. To better understand this dual atmosphere corrosion, a low-chromium (18 %wt.) FSS, AISI 441, is being studied, as it exhibits substantially accelerated and anomalous corrosion during dual atmosphere exposures and produces Laves (AB2) phases. Due to previous findings, it is believed that their presence may increase hydrogen permeability and as a result increase anomalous oxide layer formation, thereby decreasing fuel cell efficiency. By testing FSS samples in a high-temperature dual-atmosphere furnace, thereby simulating SOFC IC conditions, our research group investigated the correlation between Laves phase density, and time. We have shown that Laves phase formation is independent of time.

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Ty Show: Mechanical & Industrial Engineering
Mentor: Laura Stanley -- Mechanical & Industrial Engineering
Peer-to-Peer Effects Amongst Teen Drivers On the Blackfeet Indian Reservation

The goal of this research project was to analyze peer-to-peer effects amongst teens in a highly Native American populated high school utilizing the “Teens in the Driver’s Seat” safe driving campaign. Motor vehicle crashes are the leading cause of death for teenagers in the United States. Compared to national averages, Native American communities experience some of the highest driving fatality rates in the United States, having “twice the national rate” (Gross et al., 2007). Teens in the Driver Seat Program started in Texas, and has since seen tremendous results. Methods that will be used will analyze and compare finding of previous pilot research, and will also look at the effectiveness of the TDS program. Previous results suggest the program is effective, and also illustrates the positive impact of utilizing peer pressure in order to change the traffic safety culture. The culture shift does take time, and has been found to take approximately 5 years. Findings confirm that Browning High School, located on the Blackfeet Indian Reservation is a great candidate for further research using TDS program.

Gage Sowell: Chemical & Biological Engineering
Mentor: Rich Macur -- Center for Biofilm Engineering
Determination of optimal aeration rate and shear stress conditions for maximizing growth and lipid production by an extremophilic fungus

The extremophilic fungus named strain GS24 has the ability to convert a wide variety of organic feedstocks into valuable products. The most abundant product is oil in the form of triacylglycerides, which are ideal for biodiesel. The primary goal of this research was to understand the effects of aeration and shear stress on fungal growth and oil production. Three experimental conditions were tested; 800 mL air/min delivered as large bubbles (mean diameter ~4 mm), 200 mL air/min as large bubbles and 200 mL air/min as small bubbles (mean diameter ~0.5 mm). In comparison to large bubbles, the small bubbles significantly increased gas exchange with the liquid medium and the shear stress experienced by the cells. Growth conditions consisted of 1.2 L of medium in bioreactor tubes, 4% carbon substrate as either sucrose or glycerol (wt/wt), with peptone at a 40:1 total carbon to nitrogen ratio and a pH of 2.5. The experiments were run for 7 days before tubes were destructively sampled. Increased aeration resulted in faster and denser growth. Increased shear on the cells resulted in a shift from planktonic to biofilm growth form and significantly decreased total biomass and lipid productivity. Thus, aeration and shear stress represent important parameters that will be optimized prior to further scaling-up this bioprocess.

Mike Trenk, Adam Koziol, Connor Danelson, Hunter Lapp: Computer Science
Mentor: Clemente Izurieta -- Computer Science
Development of Dashboard Management and Monitoring System Technologies in the Software Factory

The purpose for this project is to develop a real-time dashboard monitoring system, through the Software Factory, for the various sources of information that Zoot Enterprises manages. The Software Factory laboratory exposes students to real-world professional projects, problems, and deadlines. Students work closely with developers, clients, and other relevant parties to develop and implement professional-grade software that meets the requirements of stakeholders. This project is a logical choice for the Software Factory because it is minimally intrusive to Zoot, yet provides significant help in visualizing trends for the large amount of data that they process. Using an agile approach to development, the Kanban system is employed to efficiently manage software generation through the use of visual task queues and workflow control, allowing for continuous progression while managing the work in progress. Development is done in iterative sprint cycles, another agile technique taken from the Scrum development framework. Each sprint cycle consists of planning, designing and then developing a subset of features for the end product. This allows for adaptability to changing requirements, which are difficult to account for in traditional prescriptive development methods. The resulting dashboard technology will enable Zoot to move from a reactive monitoring and customer service methodology to a predictive one. A potential use for the dashboard will be to visually analyze trends in how different services are functioning and allow the user to better identify potential areas of concern. The project will also help in continuing to establish the MSU Software Factory as an educational learning laboratory for students at MSU.

Eric Troyer: Chemical & Biological Engineering
Mentor: Ellen Lauchnor, Adrienne Phillips, Robin Gerlach -- Civil Engineering, Chemical & Biological Engineering
Method to Measure Biomass Entrapped During Microbial Induced Calcium Carbonate Precipitation

Microbial induced calcium carbonate precipitation (MICP) refers to the phenomenon of microorganisms inducing $CaCO_3$ precipitation by hydrolyzing urea in the presence of calcium. MICP has multiple engineering applications, including, but not limited to, remediating environmental concerns, improving construction materials, and cementing porous media. In order to effectively use these microorganisms in engineering applications it is important to understand the dynamics of the microbial density during the MICP process. This study focused on developing a method to measure the biomass concentration of MICP bacteria, so that quantitative relations between the amount of $CaCO_3$ precipitated and the amount of biomass present could then be made. Standard methods of biomass measurement are ineffective with MICP samples as most of the biomass is entrapped in $CaCO_3$. Therefore, multiple methods of biomass liberation and subsequent biomass measurements were investigated. It was determined that biomass could be released without harm by dissolving the mineralized sample

in 5% nitric acid prior to measurement of the biomass protein. The Bradford Protein Assay was used to measure the biomass, but the calcium interfered with the assay, therefore a method was developed to dilute the calcium while retaining biomass. The biomass could subsequently be lysed in 3M NaOH and then measured using the assay.

Mason Weber, Coltran Hophan-Nichols: Computer Science
Mentor: Clem Izurieta -- Computer Science
Mobile Application for Equation Recognition and Manipulation

The purpose of this project is to build a mobile application to recognize printed mathematical statements enabling digital evaluation and manipulation. Manually entering equations and matrices into calculators and websites is time consuming and subject to errors. This application aims to bridge that gap and allow the user to take a picture of an equation to be recognized and put in a notation that allows computational manipulation and interfacing with third-party resources such as Wolfram-Alpha. This allows the application to recognize and "hand off" even many of the equations it cannot solve. The application has been designed to run natively on iOS 8.

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

The global carbon cycle is significantly dependent on microorganisms that process and cycle carbon. Heterotrophic bacteria obtain carbon for growth from organic compounds, and as a result of utilization, these organisms can make carbon available to other living organisms. This project aims to investigate the chemotactic activity of motile heterotrophic bacteria from the Arctic and Antarctic, towards a suite of environmentally isolated carbon sources. A *Pseudomonas* sp. isolated from Antarctica has successfully been labeled with a green fluorescent protein (GFP) through electroporation, to better visualize bacterial movement. Knowledge gained by this study can be applied to strengthen our understanding of the metabolism of different organic matter source materials, and aid in the prediction of carbon fate for a changing environment. We have modified a chemotaxis method from Adler et. al. (1973), using a microfluidics based approach following Ahmed et. al. (2008). The chemoattractant and bacterial suspension are pumped into inlets of a PDMS microfluidic chemotaxis device at equal flow rates for five minutes. The flow is then stopped and the device is allowed to incubate for 30 minutes. During incubation, videos of the branched channels are taken to enumerate the bacteria that travel towards the chemoattractant, using a particle tracking software. The rate of chemotaxis to different carbon sources will be compared to that when chemotaxis media (control) is flowed in place of the chemoattractant to compare the strength of the attraction. The selected carbon sources represent the different types of carbon sources that the isolates would typically be exposed to in their natural environment.

COLLEGE OF LETTERS & SCIENCE

John Allemeier: Physics
Mentor: Hugo Schmidt -- Physics
Impedance Spectroscopy for Fuel Cell Material Analysis

Fuel cells hold great promise as sources of green, reliable, renewable energy. As numerous as the applications of fuel cells are, so is the variety of fuel cell design. However, with each new design, careful study and experimentation are needed to characterize it and analyze its imperfections. Most fuel cells are made of some variety of ceramic material. Ceramics (in our application) are powdered bits of a crystalline substance that are mixed with binding agents and sintered in an oven for several hours. This causes the crystals to begin to "melt" together, although the crystal grains (i.e. grain boundaries) can never be completely eradicated. These grain boundaries are the subject of much study in Hugo Schmidt's lab. Grain boundaries contribute greatly to the overall impedance of the constituent parts of a fuel cell. A typical fuel cell consists of three parts: an anode, a cathode, and an electrolyte. The anode and cathode are like the positive and negative terminals on a battery; they need to be electrically conductive in order for the cell to operate. However, the electrolyte that sits between the anode and cathode cannot be conductive, otherwise the anode and cathode will short together and no electricity will be produced. Therefore, in order to ensure the best possible operation of a fuel cell, its grain boundary impedance must be characterized. The method of analysis used in the Schmidt Lab is called Impedance Spectroscopy, or IS for short. Another variation, Electrochemical Impedance Spectroscopy (EIS), is also employed in the lab. The IS/EIS apparatus consists of a ceramic chamber surrounded by a heating coil. A sample (anode, cathode, or electrolyte) is placed in the chamber where it undergoes analysis. Since fuel cells typically have very high operating temperatures (in the neighborhood of 500 to 1000 degrees Celsius) it is important to know how the impedance of the ceramic materials used in the cell change over a broad temperature range. The analysis process is computer controlled, and relies on a program written in LabView. The program sweeps through a specified temperature range and probes both the real and complex impedance of the sample at each discreet temperature point. The data plot this yields is very informative to the function of the cell, in addition to aiding the improvement of cell design and manufacture. Future improvements include adding functionality to IS/EIS to measure sample impedance while in a magnetic field, as well as finer computer control options. The data yielded from this research will benefit fuel cell design and the scientific community as a whole.

Mary Frances Ambrose: Ecology
Mentor: Laura Burkle -- Ecology
Post-wildfire Vegetation Diversity in the Rocky Mountain Ecoregion

Wildfires are important disturbances that can influence ecological communities at multiple spatial scales. Though research has been increasingly dedicated to studying how different levels of fire severity affect communities across complex landscapes, the net primary productivity of a community may contribute to how the region responds to the disturbance. The objective of this project is to examine how wildfire severity affects the local spatial distribution (clumping) of certain vegetation groups (woody plants, forbs, and grasses), across a large-scale productivity gradient in the Northern Rockies Ecoregion. To better understand the relationship between wildfire severity, productivity and regrowth post-fire at fine spatial scales, I will analyze vegetation data collected by the Montana State University Burkle Lab over the 2013 field season from mixed- and high- severity fires (Monitoring Trends in Burn Severity, www.MTBS.gov, 2001-2007). Understanding why local community responses to wildfire are highly variable would improve conservation and management work, especially in naturally heterogeneous landscapes. I wish to investigate the following hypotheses: (1) clumping of species distributions is higher in landscapes disturbed by mixed severity fire compared to landscapes disturbed by high severity fire; (2) in regions with high net primary productivity, species clumping is higher than in areas with low net primary productivity; and (3) the spatial scale at which the clumping of plant functional types is most important varies with fire severity and productivity.

Sara Amish: Ecology
Mentor: Jia Hu -- Ecology
Germination Success Rates: Testing the success of an ecosystem to recover post disturbance

Decreasing snow pack levels in montane ecosystems leads to drier summers which would increase the annual amount of forest fires. While these ecosystems are designed to deal with a certain amount of fire, an increased fire cycle and drier conditions could have a detrimental effect and change to composition of that system. That is why it is important now to begin to understand the possible ways that different aspects of an ecosystem may respond to differing conditions. This study looked at one of the most crucial aspects of recovery after a forest fire: germination rates with different stratification times, sun exposure and water stress. The experiment included 4 different conifers (Douglas Fir, Ponderosa Pine, Subalpine Fir and White Bark Pine), all of which can be found in Montana forests at high and low elevations. Overall the conifers that were subjected to shade and normal water levels did the best in both percent germination as well as seedling productivity. There does not appear to be a difference in the lower elevation trees between stratification time, however there does appear to be some difference between the higher elevation groups. Douglas fir had the best germination rate with over 50% germinated and white bark pine had the worst germination rate at 20%. Subalpine fir and douglas fir appear to have the highest rate of after germination success.

Evan Atchley: Chemistry & Biochemistry
Mentor: John Peters -- Chemistry & Biochemistry
Investigating the Substrate Specificity of the 2-KPCC Carboxylation Reaction

The enzyme NADPH:2-ketopropyl-coenzyme M oxidoreductase/carboxylase, or 2-KPCC, is an atypical member of the disulfide oxidoreductase class of enzymes that catalyzes the reductive cleavage and carboxylation of 2-ketopropyl-coenzyme M (2-KPC) in the metabolism of propylene by *Xanthobacter autotrophicus*. This reaction leads to the formation of acetoacetate and coenzyme M. A side reaction can occur when carbon dioxide is the limiting reagent. This causes protonation to take place, leading to the formation of acetone and coenzyme M. Observation of the crystal structure of 2-KPCC has lead to the hypothesis that the proline loop directly adjacent to the active site plays a role in the substrate specificity. My project will explore the role of the proline loop of 2-KPCC in its substrate specificity, and could lead to the ability to eliminate potentially deleterious hydrocarbons such as propylene from the environment.

Acknowledgements: George Gauss (MSU Postdoc/Research Scientist) - Chemistry & Biochemistry, Gregory Prussia (MSU Graduate Student) - Chemistry & Biochemistry

Ryan Bachofer: Chemistry & Biochemistry
Mentor: Martin Teintze -- Chemistry & Biochemistry
Mechanisms of Action and Resistance: An Investigation of the Interactions between a Novel Antibacterial (THAM-3φG) and MRSA

Methicillin-resistant *Staphylococcus aureus* (MRSA) is a multidrug resistant bacterium which is of growing concern clinically. Synthesis or discovery of novel antimicrobial compounds, and greater understanding of resistance mechanisms is needed in order to combat MRSA. We have synthesized a novel antibacterial, trishexylaminomelamine-trisphenylguanide (THAM-3ϕG), which has been shown to have a high specificity for *S. aureus* (including MRSA). This study investigated both the mechanism of action (MOA) of THAM-3ϕG and mechanisms of resistance of MRSA. A MRSA strain resistant to THAM-3ϕG (T-MRSA) was developed through sub culturing cells in increasing concentrations of THAM-3ϕG until a four-fold increase in the minimum inhibitory concentration (MIC) was observed. Since efflux pumps are a common mechanism of resistance, we initially investigated the efflux pump activity of wild-type MRSA and T-MRSA against THAM-3ϕG by introducing efflux pump inhibitors. By evaluating the reduction in the MIC, the activity of efflux pumps on THAM-3ϕG could be determined, in addition to any potential up-regulation of efflux pumps by T-MRSA as a means of resistance. We also investigated the activity of THAM-3ϕG as a membrane disruptor, as previous studies had shown THAM-3ϕG to cause cellular leakage. To further characterize THAM-3ϕG membrane activity, lipids were extracted from MRSA and used to encapsulate a fluorescent dye (calcein) in unilamellar vesicles. Vesicles were incubated with THAM-

3ϕG and leakage of calcein was monitored using a fluorimeter to assess if membrane disruption is a potential MOA of THAM-3ϕG.

Acknowledgements: Alan Weaver (MSU Graduate Student) - Chemistry & Biochemistry

Maurisa Bell: History & Philosophy
Mentor: David Swingle -- Museum of the Rockies
Cowboys and Indians: A Perpetual Conflict

During the Reservation era in America, the Federal government set aside certain land that Native Americans could inhabit and live apart from European settlers. On these lands tribes would be able to live as they had before European contact and were given inherent rights. Through various acts, case law, statutory law, events, etc., in American history, these reservation boundaries have been diminished, altered or disregarded. On the Wind River Indian Reservation in Wyoming, the reservation boundaries are currently in dispute. The significance of boundary lines are for jurisdiction, taxation, etc. purposes. By examining past transactions, acts and statutes we can determine the Wind River Indian Reservation boundary lines.

Dani Bergey: Cell Biology & Neuroscience
Mentor: Frances Lefcort -- Cell Biology & Neuroscience
p53-mediated regulation of neuronal number in Ikbkap-deficient mice

Familial Dysautonomia (FD) is one of five hereditary sensory and autonomic neuropathies (HSANs) that devastate the peripheral nervous system. It is caused by a point mutation in the gene Ikbkap and results in sensory and autonomic dysfunction, including reduced pain and temperature sensation, tachycardia, poor regulation of blood pressure, and early death. The Lefcort lab has generated a mouse line to model FD in which Ikbkap is deleted in the neural crest, a pluripotent population of cells that migrate and differentiate during development to give rise to the peripheral nervous system. A significant observation in the Ikbkap CKO mouse model is a drastic reduction of neuronal number in sympathetic ganglia (SG), specifically the superior cervical ganglia (SCG), and the dorsal root ganglia (DRG). Deletion of Ikbkap causes these cells to undergo Caspace-3-mediated apoptosis in both regions. To test if we can rescue neurons in the DRG and SCG, we crossed the Ikbkap CKO mice with p53 KO mice. Inhibition of p53 was able to rescue neurons in the DRG, but we do not know the effect in the SCG. My aim is to determine whether inhibiting p53 genetically can rescue the neuronal number in the SCG.

Acknowledgements: Martha Chaverra (MSU Postdoc/Research Scientist) - Cell Biology & Neuroscience, Lynn George (Research Professor) - Cell Biology & Neuroscience

Timothy Bernard: Psychology
Mentor: Matthew Vess -- Psychology
Companion Animal Effects On Mortality Concerns

Terror Management Theory (TMT) states that much human behavior is driven by a need to manage psychological concerns about death. One aspect of the theory specifically focuses on relationships and the important ways that relationships function to protect people from anxieties about mortality. Close relationships are an important aspect of human life and provide people with companionship, as well as fundamental protection against potential detriments to physical and psychological health. Close relationships are not restricted to relationships between humans, however. Indeed, many people forge close relationships with companion animals. TMT has yet to consider whether relationships with companion animals might function in ways similar to close relationships with other humans. To address this gap, the proposed project will use established procedures in the TMT literature to examine whether people turn to companion animals when coping with heightened concerns about death. In the study, participants will be randomly assigned to either consider their own mortality or the experience of physical pain. All participants will then complete a questionnaire developed to measure people's level of attachment to their companion animals. It is hypothesized that participants in the mortality salience condition will display greater levels of attachment to their pet than participants in the physical pain condition. The results of the study will advance TMT and our understanding of the importance of companion animals by providing new information about

where they fit into the lives of humans. For example, how humans use their companion animals to protect themselves against potentially detrimental psychological processes.

Peter Billman: Ecology
Mentor: Matt Lavin -- Plant Sciences & Plant Pathology
Microsatellite Analysis of the Biogeographical and Phylogenetic Relationships Within Aquilegia flavescens (Yellow Columbine)

Aquilegia flavenscens, commonly known as the Yellow Columbine, is located within the family Ranunculacaea. The genus Aquilegia radiated relatively recently in its phylogenetic history, approximately 1-3 million years ago to the 70+ species of Aquilegia we see today across the northern hemisphere. This recent radiation has gained much interest in the divergence of species within this genus. Due to its unique morphology, *Aquilegia* is susceptible to the bottleneck effect of evolution due to pollinator shifts, fire intervals, and other ecological disturbances. Leaf tissues of specimens across Montana, northwestern Wyoming, and Alberta were collected and dried to preserve DNA for analysis in the lab. With this preserved DNA, we conducted PCR applications and isolated DNA yields to study multiple micro satellites (non-protein coding regions of DNA) located on the genes. Internal Transcribed Spacers were selected as specific units to focus in on. These regions are more susceptible to mutations (common throughout single populations) as non-coding regions do not receive the same selective pressures and allow the plant to reproduce normally. By studying these microsatellite regions of the DNA, we studied the patterns of gene flow between populations, migration directions, origin of the species, and many other details vital to the plants viability in the future. It appears some populations are interbreeding which may in turn be causing homozygosity among populations. Samples were collected from both sides of the Continental Divide which often have change in pollinator species, allowing genetic uniqueness to some populations. We took this and climate into account as secondary study areas of research.

Nathan Blaseg: Microbiology
Mentor: Joshua Obar -- Microbiology & Immunology
Examination of the Leukotriene and Inflammasome Pathways During Invasive Pulmonary Aspergillosis

This project is investigating the leukotriene and inflammasome pathways activated during Invasive Pulmonary Aspergillosis (IPA), which is caused by *Aspergillus fumigatus*, a fungus that is regularly breathed in by all individuals and easily dispatched by the immune system. However, immunodeficient patients often have trouble combatting an IPA challenge. This project will use various gene-deficient mice and pathway-blocking drugs to determine which pathways are most crucial to macrophage anti-fungal activity. This anti-fungal activity will be measured using multiple XTT assays, which measure fungal cell metabolic activity as an indirect measure of fungal viability. The XTT has been used by our collaborators at Dartmouth College, but we have not been able to consistently run the assay with successful results. So, the first phase of my project was to troubleshoot the problematic assay and determine how best to complete it successfully so we could establish the technique for our lab. The project then has two subsequent phases, one with Wild-Type mice, and one with ASC mice, which lack the inflammasome. Both types of mice will be applied with different leukotriene-blocking drugs, which will allow us to determine which leukotriene pathways are most important for the macrophage response to IPA. This will also help us determine and quantify any cross-talk between the inflammasome and leukotriene pathways, since previous publications have shown the possibility of such an intersection. The information learned from this project is important in clinical settings, where the most crucial pathways in an immunodeficient patient could be restored to help combat an IPA challenge.

Acknowledgements: Alayna Caffrey (MSU Graduate Student) - Microbiology & Immunology

Aaron Blaser: Ecology
Mentor: Thomas McMahon, Jerry DiMarco -- Ecology, Physics
Examination of the Fukushima Radiation Presence in the Pacific Marine Ecosystem

The Fukushima Daiichi Nuclear Disaster was a nuclear energy plant accident that occurred on March 11th, 2011. Its potential danger to the environment and the human population has been a controversial issue since the accident.

The primary radioisotopes released in a nuclear power plant fallout are Iodine-131, Cesium-137, Cesium-134, and Strontium-90, which are harmful to multiple organ systems and skeleton. This project examines if radionuclides from the Fukushima Nuclear Accident are traveling trans-ocean across the Pacific. In order to accomplish this, fish from Seattle fish markets, and a sport-fished Alaskan fish species were analyzed for possible irradiation. Lingcod, a higher food chain fish, was tested using a geiger counter. The results from the testing were then contrasted with normal levels to help determine if radiation is at elevated levels entering these populations. The results of the project yielded data concerning the maximum, minimum, and average radiation levels as well as the consistency of the reading. Outliers appeared infrequently in the data but this could be explained by background radiation present during testing or possibly the Triboelectric effect on the geiger counter's electronics, which would cause an increased reading. However overall, based off the findings of the project, there was an insignificant amount of radiation present in the ecosystem and poses no danger to the public.

Marshall Boyland: Physics
Mentor: Hugo Schmidt, Yves Idzerda -- Physics
Impedance Spectroscopy of Thin Films

Impedance Spectroscopy was performed on Cobalt Manganese and Iron Manganese thin films while in the presence of a magnetic field. Thin films tend to behave differently than materials that are not considered thin films. Most of the physics that occurs within a thin film are surface effects; this is why the project is testing the impedance of a thin film rather than a large piece of material. Thin films have useful applications in computing power which is a quickly growing industry as well as solar cells. The impedance of the Cobalt and Iron films was affected by the present magnetic field due to their magnetic properties (experiment not done yet, this is what is speculated). Analysis of the results of the impedance spectroscopy is included. The design and manufacturing process for the required Helmholtz coil are also included. The largest part of the project was creating a Helmholtz coil that could generate the necessary magnetic field while still fitting around the impedance spectroscopy apparatus.

Luke Brandenberger: Microbiology
Mentor: Ed Schmidt -- Microbiology & Immunology
Gene Expression Analysis on Mice Lacking All Classical Reductase Pathways

Our laboratory recently developed a novel line of mice in which livers lacked both of the major cytosolic NADPH-dependent disulfide reductases: glutathione reductase (GR) and thioredoxin reductase-1 (TR1). The livers of these mice, being "TR/GR-null", cannot recycle oxidized glutathione or oxidized thioredoxin, the two major carriers of reducing power in all cells, and are forced to continually synthesize new glutathione in order to control intracellular oxidative stress and remain viable. From these mice, it was discovered that the cytosolic reducing power was generated via an NADPH-independent pathway based entirely on the conversion of dietary methionine into cysteine, which is able to traffic this reducing power into the glutathione pathway. Gene expression analyses of these mice indicated that the cytoprotective Keap1/Nrf2 pathway was upregulated in the TR-null and TR/GR-null livers, but not in GR-null livers. These data suggest that the Keap1/Nrf2 pathway may not respond directly to oxidative stress, as suggested by current models, but instead responds directly to the function of the thioredoxin system.

Joseph Bretz: Physics
Mentor: Nico Yunes, Kent Yagi -- Physics
Four-Hair Relations for Differentially Rotating Neutron Stars

The gravitational potential around rigidly rotating neutron stars has been found to be completely described by their mass, spin angular momentum, and quadrupole moment. This is because the multipole moments of their exterior gravitational field satisfy approximately universal (equation of state independent), three-hair relations. Since proto-neutron stars are known to not rigidly rotate, I analytically extend the universal relations to stars with differential rotation by perturbing about uniform rotation. Including differential rotation requires the multipole moments to be a function of not only the mass monopole and quadrupole and the current dipole moments, but

also the current octupole moment. I also take the slow rotation limit to analyze the variation of the four-hair relations as one considers different equations of state. The results provide a better description of the exterior gravitational potential around differentially rotating stars without having to fully determine their internal structure, a fact that could be used to test general relativity in the strong-field regime.

Lauren Broes: Earth Sciences
Mentor: Dave Mogk -- Earth Sciences
Geochemical and Petrographic Study of the Late Precambrian Lahood Formation, Bridger Mountains, Montana

In the northwestern Bridger Mountains Cambrian age rocks rest disconformably upon the Lahood Formation, the basal member of Southwestern Montana's metasedimentary Belt-Purcell Supergroup. The Lahood comprises an approximately eighty mile long strip up to eight miles wide in the southwestern extent of the Belt-Purcell Basin, extending from the western face of the Bridger Range to the Highland Mountains. The Lahood Formation stands alone in the extensively studied Belt-Purcell Supergroup as a relative unknown. The Lahood represents a significant chronostratigraphic interval; its deposits interfinger with multiple Belt series formations, correlating in age with deposits ranging from the oldest Belt rocks to the youngest. Confounding this correlation, Lahood sediments are distinguished from Belt equivalents by a unique and unknown provenance as well as a disputed depositional environment. A marked lack of modern study can be accredited to the Lahood Formation's lack of definition. Integrated geochemical and petrographic analysis of Lahood sediments taken from Felix Canyon in the Bridger Range will be completed in an attempt to clarify the formation's relationship to neighboring Belt series rocks and provide insight into its depositional environment. Utilizing X-ray Diffraction, Scanning Electron Microscopy and Cathodoluminescence in conjunction with field observations and petrographic analysis of thin sections, a detailed chemostratigraphic, geochemical and mineralogical data portrait of this elusive formation will be created. Analysis of this data will provide a modern interpretation of the depositional environment of the formation at this locality as well as contribute to a greater understanding of the Lahood Formation as a whole.

Cody Brown: Physics
Mentor: Neil Cornish -- Physics
Differences Between Averaged and Exact Equations for Spin Procession of Binary Systems

When studying spin procession for binary system in General Relativity, the orbital averaged equations are often used in doing calculations because they are simpler to use when doing numerical integration. The down side to using orbited averaged equations is that some of the more subtle changes in the spin of the two objects and the total angular momentum can be missed. By using numerical integrators we were able to look at the differences between the orbited averaged equation and the exact differential equations. We used MATLAB's built in Runge-Kutta ode45 to integrate the averaged and exact equations. After seeing minor differences between the averaged and exact differential equations we used multiple-scale analysis to analyze the differences between the averaged and exact equations.

Katherine Budeski: Chemistry & Biochemistry
Mentor: Brian Bothner -- Chemistry & Biochemistry
Complex Metabolite Analysis in Milk Using Bovine Serum Albumin as a Molecular Sensor

Analyzing complex biological fluids has never been a straightforward or speedy process. Using a novel approach, we have tested the feasibility of using the protein serum albumin (SA) as a molecular sensor to differentiate complex biological solutions. SA is a naturally occurring protein that is present at high concentrations in the blood of mammals. It plays a major role in helping transport compounds including hormones, fatty acids, and drugs through the blood stream. We see potential for streamlining the process of analyzing complex samples by taking advantage of SA's ability to bind a wide array of small molecules and metabolites. The Bothner Lab has successfully shown that the assay can be used to differentiate states of cellular and clinical stress and varietals of wine. I hypothesize that the "cargo" loading on serum albumin can be used to differentiate similar complex biological fluids in a meaningful way. To test this hypothesis, I am investigating the molecular changes that occur during the process of milk spoilage with the goal of identifying molecular markers specific to milk spoilage.

Throughout this project I am tracking the aging of skim, two percent, and whole milk using the protein sensor assay by analyzing the fraction of small molecules selectively bound by BSA using standard ultraviolet-visual spectrophotometry (UV-vis) and mass spectrometry. Adaptation of the protein sensor assay to a standard laboratory analytical platform such as UV-vis would expand the usefulness of the method and could lead to more accurate tracking of milk shelf-life.

Acknowledgements: Tim Hamerly (MSU Graduate Student) - Chemistry & Biochemistry

Joshua Carter: Microbiology
Mentor: Blake Wiedenheft -- Microbiology & Immunology
Modeling the Dynamics of Target Binding in a Type I-E System

CRISPR loci and their associated proteins are diverse components of adaptive immune systems that protect prokaryotes from invasive genetic elements such as viruses. The type I-E 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 recognition of a protospacer adjacent motif (PAM) and subsequent base pairing with the crRNA-guide. Structural studies have shown that target binding triggers a conformational rearrangement of Cascade, and the recruitment of a nuclease-helicase called Cas3 that is responsible for the degradation of DNA targets. To model the rearrangements induced by target binding, we have integrated structural models using molecular dynamics flexible-fitting simulations to simulate target binding through the generation of force-potential maps checked by harmonic restraints. These simulations reveal several conserved loops on Cse1 and Cas7.6 that appear to participate in target DNA recognition. We are currently validating the importance of these regions experimentally.

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Ian Cavigli: Cell Biology & Neuroscience
Mentor: Michelle Flenniken -- Plant Sciences & Plant Pathology
Longitudinal Monitoring of Honey Bee Health and Pathogen Prevalence in Migratory Commercial Beekeeping Operations

Honey bee colonies play an important role in food production by providing pollination services for numerous agricultural crops valued over $15 billion annually in the U.S.A. Since 2006, commercial beekeepers have experienced unsustainable overwinter losses (32% average annual loss). A variety of factors, both biotic and abiotic, likely contribute to this increased rate of loss. To determine the effect of pathogens on colony health and overwinter losses, we monitored honey bee colony health, using colony size as a proxy for colony health, and pathogen incidence. We obtained honey bees from 60 colonies before, during, and after the 2013-14 almond pollination season, and used pathogen-specific PCR to screen for 15 pathogens including the Lake Sinai viruses (LSVs), a recently discovered group of honey bee infecting viruses. LSVs were very prevalent in both weak and strong colonies; over 30% of all positive tests were LSVs. LSV1 and deformed wing virus (DWV) were more prevalent in weak colonies (colonies with <6 frames) than strong colonies (those with >8 frames). Quantitative-PCR will be performed to determine the relative abundance of select pathogens in weak versus strong colonies. Longitudinal studies of pathogen profile and health in commercial honey bee populations are important in determining the contribution of biotic factors to honey bee colony health, which is integral to the agricultural production of numerous crops.

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Katherine Chambers: Modern Languages & Literatures
Mentor: Molly Todd -- History & Philosophy
Refugee Issues for Educators

Resettled refugees in the United States face a number of obstacles upon their arrival, including culture shock, finding employment, paying for food and shelter and creating new cross-cultural relationships. Refugee children introduced into the U.S. school system, moreover, must adapt to a new culture, while learning English and academic content at the same time. With the increasing trend for refugees to resettle in less-popular areas of the United States, many rural-area teachers face obstacles when refugee children are enrolled in their classes. This engaged research aims to ease this process of adaptation by providing refugee-related resources to the educators of these children. Through the creation, distribution, translation and interpretation of surveys sent to both refugee families and their teachers in lesser-known resettlement areas, I gathered information to begin a training program for educators who find themselves with refugee students. After further researching pre-existing refugee materials available online, literature on refugees, and English as a Second Language (ESL) best practices, I have compiled the research into the Refugee Issues for Educators primer document that will later turn into a program to be piloted and distributed by the 2015- 2016 school year.

Bruce Chappell: Physics
Mentor: Recep Avci -- Physics
Corrosion of CuNi alloy in a suboxic and sulfidogenic marine environment

The corrosion of a Copper/Nickel alloy at 70/30 mixture, co-inoculated with a low carbon steel coupon, were studied in the presence of aerobic *Marinobacter* and anaerobic, sulfate reducing *D. indonesiensis* marine organisms. Inoculum consisted of filtered Key West sea water with a layer of JP5 Navy Jet-fuel on the top exposed to air. Presence of aerobic and anaerobic marine bacteria assured that dissolved O_2 in the seawater is utilized continually, causing a suboxic environment. The corrosion process was analyzed *in situ* by electrochemical means and *ex situ* by microscopy and spectroscopy. During the experiment, dissolved O_2 concentration and the viable microbial concentrations were monitored by means of an O_2 sensor and ATP assays. After ~1-month of exposure the coupons were removed and analyzed by electron microscopy and X-ray photoelectron spectroscopy. Results showed that dissolved Ni and Cu ions were deposited on the oxidized Fe surface; conversely oxides and sulfides of Fe corrosion products were deposited on the oxidized Cu/Ni surface. Substantial biofilm formation was observed on both coupons. These results are of interest to the Navy because Cu/Ni is considered to be fairly resistant to corrosion. Additionally, our experiments showed evidence of Ni dissolution. This occurrence is rarely observed in model experiments, but known to take place in real live marine corrosions.

Elizabeth Corey: Sociology and Anthropology
Mentor: Cindi Spinelli – Gallatin City-County Health Department
Risk of Vaccine Preventable Diseases in Gallatin Valley Schools

Measles and pertussis (whooping cough) are highly contagious vaccine preventable diseases. School vaccinations are mandated by state legislation. Montana allows for religious and medical vaccine exemptions in schools. Communities with high exemption rates, which reduce vaccine coverage below herd immunity thresholds, are at a greater risk for outbreaks of vaccine preventable diseases. Herd immunity thresholds are specific to how contagious a disease is and these thresholds determine the percentage of the population that must be vaccinated to limit the transmission of an introduced disease. The theoretical risk of outbreaks in Gallatin County schools was assessed using data including: rates of religious/ medical exemptions, herd immunity thresholds, school policies regarding parental acknowledgement of potential exclusion, and use of seating charts in the classroom. Overall trends display higher rates of unvaccinated students in private schools and small public schools, placing these schools at higher risk of outbreaks of vaccine preventable disease. Directions for future research suggest that greater involvement of legislators, Health Department officials, parents, and school administration is necessary to decrease the risk of vaccine preventable disease outbreaks in Gallatin County. Future policy decisions can be informed by this analysis and aided by quantitative research.

AnneMarie Criddle: Microbiology
Mentor: Matthew Taylor -- Microbiology & Immunology
Using Co-Infection of Fluorescent Herpes to Characterize Viral Exclusion

Herpes viruses are large DNA viruses that mutate through genome recombination when similar strains co-infect the same cell. Viral and cellular factors can interfere with co-infection. We use fluorescent protein (FP) expressing Herpes Simplex virus (HSV) and Pseudorabies virus (PRV) strains to quantify the extent of viral co-infection, and the timing of co-infection exclusion at a cellular level. Epithelial cells are infected with two viruses engineered to express two different FP's. The time of the first viral inoculum is constant, while the second inoculum was applied at different time intervals to determine when exclusion occurs. FP expression was visualized by epifluorescent microscopy and quantified by fluorescent activated cell sorting. Progeny virions generated from the mixed infection were quantified by viral titering. These methods identified a reduction in expression of the second FP and of the secondary inoculum progeny at 2 hours post infection of the initial inoculum. Cycloheximide treatment reduced co-infection exclusion, relative to controls. The timing of and necessity for new protein synthesis suggests the co-exclusion block involves immediate/early viral proteins or cellular responses to viral infection. Future work involves investigating the step in viral infection that is blocked during co-infection exclusion

Acknowledgements: Irina Kochetkova (MSU Postdoc/Research Scientist) - Microbiology & Immunology

Erica Dunn: Psychology
Mentor: Ian Handley -- Psychology
Does the tendency to correct against expectation biases reduce the stereotype threat effect?

The current research tested the possibility that greater beliefs that expectations bias experiences could eliminate the stereotype-threat effect. Results thus far indicate that men performed significantly better on a math test than women. Further, women performed marginally better if they reported their gender after (vs. before) the test, consistent with stereotype threat effect. However, thus far these effects are not moderated by individuals' beliefs in expectation biases, counter to predictions.

Acknowledgements: Emily Carstens-Namie (MSU Graduate Student) - Psychology

Melissa Emery: Chemistry & Biochemistry
Mentor: Charles McLaughlin -- Chemistry & Biochemistry
Chemistry Student Perceptions Toward TEAL: Gender and Achievement

TEAL, Technology-Enhanced Active Learning, uses a pedagogy approach to encourage collaboration amongst students and encourage active participation in the classroom. During 2013 summer session this approach was incorporated into second semester general chemistry at Montana State University to enhance traditional chemistry lecture with an active learning session. One of six weekly lectures was held in a TEAL classroom. In the active learning environment, students sat at round tables to promote the creation of a small learning community. The chemistry students were surveyed on their perceptions toward the TEAL learning environment at the beginning and end of the six week course. Students overwhelmingly agreed the TEAL experience enriched their learning experience and increased their classroom participation. To continue the research, during Spring of 2014, Analytical Chemistry was held exclusively in the TEAL classroom. The pre/post survey was modified to include gender and GPA information. In 2011, Shieh and colleagues collected data from an Introduction to Physics class and concluded the TEAL approach was favored by females over males, which shows potential for TEAL to aid in narrowing the learning gap between genders. Also, GPA will be assessed to investigate varying attitudes between high and low achieving students in Analytical Chemistry.

Laura Fisch: Chemistry & Biochemistry
Mentor: Deborah Keil -- Microbiology & Immunology
Evaluating Epigenetic Alterations Associated with Immunotoxicity following Complex Metal Exposures

Epigenetic mechanisms manage cellular processes. Environmental exposures can interfere with normal mechanisms leading to altered gene expression and potential pathogenesis. Disease due to environmental contaminant exposures linked to epigenetic processes may elucidate mechanisms of toxicity on a molecular level. The objective of this study is to understand a possible mode of action for suppression of antigen specific IgM antibody production observed in mice exposed to geogenic dust from Nellis Dunes Recreation Area (NDRA), Clark County, Nevada. The dust in NDRA contains different heavy metals including arsenic. Mice exposed to this dust, which represented all locations at NDRA, exhibited suppressed IgM production to a T cell dependent antigenic challenge. The dose-responsive immunosuppression is a public health concern for those that recreate at NDRA. Global methylation in splenic DNA was analyzed from exposed mice. A statistically significant increase in global methylation occurred in the high dose mice compared to control. DNA methylation changes were detected; however this was not likely mechanism for IgM immunosuppression since only high dose mice exhibited hypermethylation. Heavy metal exposure is linked to epigenetic histone modification. Cells exposed to arsenic have shown different methylation patterns of histones. If histone modification is a possible mechanism for IgM immunosuppression, it will be reflected in a H3 global methylation ELISA. Absorbance readings given by the spectrophotometer will be analyzed for statistically different quantities of histone methylation based on a standard curve. If changes are observed, specific histone modifications to tails (acetylation, methylation, and phosphorylation) will be analyzed with additional ELISAs.

Acknowledgements: Lacy Taylor (MSU Graduate Student) - Microbiology & Immunology, Mason Jablonski (MSU Undergrad Student) - Microbiology

Karissa Floerchinger: Cell Biology & Neuroscience
Mentor: Jamie Sherman -- Plant Sciences & Plant Pathology
Confirming QTLs for seed size and yield

High yielding wheat crops provide farmers with more income. In an effort to better understand genetic control of yield, quantitative trait loci (QTL) for yield and yield components were identified in a mapping population of two wheat lines, McNeal and Thatcher. One QTL increased yield per se and the other increased seed number at the expense of seed size. To test the impact of the QTLs in a different genetic background, the QTLs were backcrossed into a different variety, Choteau. Near isogenic lines (NILs) from the Thatcher by Choteau crosses were created using molecular markers. NILs are sister lines that are nearly genetically identical providing the ability to test the impact of a single QTL. The NILs were tested in a replicated field trial with randomized complete block design. Impact of QTLs on yield, seed size and number of seeds per head will be reported.

Holley Flora: Earth Sciences
Mentor: James Hicks -- Education
Developing an Identification Guide for Microfossils in the Hell Creek Formation

I developed an identification guide for museums to use in the field and lab when working with microsite material in the Hell Creek Formation. After identifying weaknesses in existing guides, a volunteer survey was developed to gauge the helpfulness of pictures and descriptions in the sorting and identifying of fossils. By identifying what worked best for introductory level volunteers, a guide was developed to allow for more efficient and effective training. The resulting guide is more accessible and simplified for volunteers who vary in experience levels and is ideal for field use where a larger amount of information is not always available. As a result, this project will serve as another resource for museums to use as an aid when training citizen scientists in the field and lab settings.

Korey Flynn: Modern Languages & Literatures
Mentor: Ada Giusti -- Modern Languages & Literatures
The Representation of Indigenous Moroccans in Regional Moroccan Museums

I will be taking a look at the representation of indigenous Moroccans in regional museums. The Amazigh (indigenous Moroccans) have been a marginalized population throughout history. I am curious to see how they have been represented in local museums both dedicated to their cultural history as well as museums that include the Amazigh culture among other Moroccan cultural aspects. I have been researching the Amazigh culture and will be traveling to visit museums in Marrakech, Morocco as well as visiting an Amazigh village, Zawiya-Ahansal, in the Atlas mountains. While in Marrakech I will be interviewing museum curators on the representation of Amazigh culture as well as other aspects of the museum. I believe that my research could be valuable for museum professionals to avoid bias and create informative, non-preferential exhibits and displays to properly present all cultures. As well as inform other academics about indigenous populations representation in institutions such as museums.

Jacob Gardner, Helen Dailey: Earth Sciences, Organismal Biology
Mentor: Dale Greenwalt, Colin Shaw – Smithsonian Institution Research Collaborator, Earth Sciences
Smithsonian Paleobiology Internships: Fossil Insects and Fish from the Kishenehn Formation, Montana

The Montana State Undergraduate Scholars Program (USP) and the Smithsonian National Museum of Natural History (NMNH) collaborated on a program that selects two students to conduct field work in the oil shale exposures of the Eocene Kishenehn Formation near Glacier National Park, northwestern Montana. The objective was for students to help Smithsonian Research Collaborator, Dr. Dale Greenwalt, collect insect fossils as well as learn about the geology and ecology of the region. These insect fossils are some of the best preserved in the world; often preserving fine details (perfect for classification), color patterns, and even remnants of hemoglobin-derived porphyrins. Throughout the two week summer trip, the students collected insect and fish fossils at various sites and went on tours with experts on the geology and entomology of the region. In the spring of the following year, the students went to the NMNH in Washington DC to study the fossils that they had collected. Helen Dailey focused on the classification of pupae from the insect order of Diptera (flies). Out of a sample of 200 insect pupae fossils, six different morphotypes were identified; with more likely to be distinguished in the future. These morphotypes were sorted based on high-resolution photographs of the specimens and the identifying traits and structures visible therein. The primary structures looked for in the pupae were the presence and appearance of respiratory “horns” or “trumpets” visible on the cephalothorax of some specimens. Jacob Gardner focused on the CT scanning and 3D imaging of a fossil fish that was discovered the previous summer. The specimen is currently the largest (60cm) and most complete fish fossil from the Kishenehn Formation. Typical fish fossils found in the formation are less than 8cm on average. This specimen offers insight into the depositional environment of the site at which it was discovered as well as the biodiversity of fish from this formation.

Jaime Gilden: Psychology
Mentor: Colleen Moore -- Psychology
Trust and Uncertainty in Risk Perceptions of Asbestos Contamination in Libby, Montana

This study examined the roles of trust and uncertainty in risk perceptions of asbestos exposure in Libby, Montana. The deadliest Superfund site in the nation, Libby is host to widespread asbestos contamination from a nearby vermiculite mine that operated for most of the twentieth century. Uncertainties of exposure and health effects are inherent in Superfund cleanups, but have rarely been studied in communities like Libby. Additionally, trust versus distrust of public institutions, in this case, the Environmental Protection Agency (EPA), also plays a role in risk perception. The present study looked at the combination of trust (versus distrust) of the EPA and uncertainty surrounding health risks caused by asbestos exposure in the Libby area, and their relationships to community risk perceptions. We conducted two parallel studies: 1) a mail and online survey of Libby residents, and 2) an experiment with 92 MSU college students manipulating trust in the EPA and uncertainty of asbestos exposure. The trust manipulation significantly influenced participants' trust in the EPA. Also, those in the trust condition had lower risk perceptions than those in the distrust condition. Additionally, trust was negatively related to negative

emotion, which in turn was positively related to risk perceptions. Data analyses of the community survey are underway using multiple regression. Information from the combination of an experiment with the community survey will aid in understanding the community's feelings and risk perceptions relating to the asbestos contamination.

Conor Hagan: Physics
Mentor: Sachiko Tsuruta -- Physics
Thermal Evolution of Low Mass X-ray Binaries

A neutron star accreting matter can, under certain circumstances, undergo X-ray bursts in which heavy metal ash is deposited on the star's surface. The effects of this ash on the star's equation of state as it sinks through the star are explored. As the nuclear ash sinks through the crust, which has low thermal conductivity, the nuclear ash undergoes pycnonuclear fusion. Models for the paths of fusion are examined and the overall effect of these fusion paths of the sinking ash on the star's temperature is given. Heating due to hydrogen fusion occurring just above the crust is looked at as well. An introduction to what neutron stars are and how they are formed is also included, along with a general discussion of neutron star cooling. A variety of possible equations of state are analyzed, with special attention paid to exotic core equation of state models which suggest hyperon and pion cores.

Danielle Hanger: Psychology
Mentor: Hutchison Keith -- Psychology
Working Memory Capacity and Deception

This project investigates the relationship between working memory capacity (WMC), cognitive load, and ability to tell and detect lies. Investigating this relationship will help to provide a more specific basis on which to evaluate the cognitive processes used when telling a lie or attempting to detect a lie. Individual differences in WMC, a construct that includes short-term memory and attention control, underlie individual differences in many cognitive tasks. As lying has previously been found to be a cognitively demanding task, we hypothesize that differences in deception ability and ability to detect deception will arise based on differences in WMC and that this difference will be moderated by cognitive load. In order to investigate whether a relationship between WMC and deception exists, subjects are asked to attempt lying under high and low cognitive load as well as to attempt detecting lies in an interview setting. Subjects are also asked to perform two cognitive tasks that are used to determine a WMC score. Results of this project will be used to draw conclusions about the possible roles WMC and cognitive load play in actively attempting to deceive another person or attempting to detect deception in another person.

Acknowledgements: Ted Maldonado (MSU Graduate Student) - Psychology

Devin Hansen: Physics
Mentor: Nicolas Yunes -- Physics
Slowly-Rotating Black Hole Solutions in Dynamical Chern-Simons Gravity with an ADS Background

We investigate slowly-rotating black holes with asymptotically anti-de Sitter boundary conditions within dynamical Chern-Simons gravity. This theory modifies General Relativity in a way that naturally introduces parity-violation by introducing a dynamical scalar field that couples to the Pontryagin density in the Einstein-Hilbert Lagrangian. Such a theory allows the stationary Schwarzschild/anti-de Sitter metric as a spherically symmetric vacuum solution, but the Kerr/anti-de Sitter metric does not satisfy the modified field equations as an axially symmetric solution. This is because the Pontryagin density does not vanish for the latter, thus sourcing a non-trivial scalar field that in turn modifies the field equations. Through a small-coupling and slow-rotation approximation, we calculate an approximate metric for vacuum, axisymmetric solutions in this theory. Unlike the case with asymptotically flat boundary conditions, in the anti-de Sitter case the equations must be solved semi-numerically. This spacetime could be used in a duality context to extract parity violating hydrodynamic coefficients in a conformal field theory that lives on the spacetime boundary.

Acknowledgements: Bogdan Stoica (Caltech)

Andrew Helming, Amanda Leckband: Chemistry & Biochemistry, Animal Science
Mentor: Edward Dratz -- Chemistry & Biochemistry
Study and Isolation of Nontoxic, Plasmid-Curing Agents

Antibiotic resistance is a major public health problem that is becoming increasingly serious in recent years. For example, it is responsible for the proliferation of Methicillin resistant bacteria (MRSA) and Vancomycin resistant bacteria (VRSA and VRE) in hospitals. Bacteria carry the information for antibiotic resistance in small, circular pieces of genetic material called r-plasmids. Through horizontal gene transfer, these bacteria are able to spread the plasmid, or plasmids, for antibiotic resistance through a bacterial population. The prolific nature of this horizontal gene transfer has allowed bacteria to mitigate the effects of antibiotics, as well as outpace the development of new antibiotics. Thus, an urgent need for a new solution has arisen. We believe an answer to this problem may lie within an ancient strain of Ethiopian barley. Through an unknown mechanism, this barley has been shown to "cure" (eliminate) plasmids. However, unlike most of the compounds that have plasmid curing activity, this barley shows no cytotoxicity. This property alone prompts further research. A collaborative effort involving faculty and students from a variety of disciplines have undertaken this project. It is my goal to isolate and characterize the compound, or compounds, within this barley that produce its plasmid-curing effects. We will use multi-step, centrifugal filtration, chromatographic analysis and purification, and finally mass spectroscopy in order to isolate and identify the exciting new compound(s). Through this identification, we hope to infer the mechanism of action of the compound(s). The isolation and characterization of this compound, or compounds, will produce a new avenue through which a more effective war on antibiotic resistant bacteria may be waged.

Acknowledgements: Jonathan Martinson (MSU Graduate Student) - Microbiology, Seth Walk (MSU Faculty Member) - Microbiology, David Sands (MSU Faculty Member) - Plant Sciences & Plant Pathology

Kendra Hertweck: Microbiology
Mentor: Michael Giroux -- Plant Sciences & Plant Pathology
Impact of new Rht Alleles upon Plant Height

During the green revolution the application of semi-dwarfing genes Rht-B1b and Rht-D1b in hexaploid wheat resulted in plants that were 10-20% shorter, had reduced lodging and significant yield increases. Rht-1b genes reduce plant height by encoding DELLA proteins that cause a decreased sensitivity to Gibberellin. Little allelic variation exists for these genes and currently no Rht-A1 semi-dwarfing genes are being used. The goal of this project was to identify new mutant alleles of the Rht-1 genes which could have different levels of function. This could be shown as slightly shorter or taller plants, higher yielding, or different genetic linkages than the current Rht-1 alleles. New alleles were created in the cultivar Fortuna using EMS mutagenesis which induces point mutations. Fortuna is a solid stemmed, hard red spring wheat that does not contain any Rht-1 mutations. Several novel mutations in all three genome copies of Rht-1 were discovered which included both missense and nonsense mutations. Further genotyping was performed to identify mutant and wild-type lines. Preliminary results suggest that the creation of stop codons had the greatest effect on reducing plant height while other allelic mutations had smaller effects on reducing plant height.

Acknowledgements: Andy Hogg (MSU Postdoc/Research Scientist) - Plant Sciences & Plant Pathology, Jack Martin (MSU Faculty Member) - Plant Sciences & Plant Pathology

Alexandra Hinchcliff: English
Mentor: Allison Wynhoff Olsen, Ada Giusti -- English, Modern Languages & Literatures
The different methodologies between adult and adolescent education with an emphasis in culture

My research project is researching the different methodologies between teaching foreign languages to adults and adolescents. I will utilize research done in English as a Second Language and English as a Foreign Language to differentiate the learning practices between adult and children learners. Then my peers in ML492: Voyage and Discovery in the Francophone World during the spring 2015 semester and I we will create lesson plans that will be taught in the rural communities of Zawiya Ahansal located in the Central High Atlas Mountain of Morocco. In March, a group of students led by Professor Giusti and myself will travel to those villages and complete a service-

learning project. Upon our return, I will complete my research paper based off of my experience in the Moroccan villages and begin to alter my perceived methodologies to aid the second group of students led by Professor Hickman who are traveling in May. They will continue the service-learning project in the villages of Zawiya Ahansal and teach the new lesson plans based on the needs of the villagers. By changing the methodologies to the necessary learning styles of the villagers, we will enhance their learning experience and they will become successful learners.

Trace Hobbs: Chemistry & Biochemistry
Mentor: Robin Gerlach -- Center for Biofilm Engineering
Investigation of the Relationship between Biofilm and Mineral Formation in a Clinically Relevant Model Flow System of the Kidney

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 ($CO(NH_2)_2$), producing 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 (Mg^{2+}) and phosphate (PO_4^{3-}). A model flow system has been developed to simulate biofilm formation in the kidney, ureters, and bladder. 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 model flow system can be used to investigate initial formation of biofilm and minerals, the relationship between biofilm growth and mineral formation, and migration of bacteria from the bladder to the kidney, among other possibilities.

Acknowledgements: Logan Schultz (MSU Postdoc/Research Scientist) - Center for Biofilm Engineering, Ellen Lauchnor (MSU Faculty Member) - Center for Biofilm Engineering

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

Cognitive control (CC), including mental flexibility and attention control, is a resource for coping with psychological stress. In high-risk groups, heightened CC, typically associated with positive outcomes (e.g., academic achievement), predicts high allostatic load, a long-term risk factor for physical health problems. This association has not been studied in normative populations who may experience nonextreme elevated levels of stress. For example, first-generation college students may experience greater stress than returning-generation students as they try to independently cope with the new, challenging university environment. Although CC may support such coping and lead to academic achievement in first-generation students, it may also lead to greater allostatic load. If this is the case, high CC could lead to decreased physical health for first-generation students despite providing other benefits. The current study addresses this possibility. Forty MSU Students completed a laboratory assessment of CC and self-report measures of physical health. With student permission, academic transcripts were provided from MSU. At very high levels of CC, both first generation and continuing generation students reported decrements in physical health. As CC levels became less extreme, physical health improved for both groups, albeit not uniformly. Physical health benefits appeared limited for first-generation relative to continuing-generation students. Additionally, fluctuations in CC correlated with academic achievement for first-generation, but not returning-generation, students. Our results suggest an optimal range of CC may support high levels of function without compromising physical health. First generation students may be particularly sensitive to deviations from this range

Zane Huttinga: Mathematical Sciences
Mentor: Tomas Gedeon -- Mathematical Sciences
Admissible Linear Extensions of Function Values in Continuous Time Boolean Networks

This project is an attempt to find the number of ways that values of a certain function can be ordered. The function is composed of one or more piecewise functions, each of which switches between two values, and by adding or multiplying these smaller functions together, several different values of the entire function arise. These values form a partially ordered set, and it is unknown how many complete orders are possible. More importantly, the number of possible values of the function depends on how many individual piecewise functions it contains. In addition, even for any fixed number of piecewise functions, the number of possible orderings of the values of the entire function varies depending on what operations are performed on each smaller function. For example, given four piecewise functions a, b, c, and d, the values of a + b + c + d have fewer possible orderings than the values of (a + b)(c + d). This project is aimed at finding the number of possible orderings of these values for any number of piecewise functions, and particularly for the two sets of operations just mentioned (i.e. a sum and two sums multiplied by one another). The reason for finding the number of total orders is that the function used has frequently been used to model gene regulation. In fact, it has recently been conjectured that the (a + b)(c + d) case may perfectly model the cell cycle. If the number of possible orderings in known, the cell cycle may be understood thoroughly.

Katrina Jackson: Microbiology
Mentor: David Ward -- Land Resources & Environmental Sciences
Survey of the Microbial Taxa and Chemical Properties of Mammoth Terraces Hot Springs in Yellowstone National Park

Yellowstone National Park hot springs offer an opportunity to study microbial mats in isolated environments. Hot springs mats in Yellowstone's Lower Geyser Basin have been thoroughly studied on a molecular lever, and these studies have led to insights into the role of adaptive processes in the evolution of the predominant cyanobacteria (Synechococcus). In contrast, Mammoth Hot Spring mats have not been as extensively studied, yet they are unique for a variety of reasons. First, Synechococcus populations in Mammoth are phylogenetically distinct. Second, the chemistry of these springs results from dissolution of an ancient seafloor and the deposition of carbonate frequently plugs the springs, making them ephemeral. Third, there is evidence that this ephemerality may have caused frequent reductions of population size (bottlenecking), increasing the importance of neutral evolutionary processes, such as genetic drift. The last comprehensive microbiological survey of Mammoth Hot Springs was published in 1977. This was, however, before the advent of molecular based studies. Subsequent molecular studies of Mammoth springs have been limited to only a few springs, or have only targeted specific cyanobactial taxa. To initiate a long-term study, Mammoth hot springs were surveyed over the course of a year and a half with the twin goals of sampling from extant springs and discovering the presence of and sampling from new springs. This survey and the subsequent determination of the physical, chemical and microbiological properties of the springs creates a platform for future studies based on the adaptive and neutral processes involved in the evolution of Synechococcus.

Sydney Jaramillo: English
Mentor: Dave Swingle -- History & Philosophy
Preserving a Museum's Own History: Digitizing the Video Archives of the Museum of the Rockies

Museums strive to preserve the history of the world. They record the history of the community in which they are located, reenact history so that visitors can explore it hands on, and explain science and scientific advancements. One thing with which museums often struggle is preserving their own history. There may be some effort taken to preserve news footage or Press Releases about the museum but for the most part, the day-to-day activities of the museums are left unrecorded, unpreserved. This was the case at the Museum of the Rockies. While the museum does have a decent sized collection of videos recording the museum's press releases, guest speakers, and exhibits, they were stored on old ¾" tapes that were becoming obsolete. And although the tapes were labeled with their content, there lacked a detailed, minute-by-minute description. With that came my goal, to save these tapes from

becoming unreadable and to record their contents. All in all, I ended up digitizing, 41 ¾" tapes ranging from a few minutes in length to hours. Now the museum's history is available in a format the many people can access. These tapes have been saved from becoming obsolete and with them the Museum of the Rockies' history. The project is set to continue with others passionate about the work and currently David Swingle and a few of his interns are helping the Montana State University Renee Library digitize ¾" tapes.

Andrew Kavran: Chemistry & Biochemistry
Mentor: Edward Dratz -- Chemistry & Biochemistry
Activating Wnt signaling in Induced Pluripotent Stem Cells by fatty acid supplementation

The canonical Wnt signaling pathway is important in induced pluripotent stem cell reprogramming and proliferation, while the non-canonical pathways can cause differentiation and apoptosis. Wnt proteins are post-translationally modified on Cys93 and Ser224 by palmitate and palmitoleate, respectively. While both of these fatty acids help in the secretion of Wnt, they appear to have distinct roles in directing the cell to signal through the canonical and non-canonical pathways. The goal of this project is to develop a lipid supplement for pluripotent stem cell culture media to help activate the canonical Wnt pathway while minimizing the activation of non-canonical pathways. The lipids will be delivered to the cells using the chemically defined carrier, γ-cyclodextrin. Activation of the Wnt pathway will have effects on the transcriptome, metabolome, and redox state of the stem cells. Transcription by the Wnt pathways will be tracked using a qPCR array of Wnt signaling targets. This will help determine if Wnt signaling is active and whether it is signaling through only the canonical pathway. Further, the cells should have a metabolome closer to Warburg metabolism, as Wnt decreases the flux of pyruvate into the mitochondria and increases fermentation of pyruvate to lactate. Finally, the redox state of the cells will be tracked using redox sensitive fluorescent proteins. Fusion of roGFP2 to glutaredoxin allows for real time imaging of the ratio of glutathione to glutathione disulfide (GSH:GSSG), which has been shown to be important in keeping iPSCs undifferentiated.

Acknowledgements: Elizabeth Corbin (MSU Graduate Student) - Chemistry & Biochemistry

Phyu Pannu Khin: Cell Biology & Neuroscience
Mentor: Christa Merzdorf, Jennifer Forecki -- Cell Biology & Neuroscience
The Role of ZIC1 in Cranial Suture Formation

The *zic*1 gene plays an important role in embryonic development, in part by regulating the expression of many other genes including the *engrailed* gene. Previous investigators have reported that abnormal *engrailed* expression shifts the location of cranial suture formation and affects gene expression in the developing sutures (Deckelbaum et al. 2012). Such defects may cause a premature fusion of cranial sutures, leading to a serious birth defect known as craniosynostosis. Dr. Andrew Wilkie (Oxford University) has found that mutations in the human *ZIC*1 gene cause craniosynostosis. He hypothesizes that the *engrailed* gene is abnormally regulated in patients with these *ZIC*1 mutations. In collaboration with the Wilkie lab, we are testing this hypothesis by injecting RNA derived from the human *ZIC*1 mutants into Xenopus frog embryos. The goal of our experiments is to observe whether the mutated human *ZIC*1 genes affect the expression of the *engrailed* gene in frog embryos, which we were able to show by *in situ* hybridization. The degree of abnormality of *engrailed* expression caused by the various human ZIC1 mutations corresponds to the severity of the patients' phenotypes. These findings provide a better understanding of the molecular mechanisms underlying craniosynostosis and suggest possible gene regulatory pathways.

Trisheena Kills Pretty Enemy: Microbiology
Mentor: Seth Walk, Susan Broadaway -- Microbiology & Immunology
Molecular epidemiology of Clostridium difficile in Bozeman, MT

Clostridium difficile is the most commonly acquired nosocomial pathogen in the United States. Of all patients on antibiotics, 10-25% of them will develop C. difficile infection (CDI) and some of these may develop into a severe condition, known as pseudomembranous colitis. The overall goal for studying *C. difficile* is to explore its epidemiology for intervention and prevention in hospital settings. In my project, I collected clinical specimens from

patients who are suspected of having CDI. I verified through a biological technique called PCR that isolates were indeed C. difficile and that they carried genes encoding for the *C. difficile* toxins, TcdA and TcdB. Other aspects of the project will determine the distribution of individual strains of *C. difficile* among patients in the hospital using another biological technique called PCR ribotyping.

Gabriel Kletter: Physics
Mentor: David Klumpar -- Physics
Nozzle Variations and Paraffin Wax Mechanics in Hybrid Fueled Rocket Engines

Current rocket technology is expensive, dangerous, and complex. Hybrid rocketry is a cheaper, safer, more efficient branch of propulsion, but is still in its experimental prime. There are many advantages that hybrid rocketry exhibits over its solid and liquid bipropellant counterparts; namely being inherently simple, clean, and having a negligible contamination hazard. Because the liquid oxidizer is stored separately from the solid fuel, hybrids are inherently very safe. The fuel is non-toxic, non-carcinogenic, non-hazardous and environmentally friendly; the by-products of combustion are carbon dioxide and water. We believe the rapid advancement of this field will lead to widespread improvements in the efficiency, safety, cleanliness, and cost of sounding and amateur rocket propulsion technology. Our objective is to explore hybrid mechanics related to fuel performance and reaction efficiency. We further aim to research fluctuations in paraffin wax fuel density when mixed with certain high-energy additives, and to test variations in bell and aerospike nozzle design pertaining to our unique venture: paraffin/N2O based hybrid sounding rockets.

Jeffrey Kuntz: Physics
Mentor: Dana Longcope -- Physics
Numerical Analysis of Anomalous Solar Flares

Surprisingly little is known about the specific mechanism that causes solar flares to occur in the fashion that they do. We see flare loops when separate and oppositely charged magnetic field lines that run away from the sun and parallel to current sheets in the corona meet and release energy. This process, known as reconnection, creates a force back towards the sun on the charged particles that were being carried along the magnetic field lines. This in turn shortens the flare, and dramatically increases its density and temperature. Curiously, these reconnections seem to occur in small chunks so that we see individual filaments of flare loop as opposed to one large sheet of flare. In order to understand this, data needed to be collected and analyzed on the length, position, and lifetime of the loops. We used Interactive Data Language (IDL) to write scripts for this purpose.

Madison Martin: Microbiology
Mentor: Michelle Flenniken, Brian Bothner -- Plant Sciences & Plant Pathology, Chemistry & Biochemistry
Metabolic Signatures of Pathogen and Pesticide Stress in Honey Bees

Honey bees are critical pollinators of agricultural crops (e.g.,almonds, apples, oranges) that are valued at $14.6 billion annually in the USA. Since 2006, annual bee colony losses have averaged 32% (up from ~ 12% historically). These losses are partially attributed to Colony Collapse Disorder (CCD), an unexplained phenomenon associated with increased pathogen incidence and abundance, though additional factors may be involved. To quantitatively examine the effects of biotic (virus-infection) and abiotic (agrochemical) stress on honey bees, metabolic profiling was performed using mass spectrometry. We hypothesize that the honey bee metabolome is altered by virus-infection and agrochemical-exposure. To address this hypothesis, metabolites were obtained from individual honey bees infected with a model virus (Sindbis-GFP) and/or exposed to an agrochemical, Pristine®, via their diet. Metabolites were analyzed using mass spectrometry (HPLC-MS) and compared using XCMS and metaXCMS computational programs in the R framework. Principal Component Analyses (PCA) of the metabolomes of virus-infected vs. mock-infected bees were distinct. Likewise, the metabolites from agrochemical-exposed bees were different from controls. Differential analysis of the metabolites present in virus-infected bees vs. mock-infected controls determined that more than 30 compounds had greater than a 3-fold change in abundance ($p<=0.005$). Some of these metabolites have putative roles in amino acid metabolism. This analysis also revealed a greater abundance of 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.

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Jordan Maxwell: Physics
Mentor: Dave Klumpar -- Physics
Calibration of Cube-Satellite Ranging Module

The CPOD (Cubesat Proximity Operations Demonstration) mission is a NASA project consisting of two 3U (10cm x 10cm x 33cm) cube-satellites aimed at testing several small-scale avionics technologies. One of the goals of this mission is for the two spacecraft to be able to locate one another and dock in orbit. This will be accomplished using a variety of technologies, one of which is the Inter-Satellite Link (ISL). The ISL system consists of two identical modules which use RF to communicate and, by sending time-stamped data, calculate the range between them. This module will be used to measure distances between 100m and 2.4km while the cube-satellites are in orbit. In order to ensure the accuracy of these modules, a thorough calibration was completed. This paper discusses that data along with the challenges faced throughout that endeavor.

Will McGuinness: Microbiology
Mentor: Jovanka Voyich-Kane – Microbiology & Immunology
Analysis of Staphylococcal Virulence Factor Transcription By The SaeR/S Gene Regulatory System In Human Neutrophil Evasion

The bacterial pathogen *Staphylococcus aureus* is a veritable archetype for adaptability in hostile environments. In the context of human disease *S. aureus* can be quiescent, residing within the nares of the human nostril, or *S. aureus* - as one of the leading causes of infection in the United States - can be massively destructive, with significant tissue tropism, fast rates of antibiotic resistance, and an entire retinue of virulence factors that allow for effective evasion of the host innate immune system. These virulence factors are tightly regulated by the TCS SaeR/S to promote reactionary adaptability and ensure survival. This project elucidated more about the control mechanism by which Staphylococcal virulence factors are regulated by the two-component system (TCS) SaeR/S within *Staphylococcus aureus* (*S. aureus*) during evasion of human neutrophils. Analysis of the virulence factor transcript production of the *Staphylococcus aureus* saeR/S gene regulatory system, both in vitro and in vivo, was reliant upon utilizing investigation into individual amino acids in the response regulator SaeR to elucidate which residues are paramount to virulence regulation. Indeed, RNA-transcript data demonstrate differential regulation of virulence in response to neutrophil-derived stimuli on the sensor kinase SaeS is regulated at the level of single amino acids. Moving forward, this project will provide a framework for understanding how the SaeR/S TCS acts as a control mechanism for virulence factors and provide vital perspective that could outline future research into the role of expression shifts in SaeR/S in nosocomial infection rates or novel treatment strategies.

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Kathryn McNamee: Microbiology & Immunology
Mentor: Blake Wiedenheft -- Microbiology & Immunology
Signaling the CRISPR Alarm

Bacteria and archaea acquire resistance to invading genetic elements like viruses and plasmids by integrating fragments of foreign DNA into one end of a repetitive element called a CRISPR (Clusters of Regularly Spaced Palindromic Repeats). CRISPR loci function as molecular vaccination cards by maintaining a chronological record of previously encountered invaders. This molecular record is transcribed and processed into a library of small CRISRP-derived RNAs (crRNAs) that guide immune system effector complexes to complementary target sequences. While the mechanisms of RNA-guided targeting of foreign nucleic acids have been extensively studied, significantly less is

known about the signals that trigger new sequence acquisition. Using cultures of *Escherichia coli* K12, we are temporally monitoring CRISPR growth in cultures transformed with a high copy number plasmid. We have shown that CRISPR begin acquiring plasmid-derived spacers 7 to 14 days post-infection and we hypothesize that this event is linked to the release of a cellular alarm signal. To test this hypothesis we are analyzing the media from cultures with expanding CRISPRs using mass spectrometry. Results from this study may help explain how cellular communication facilitates the antiviral response.

Chazlyn Miller, Alyssa Sferrazza: Psychology, Health & Human Development
Mentor: Monica Skewes -- Psychology
The Sexual Experiences, Substance Use, Mental Health and Academic Performance among Montana State University Students: Toward the Development of a Social Norms Intervention

Sexual assault is an extensive public health problem affecting college campuses across the United States, including Montana State University. Alcohol has been implicated as a risk factor in the perpetration and victimization of sexual assault. Experiencing sexual assault can impact academic performance and mental health outcomes. Given the negative consequences associated with both sexual assault perpetration and victimization, efforts to address and prevent sexual assault are critical to public health. This study will utilize a social norms approach to behavior change, theorizing that peer influences have an important impact on individual behavior. In other words, people behave the same way they believe their peers behave, whether their perceptions of the norm are accurate or not. This study aims to investigate the degree of misperceptions regarding alcohol-related sexual experiences among female students at MSU. This will be done by examining differences between self-reported rates of various sexual experiences, such as victimization of sexual assault, and perceptions of how common these experiences are in the participants peer groups. The associations between different levels of sexual assault and mental health and academic variables will be examined, and the associations between substance use and history of having experienced sexual assault will be considered. The researchers hope to identify descriptive norms and perceived norms to develop a future norms correction intervention.

Sarah Miller: Chemistry & Biochemistry
Mentor: Trevor Rainey -- Chemistry & Biochemistry
Acutumine Synthesis

Acutumine, derived from *Sinomenium acutum*, is a biologically active product shown to inhibit T-cell growth and decrease memory loss. We sought to understand and develop a new synthetic pathway culminating in the stereoselective synthesis of acutumine via an unprecedented nitrenium-ion initiated cyclization.

Cody Minor: Mathematical Sciences
Mentor: Ron June -- Mechanical & Industrial Engineering
A Stoichiometric Matrix Model of the Biochemical Network of Central Energy Metabolism in Human Cells for Understanding Chondrocyte Mechanotransduction

Osteoarthritis (OA) is the most common joint disorder worldwide and affects 12.1% of the overall US population aged 25-74. The disease is poorly defined, but is known to involve the metabolic dysfunction of articular chondrocytes responsible for the synthesis and maintenance of the cartilage. The objectives of this study were to (1) develop a stoichiometric network model of human central energy metabolism and (2) use this model to predict fluxes in order to maximize production of precursors to cartilage matrix proteins. A stoichiometric matrix was created to model human central energy metabolism to include glycolysis, the tricarboxylic acid cycle, the pentose phosphate shunt, the electron transport chain, and two anapleurotic reactions. We hypothesize that sinusoidal compression of chondrocytes results in cartilage matrix production. Amino acid ratios and the corresponding precursor metabolite ratios of cartilage proteins were determined from the NCBI database. These ratios and the stoichiometric matrix were given to MATLAB as a linear program and used to calculate the flux through energy metabolism that would result in the maximum amount of necessary precursors being synthesized. CellNetAnalyzer was used within the MATLAB environment to find the elementary modes of our network. Hypothetical maximal fluxes for Types I, II, VI, and X collagen as well as negative controls were calculated along with 12 elementary

modes. We found distinct patterns of predicted fluxes between cartilage-specific matrix proteins (e.g. Type II collagen) and negative control proteins (e.g. albumin). Comparison of these results to experimental data will enable understanding how chondrocytes alter their energy metabolism in response to mechanical loading.

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Rosana Molina: Cell Biology & Neuroscience, Ecology
Mentor: Edward Schmidt -- Microbiology & Immunology
Histopathology of Mouse Liver Lacking Major Redox Enzymes

To combat oxidative stress as well as perform other vital functions, all cells have two major reduction systems: the glutathione system and the thioredoxin system. Recently, our lab generated a mouse model lacking the first enzymes for both of these systems in the liver, and found that these mice survive indefinitely at a resting state. It was discovered that they use a previously unrecognized pathway based on dietary methionine to maintain a reducing environment in the liver. This project aims to investigate the impact this has on the physiology of the hepatocyte and characterize the overall histopathology. The double null liver tissue stained with hematoxalin and eosin has been compared with controls, and the same has been done under transmission electron microscopy. Evidence of bile duct proliferation and possible endoplasmic reticulum stress has been observed. Further observations will be analyzed and matched to other pathological conditions. Oxidative stress is implicated in many diseases, including cancer, and learning more about how it is mitigated in a liver forced to use atypical pathways can lead to new therapeutic possibilities.

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Jonathon Mortenson, Sonja Benton: Physics
Mentor: Sachiko Tsuruta -- Physics
Population III stars as possible progenitors of ultra-long gamma-ray bursts

In the 1960s, the Vela satellites detected mysterious flashes of high energy light from the universe which came to be known as gamma-ray bursts(GRBs). Recently a handful of these bursts have shown emission timescales much longer than the majority. These GRBs are entitled ultra-long gamma-ray bursts (ULGBs). These bursts are poorly understood at the moment due to limited observational data and lack of a working model for the bursts, which makes solid predictions difficult. The possible progenitor detailed in this paper are population III stars. If these stars are indeed the emitters, great strides could be taken in our understanding of the early universe, since these ultra-long gamma-ray bursts could provide insight into some of the first stars to form in our universe. By doing so, we can effectively pull back the curtain of time and reveal knowledge about the beginning of everything. In this paper, we analyze the 343 GRBs for which a characteristic timescale for the central engine activity has been compiled by Zhang et al. in "How long does a burst burst?" Using this data and redshift data from Swift, a correlation could possibly be found that presents some evidence that population III stars may be the progenitors of ULGBs.

Jonathan Murtaugh: Physics, Philosophy
Mentor: Sara Waller -- History & Philosophy
The Social Predator Consortium

The Coyote Group, part of The Social Predator Consortium, is interested in understanding the methods, mechanics, and meanings conveyed by coyote's form of communication. Analyzing coyote's form of communication casts light on human's niche on this vast planet. Communication is a very broad topic that for this summary can be taken as information conveyed by one party and understood by another party. Of course this definition is flawed, for information is conveyed between organs in our body, but we may not want to state that they are communicating, at least not in the same way animals communicate. Nonetheless coyotes convey unbelievable amounts of information between their packs, other packs in the area, and other species. Using this simplified definition of

communication, how much information is conveyed by a coyote during its daily activities? And more importantly how much more or less information is conveyed by a coyote compared to a human? This is the heart of my research. Using the methodological framework explained in the Project Proposal we can accomplish this task. By analyzing human language and coyote's form of communication with the same criteria, we can begin to assess the relative differences or similarities in these two different forms of communication. The project takes advantage of Raven Pro, software that is able to objectify sounds, by transforming them into visual data. The results of this research show that the humans wide range of fundamentally different meaningful sounds outweighs the coyotes. On the other hand, coyotes use of synchronization heavily outweighs humans. In conclusion, humans take advantage of crucial paradigms and appear to convey more meaning, but the use of synchronization leaves for the potential of highly complex coyote calls.

Brigit Noon: Chemistry & Biochemistry
Mentor: Brian Bothner -- Chemistry & Biochemistry
Real-Time Metabolomics

The analysis of metabolites from biological fluids is of interest to the biomedical community because metabolites can be used as biomarkers to identify disease progression and environmental stress. The development of technologies capable of realtime monitoring of metabolic state has the potential to transform personal medicine and healthcare. We have developed a diffusion-based metabolite extraction chip (MEC) capable of extracting small molecule biomarkers directly from complex biological fluids with high time resolution. Chips are fabricated from PDMS (polydimethylsiloxane) and sealed to glass microscope slides using oxygen plasma. Sample injection is fully automated; the MEC can be directly connected to a mass spectrometer and will run for hours without interruption. This work is specifically focused on monitoring growth patterns of e. coli in stressed and unstressed states in real time to evaluate cellular adaptation and response to oxidative stress and stress from environmentally relevant heavy metal ions. Diffusion based separation is a promising approach for continuous monitoring of biomarkers. The simplicity and ability to avoid biofouling suggest that this device, in conjunction with a small biosensor, could become part of personalized medicine technologies and as a tool for diagnostics in remote and/or low-resource areas.

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Maggie O'Donnell: Agricultural Economics & Economics
Mentor: Jason Pearcy -- Agricultural Economics & Economics
Addressing the Validity of Using The Test of Understanding in College Economics to Measure Student Learning

The Test of Understanding in College Economics (TUCE) is a standardized test with national data for comparison. A common method for evaluating educational interventions in economics courses is to compare pre and post score differences between control and treatment groups. Although there are benefits to using this method, evidence that pre and post TUCE score differences accurately gauge course learning is lacking. In this paper we examine the correlation between course performance and change in pre/post course TUCE scores over four semesters of data from an intermediate microeconomics with calculus course at Montana State University. Along with the overall difference in pre and post course TUCE scores, we look at the correlation between course performance and the change in scores of TUCE questions that are highly applicable to the course in question. This research assesses the accuracy of pre and post TUCE scores as a means to gauge student learning in economics courses. As a result, we determine whether the TUCE - or parts of it - can be used to measure the causal effects of educational innovations.

Dillon Osleger: Earth Sciences
Mentor: Dixon Jean -- Earth Sciences
Bathymetric mapping and Geophysical investigation of Rocky Mountain Alpine Lakes

Little is currently known about the underwater topography and lithology of high alpine lakes in the Northern Rocky Mountains. Mapping both the bathymetry and stratigraphy of these lakes is integral to further scientific studies

from climatology to ecology. Bathymetric mapping has been performed in many lake environments across the world and has proved an invaluable resource to both recreation and scientific endeavors, specifically in the use of taking lake cores for the study of paleoclimatic records (Osleger et al. 2008). Recent advances in ground penetrating radar technology have made imaging of fresh water environments possible year round, allowing for lakes that are typically inaccessible to watercraft to be surveyed through winter ice cover. The suitability of ground penetrating radar for bathymetric mapping of ice covered alpine lakes was investigated through multiple antenna surveys of several lakes within the Greater Yellowstone Area.

Kirra Paulus: Biotechnology
Mentor: Blake Wiedenheft, MC Rollins -- Microbiology & Immunology
The Subcomponent Interactions of the CSY Complex

Approximately 50% of bacteria possess a sophisticated adaptive immune system in addition to their innate defenses. This system, called CRISPR, protects the cell from invading nucleic acids by incorporating a sample of the foreign genomic sequence into the bacteria's CRISPR locus, before transcribing and processing it into short crRNA sequences. The crRNA guides are then assimilated into a scaffold of several different Cas proteins. The resulting large RNA-guided surveillance complex pursues an exact match to the genetic material coded for by the crRNA before recruiting the nuclease Cas 3 to cleave the target. There are ten identified categories of CRISPR-mediated immune systems varying in protein composition and general construction; this proposal will be working with the type 1F CRISPR system. The Cas 1 protein from this system has been shown to interact with a Cas2/Cas3 hybrid (unique to the 1F system) in a manner that suggests that both proteins play integral roles in both the acquisition and interference of foreign genetic material. This proposal further probes the specific interactions of the large RNA-guided surveillance complex with the individual Cas protein subcomponents, specifically with Cas 1 and the recruited nuclease Cas 3. These interactions will be investigated by first optimizing the purification technique to create stocks of the requisite proteins, and then using Surface Plasmon Resonance and liquid chromatography, the specific interactions of the proteins will be further analyzed. The aim of this project is to discover the conditions required for various Cas protein interactions to occur, as this system has incredible potential as a highly specific genome-editing tool once the system is better characterized.

Randi Phelps: Psychology
Mentor: Rebecca Brooker -- Psychology
Composites of neural markers of prediction of risk for anxiety symptoms

Cognitive control (CC) involves the ability to monitor performance and resolve conflict, which typically contribute to better mental health. However, individuals with greater numbers of anxiety symptoms adopt overcontrolled behavioral styles that include extreme levels of CC. CC is associated with several aspects of event-related potentials (ERPs), such as ERN, which is visible at the neural activity level as heightened performance, and N2 visible as heightened conflict monitoring in more anxious individuals. Neural measures, such as delta-beta coupling, also might improve prediction of anxiety risk. Delta-beta coupling may reflect efforts by cognitively-oriented, cortical systems to regulate reactivity in emotionally-oriented, subcortical systems. Limited work investigates the degree to which singular indices might be composited to increase prediction of risk for anxiety problems or whether composites of CC and neural indices linked to anxiety risk might further increase prediction for anxiety risk. Examining these possibilities is the aim of the current study. Participants ($n = 42$) completed a set of questionnaires measuring anxiety symptoms. Neural activity was recorded during a resting baseline and while participants completed one computerized CC task. Initial analyses suggest that individuals with higher anxiety symptoms show greater delta-beta coupling at frontal electrodes ($z = 0.69$; $p < 0.01$), a positive association between delta and beta power. This link between coupling and anxiety symptoms is a replication of previous work (Miskovic et al., 2010). Data processing is ongoing; final results will test delta-beta coupling as part of composite of multiple neural markers of CC to determine if combining measures provides a strengthened predictor of anxiety risk.

Jenna Pinto: Cell Biology & Neuroscience
Mentor: John Peters -- Chemistry & Biochemistry
Oxidative Stress Protection in Clostridium Perfringens

Clostridium Perfringens is a gram-positive spore forming anaerobic bacteria that is a known culprit for causing both food poisoning and gas gangrene in wounds. This bug contains a particular gene of interest that serves an unknown function in the cell. Based on homologous proteins in different organisms it is hypothesized that the resulting protein plays a role in oxidative stress protection, which provides defense against the damaging hydrogen peroxide produced by neutrophils. The gene in question is known to contain a hydrogenase domain, a ruberythrin domain and two rubredoxin domains. From previous characterization of these domains it is expected that the protein will consume H_2O_2 and produce H_2. The gene of interest was cloned from clostridium perfringens and overexpressed in *E. coli*. Minimal results from a large-scale expression and a hydrogenase assay suggested protein expression difficulties, which were traced to proteolytically sensitive portions on the gene. New clones were constructed containing an N and C terminal strep tags in order to observe changes in proteolysis. We hope to test the hypothesis that this gene performs a protective function in clostridium.

Acknowledgements: George Gauss (MSU Postdoc/Research Scientist) - Chemistry & Biochemistry

Kaitlin Poole: Physics
Mentor: Rufus Cone, Charles Thiel -- Physics
Laser Spectroscopy of Semi-transparent Rare-Earth-Doped Materials

Methods that enable laser spectroscopy techniques to be used to study semi-transparent resonant optical materials are described. Powders of nano- or micro-crystallites can often be synthesized readily using known processes and inexpensive materials, whereas bulk transparent materials can be difficult and expensive to fabricate. Traditional spectroscopic methods that rely on transmission of the probe light through a sample cannot be directly applied to highly scattering powders. In this work, we investigate transparent composite materials where the inorganic powder is suspended in a transparent host material and also consider more general methods of evanescently coupling laser light to any semi-transparent material. Among these techniques, we find that fabrication of semi-transparent and transparent composites using polymer resins is a particularly simple and effective method suitable for many powder materials. We have studied the transparency, index of refraction, optical absorption spectra, and ability to withstand cryogenic conditions for transparent polymers such as epoxy resins, urethane, polyester, PVA, and PMMA. Using these results, we carried out high-resolution laser spectroscopy studies of rare-earth-activated crystalline powders at 1.5 micron telecom wavelengths.

Arielle Potter: Microbiology & Immunology
Mentor: Seth Walk, Susan Broadaway -- Microbiology & Immunology
Novel Escherichia Lineages and the Campus Waterfowl Environment

Escherichia coli is one of the most studied organisms of all time. It is a Gram-negative facultative anaerobic bacterium, whose primary habitat is the vertebrate gut. However, recent studies have shown that certain phylogenetic groups of *E. coli* are more commonly found in environments outside of warm-blooded hosts. In addition to *E. coli*, other phylogenetic groups of Escherichia, known as "cryptic clades", are present in the gut of warm-blooded hosts and the environments where these hosts live. These understudied bacteria are referred to as "cryptic" because they are genotypically distinct but phenotypically indistinguishable from *E. coli* by commonly used biochemical assays. Currently, cryptic clades can be phylogenetically grouped into five clades (I, II, III, IV, and V), but it is possible that even more novel phylogenetic diversity can be sampled from hosts or their environments. In this study, we test the hypothesis that cryptic clades are more prevalent in the water and sediment environments than has been found in vertebrate hosts; furthermore, we aim to elucidate the ecological relationships between each niche. Environmental samples were collected weekly from the campus duck pond, including freshly deposited fecal matter from ducks as well as pond sediment and water. Escherichia from these samples were isolated on selective (mTec) agar. DNA was extracted from isolated colonies and analyzed by phylogenetically informative multiplex PCR.

Paul Puettmann: Cell Biology & Neuroscience
Mentor: Roger Bradley -- Cell Biology & Neuroscience
NFPC Is required for proper secretion of Wnts during Neural Crest specification in Xenopus

Cadherins are calcium dependent transmembrane adhesion proteins that facilitate many functions, including cell differentiation and migration, in the early embryo. In the frog, *Xenopus laevis*, NF-Protocadherin (NFPC) was shown to play a role in the differentiation of Neural Crest (NC) Cells, particularly in cell specification. When inhibiting expression of NFPC in the border region of the ectoderm (sensorial layer) and neural plate, apoptosis was observed in NC cells. This relationship is quite interesting because very few NC cells express NFPC; most NFPC expression during this time is located in the sensorial layer of the ectoderm, outside the neural crest zone. Our research team aims to identify possible growth factor(s) associated with NFPC that are secreted from the sensorial layer to the NC cells during cell specification. Wnt8 and Wnt11 are two possible candidates that have been shown to rescue NC apoptosis caused by loss of NFPC expression. By using in situ hybridization we observed the effects of NFPC knock down on Wnt8 and Wn11 expression.

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Samantha Reap: Chemistry & Biochemistry
Mentor: Mary Cloninger -- Chemistry & Biochemistry
Lactose-Functionalized Dendrimers Influence Galectin-3 Meditated Cancer Cell Migration

Cancer aggregation, tumor formation and metastasis are accomplished with the assistance of a cell surface protein Galectin-3 (galactose-binding protein) via its interaction with carbohydrates in the biological system. Highly-branched multivalent frameworks with attached carbohydrates known as glycodendrimers, which have been shown in previous research to influence cancer cell aggregation, have been introduced into the system to determine whether these molecules modulate the migration of Galectin-3 mediated cancer cells. To study cell migration, an in vitro scratch assay was conducted by creating an artificial "scratch" in a cell monolayer, capturing images at intervals during the migration to close the "scratch" and comparing the images to quantify the migration rate of cells. By investigating migration, the results can demonstrate whether glycodendrimers have the ability to modulate the migration of cancer cells toward Galectin-3, and can be used as an initial step to develop therapeutic agents that target tumor formation and cancer metastasis.

Steven Rehbein: Chemistry & Biochemistry
Mentor: Thomas Livinghouse -- Chemistry & Biochemistry
Development and Synthetic Application of Metalloamination of Zn(II)

Synthesis of the alpha-vinyl alcohol substituted camphor substrate was carried out by treatment of camphor with potassium hydride in THF at reflux and subsequent addition of ethyl formate. Treatment of this vinyl alcohol with (a) *p*-anisidine and (b) isopropylamine in dimethoxyethane resulted in the vinylagous *p*-anisidine and isoproylamine products. On a microgram scale, these substrates were treated with diethyl zinc in toluene under argon and monitored by no-deuterium NMR to confirm complexation has occurred for both substrates. Treatment of the $ZnEt_2$ complexes with 2-(2,2-dimethylpent-4-en-1-yl)-1,1-dimethylhydrazine failed to produce the ring-close product as desired, and instead was observed to either not react or form minor, undesired side-products. Diethyl zinc catalyzed ring closures of alpha-substituted camphor derivatives are therefore not believed to be facile or commercially viable.

Amanda Richards: Microbiology & Immunology
Mentor: Michael Franklin -- Microbiology & Immunology
Flourescent staining and imaging of the Pseudomonas aeruginosa PAO1 biofilm matrix material

Pseudomonas aeruginosa is an opportunistic pathogen, capable of forming biofilm infections on pulmonary tissue. Biofilms form complex communities which are maintained by extracellular matrix materials. In this study, we used fluorescent staining and confocal scanning laser microscopy (CSLM) to characterize the extracellular matrix

material of *P. aeruginosa* PA01. *P. aeruginosa* has the ability to produce three secreted polysaccharides, termed, Psl, Pel, and alginate (Alg). *P. aeruginosa* PAO1 primarily produces the Psl polysaccharide. Four fluorescent probes bound to the extracellular matrix of this strain. Three-dimensional images of the biofilms indicated that matrix material is a fibrous network, forming its structural architecture. Rather than being embedded in a gel-like matrix, the bacteria are attached to the fibers. Interestingly, when two of the stains, Cell Mask Orange and Bodipy X-SE 630/650 (CMO and BOD) were used simultaneously, each stain appeared to bind separate matrix components. We analyzed PAO1 strains containing an arabinose-inducible operon for the Psl polysaccharide, and a strain with a deletion of the pilA gene. In the absence of Psl induction with arabinose, the matrix material stained with CMO, but little staining was seen with BOD, suggesting that BOD may bind the Psl polysaccharide. Both stains bound to the matrix of the pilA mutant, but the biofilms showed impaired structure and a staining pattern that differed from the matrix material of the wild-type strain. The results indicate that specific fluorescent stains bind the matrix material of *P. aeruginosa* PAO1 biofilms, that both the Psl polysaccharide and pili are necessary for this strain to produce a fibrous extracellular matrix structure.

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Jamie Ritter: Cell Biology & Neuroscience
Mentor: Darcy Hunter – Gallatin WIC Program
Early Childhood Nutrition

Through my INBRE Public Health internship at WIC I am analyzing what nutritional habits and factors contribute to a healthy childhood (Ages 0-5). I am doing this by surveying WIC parents or guardians about what their child or children eat, whether it be: WIC foods, formula, or breast milk. The surveys also ask parents a few general health questions about their child or children. The various surveys will help determine what health benefits WIC provides from the perspective of the parents. Parents are given the survey most appropriate for their family. Currently I am collecting survey data on the effectiveness of the Portion plate program. In this program parents were given plastic plates sectioned off to show the portions of each food group. The goal of the program is to compare the effectiveness of the plastic plate against just educating parents and giving them a print out of the My-plate guidelines. Early data shows an increase in the amount of vegetables and nutritious food children are consuming. I am also in the process of contacting mothers to take part in my breastfeeding surveys. Goals of the surveys are to increase breastfeeding rates, see if there is a correlation between infant and toddler nutrition, and/ or a correlation between the amount of time a mother breastfeeds and the frequency in which the infant gets sick. Through the various surveys I hope to determine what else WIC can do to increase the health of Montana children.

Monica Rodriguez: Earth Sciences
Mentor: Cody Warner -- Sociology and Anthropology
Community-based resources in Montana: Locations and neighborhood features

Many Montanans suffer from substance abuse and mental health issues. For instance, rates of risky drinking and suicide in Montana are among the highest in the nation. Without proper availability of community-based resources, those suffering from these issues cannot access the help they need. Existing research shows an important predictor of utilization of community services is physical proximity to such services. This study looks at the physical locations of community-based resources across Montana, and also considers how close these resources are to neighborhoods in need. Community resources are identified through state and local prisoner reentry task force databases. These organizations provide information on resources related to health, chemical dependency, employment, and education. Neighborhood features, including poverty and healthcare coverage, are taken from the American Community Survey. This data is analyzed using ArcMap 10, a program that allows for spatial representation of data. Preliminary results show that the areas with the greatest concentration of community resources are those regions with the highest population density. Areas outside of the more populated regions of the state are less likely to have community-resources that are readily available. Moving forward, the study will also examine the location of community resources relative to populations in need (measured by ACS characteristics such as poverty rates). Our study demonstrates that there are areas of the state that lack access to

social and health services. Given high rates of substance abuse and mental health issues in Montana, this study provides important information for practitioners and policymakers interested in improving access to needed services.

Magdalena Russell: Cell Biology & Neuroscience
Mentor: Frances Lefcort -- Cell Biology & Neuroscience
Neuroprotective effects of BGP-15 on IKAP deficient dorsal root ganglia neurons: increasing lifespan of a Familial Dysautonomia model

Familial Dysautonomia (FD) is a developmental and progressive disorder whose hallmarks include decreased pain and temperature sensation and autonomic dysfunction, marked by vomiting crisis, cardiovascular instability, renal failure, scoliosis, and high mortality. FD devastates the peripheral nervous system. The Lefcort laboratory in the Department of Cell Biology and Neuroscience at Montana State University has developed a mouse model that recapitulates the hallmarks of the disease. BGP-15 is a drug developed against insulin resistance and is currently in phase II clinical trials for its insulin sensitizing effects. It is a drug of current interest and promise with its ability to target stressed cells with minimal secondary influence on healthy cells. My objective is to increase the lifespan of mutant mice and potentially lead to the discovery of a treatment for FD in the future. By injecting our IKAP deficient FD model mouse with doses of BGP-15, I hypothesize that BGP-15 will help rescue progressive neuronal death and combat the hallmark symptoms of FD. I have conducted daily BGP-15 injections in-vivo at varying concentrations. Currently, I have been harvesting embryos from the injected model mice for immunohistochemical analysis. I am using immunohistochemical staining techniques to analyze the effects of BGP-15 on neuronal survival in the dorsal root ganglia. I will also examine the effect of the BGP-15 on other hallmark symptoms of FD (scoliosis, short lifespan, etc.). The results of this experiment could hopefully lead to future advancements in the treatment of Familial Dysautonomia.

Acknowledgements: Sarah Ohlen (MSU Graduate Student) - Cell Biology & Neuroscience, Haley Dunkel (MSU Postdoc/Research Scientist) - Cell Biology & Neuroscience

Anna Scott: Chemistry & Biochemistry
Mentor: Joan Broderick -- Chemistry & Biochemistry
Mechanistic Studies of Hydrogen Abstraction in the Radical SAM Enzyme HydG

[FeFe]-hydrogenase is a promising catalyst for the industrial production of molecular hydrogen. Central to the maturation of the catalytic cluster at its active site are three enzymes: HydG, HydE and HydF. Elucidation of the mechanism of these enzymes will provide important information for [FeFe]-hydrogenase's application in industry.
HydG is a radical S-adenosylmethionine (SAM) enzyme characterized by its generation of a deoxyadenosyl radical that abstracts a H-atom from the substrate tyrosine to begin its amino lyase activity. The source of this H-atom was originally thought to be the phenolic OH group of tyrosine, but based on the recently published crystal structure of a closely related SAM enzyme, NosL, this is unlikely. It is more likely that HydG initiates its mechanism by abstracting a H-atom from the activated amino nitrogen of tyrosine. Further, the OH group likely serves to promote binding in the active site to anchor tyrosine in place during the reaction by hydrogen bonding to the serine fragment. To test this hypothesis, strategic mutations of serine have been generated and different substrates will be used with each mutation to produce similar anchoring interactions while preserving the functionality of the rest of the substrate during the mechanism of the enzyme. After producing the mutated HydG proteins, they will be used in kinetic assays of which the major products will be quantified. Comparisons of the experimental ratios of these assays to the wild type enzyme product ratios and how these results elucidate the mechanism of HydG will be discussed.

Kaitlyn See: Microbiology
Mentor: Christa Merzdorf -- Cell Biology & Neuroscience
The Role of aqp3b in Convergent Extension in Xenopus Embryos.

Much is known about the function of aquaporins within individual cells. Aquaporins are membrane protein channels that are permeable to water and a subset, the aquaglyceroporins, are also permeable to glycerol. Little research has been conducted on how they contribute to larger processes such as gastrulation. Gastrulation organizes embryos into germ layers, which will later form different body tissues. Convergent extension cell movements are critical for driving gastrulation. During convergent extension, cells fold into the embryo at the dorsal lip of the blastopore and then merge to help form the long body axis. An aquaglyceroporin, aqp3b, is expressed during convergent extension. When it is inhibited using a morpholino oligonucleotide, convergent extension does not occur properly. Since this process is difficult to manipulate in whole embryos, I explant and culture the dorsal lip of the blastopore region of embryos, which then undergoes convergent extension by growing long and narrow protrusions. When aqp3b is inhibited, these protrusions do not develop. My project focuses on rescuing the convergent extension defects caused by inhibiting. If rescue methods are successful, explants will form a long and narrow protrusion as observed in control embryos. For these experiments, 4-cell embryos are injected into the dorsal blastomeres and explants are cut at early gastrula stage. So far, I have achieved 25-35% convergent extension in control explants. I plan to achieve 80% convergent extension and will then begin the rescue experiments.

Acknowledgements: Jennifer Forecki (MSU Postdoc/Research Scientist) - Cell Biology & Neuroscience

Alex Sherman: Chemistry & Biochemistry
Mentor: Rob Walker -- Chemistry & Biochemistry
Analysis of Secondary Amine 7-(methylamino-4-trifluoromethyl) Coumarin

Recently synthesized secondary amine 7-(methylamino-4-trifluoromethyl) coumarin (C151.5), a molecule of intermediate structure to the highly studied primary amine C151 and tertiary amine C152, was examined on a liquid/silica interface to gauge the differences in surface behavior due to the secondary amine. Using time correlated single photon counting (TCSPC) spectroscopy, the emission lifetime for the C151.5 in bulk concentrations was determined. Coupling the TCSPC instrumentation with a total internal reflection (TIR) geometry, a pseudo surface method, the molecules on just the surface and immediate surroundings were excited. Bulk properties of C151.5 in the polar, protic MeOH, polar, aprotic Acetonitrile (ACN), and non-polar n-Hexane were found to have long emission lifetimes. At smaller concentrations of the adsorbate, a second shorter lifetime appeared and was taken to be due just from the surface. While C151.5 has a methyl group on the secondary amine, C500, another molecule of interest, has ethyl group on the secondary amine instead. Using the surface data collected for C151.5, the behavior changes due to substituent change can be determined.

Acknowledgements: Lauren Woods (MSU Graduate Student) - Chemistry & Biochemistry

Roy Smart, Jackson Remington: Physics
Mentor: Charles Kankelborg -- Physics
MOSES Flight Software Design and Development

The *Multi Order Solar EUV Spectrograph* (MOSES) sounding rocket payload is a slitless spectrograph that allows snapshot imaging spectroscopy of the Sun in extreme ultraviolet (EUV) wavelengths (Fox, Kankelborg and Thomas, 2010 Astrophys.J., 719:1132-1143). The MOSES research group led by Charles Kankelborg hopes to capture data that will provide insight into transient phenomena in the Solar transition region. The instrument first launched in 2006 and is planned to launch again this year with updated optics and electronics. The MOSES payload relies on an embedded fight computer and FPGA to control the instrument, command exposures from the cameras, save the experimental data, and send the data with additional telemetry back to Earth. Replacing the previous command and data handling system with a low-power solution necessitated the development of new software that could satisfy the same requirements as last mission while improving on the latencies present in the old flight software.

The new configuration is still in development, and is undergoing debugging and optimization in preparation for launch. The software uses direct memory access (DMA) to transfer the scientific data from the FPGA to the flight computer, where it is written to an SD card. The data is then transferred via a 10 Mbit/s radio link to the Earth for real-time viewing during flight. The updated software accomplishes our goal of improvement over the flight software implemented in the previous flight, including a more user-friendly interface, lower latency between subsequent images, and being able to successfully transmit images back to Earth. MOSES is planned to launch on a Black Brant IX sounding rocket from White Sands Missile Range, NM in August of this year.

Molly Taylor: Sociology and Anthropology
Mentor: Jack Fisher -- Sociology and Anthropology
Horsing Around: The Skeletal Analysis of an Excavated Horse

A horse skeleton of uncertain antiquity was excavated near Roundup, Montana, in September 2014. Analysis of skeletal remains of animals such as this from archaeological sites can provide valuable information regarding the individual's life and its impact/significance on human activity in the area. Horses are of particular interest because they and humans have shared a unique relationship throughout history. This project aimed to collect as much information as possible from an excavated horse skeleton. After meticulous cleaning, the bones were macroscopically analyzed, with detailed notes, descriptions and photographs being recorded, indicating any informative characteristics and/or other modifications for each individual bone. Analyses sought to determine the horse's sex, age at death, season of death, living stature (withers height), assessment of breed, evidence of bitting/other human modifications, evidence of trauma/remodeling, as well any other visible surface modifications (e.g. tooth marks, evidence of skeletal anomalies/pathologies). Skeletal analysis and contextual evidence suggest the horse was male, likely died in late spring/early summer at 1.5-2 years of age, and was not worked/ridden. The individual also exhibits pathological joints in the hind limbs, likely a result of infection. Some bones display tooth marks imparted by both carnivores and rodents, suggesting scavenging by the former. Estimations of withers height and breed were attempted, but results are inconclusive, since the horse was still growing at time of death. This analysis provided useful information regarding the horse's life and taphonomic agents that acted upon the bones between the time of death and the time of discovery.

Brandon Thiesen: Physics
Mentor: Hugo Schmidt -- Physics
Effects of Temperature Variation on the Impedance Spectra of Doped Perovskite Ceramics

Perovskite ceramic materials are being widely researched for their unique physical properties, including photovoltaic, thermoresistive, and piezoelectric properties. Dr. Tim Tu of Fu-Jen Catholic University in Taiwan has observed improvements in the photovoltaic properties of $BiFeO_3$ (BFO) based ceramic electrolytes, by doping with rare earth elements including Samarium, Neodymium, and Lanthanum. Impedance properties of BFO, $(Bi_{.95}\ Nd_{.05})FeO_3$, $(Bi_{.95}\ Sm_{.05})FeO_3$, and $(Bi_{.95}\ La_{.05})FeO_3$ were measured with a Solartron-SI1260 Impedance/Phase Gain Analyzer at a range of temperatures from 100°C to 500°C, to determine the effects of temperature on the impedance characteristics of BFO and doped BFO electrolyte materials.

Josh Thornton: Physics
Mentor: Randy Babbitt -- Physics
Upgrading Tapered Amplifer Chips

Spectrum Lab conducts many spatialspectral holography experiments utilizing exotic materials “programed” with frequency chirped lasers. Once a material is “programed”, a RF modulated probe laser is passed through the material, where it is spatially split into its various frequency components. This process allows for instantaneous spectral analysis of incoming RF; as opposed to a traditional RF spectrum analyzer, which takes a significant amount of time to sweep across a frequency range. This process utilizes the excitation of ions within the crystal structure to program the material. When a large number of ions are excited, the material is programed more efficiently. At the same time, a more intense probe increases the sensitivity of the experiment. Both of these aspects are greatly improved by increasing the power of both the programming and probe lasers. The set up

spectrum lab utilizes consists of two main parts: the chirped programming laser set up and the probe laser set up. The chirped set up starts with a highpower 1580nm source which is chirped, and then frequency doubled down to the operational wavelength of ~793nm. It is then amplified via a BoosTA laser amplifier before being sent into a series of alignment mirrors and ultimately into the material. The probe set up starts with a 793nm diode laser which is then RF modulated via an Electro-Optic Modulator. It is then amplified via a BoosTA laser amplifier and then sent into a series of alignment mirrors and ultimately into the material. Both optical set up require the use of a BoosTA laser amplifier to amplify the chirped/modulated lasers into a power regime that is necessary for this kind of spatial-spectral holography. However, many of the BoosTAs Spectrum Lab was using were of lower power than was truly necessary for these experiments, and the discussion about possible replacement options started. While it would be possible to outright replace the aging BoosTA units with the new model, doing so would be very expensive. The prospect of simply replacing the Tapered Amplifier chips themselves, as opposed to the entire unit could be a more affordable option. Before this option could be fully explored, we would need to find out if the aging BoosTA units could supply enough current to drive the high power chips. Fortunately, the BoosTA units were capable of supplying the necessary current, which allowed us to install the new chips, and fully characterize the high power TA chips once they were installed in the old BoosTA's

Will van Gelder: Earth Sciences
Mentor: Mark Skidmore -- Earth Sciences
Clay Mineralogy of Subglacial Lake Whillans Sediments

Subglacial Lake Whillans (SLW) is a subglacial lake beneath the West Antarctic Ice Sheet, which acts as a conduit for water from the ice sheet to the Ross Ice Shelf. The WISSARD project successfully drilled into the lake in January, 2013 and collected water and sediment samples from the lake. Research conducted thus far is revealing a geochemically complex and biologically active system. The sediments contain clay minerals, which are capable of the adsorption and exchange of cations with aqueous solution. We determined the capacity for clays in the sediment to exchange cations and the cations that are adsorbed to clays under in-situ conditions. Research involved performing cation exchange experiments with the clays, in which sediment were suspended in cation solutions at temperature simulating that of SLW. The cations exchanged and their quantity were measured through ion-chromatography. The specific clay minerals present in the sediment were determined through X-ray diffraction analysis; and the relative proportion of clays minerals in the sediment were determined through laser particle size analysis.

Fred Vollmer: Agricultural Economics & Economics
Mentor: Eric Hyyppa, Scott Sterling – Montana PBS
Creating an iOS App to Showcase Montana's Music

Music in Montana is a treasure trove that only a relatively small slice of society has the privilege of experiencing. The Emmy-award winning 11th & Grant television show, produced by MontanaPBS, aims to present and preserve Montana's finest musical artistry in a profoundly beautiful way. The 11th & Grant iOS app will aim to take Montana's music to yet another stage with an even wider audience, showcasing the content in an appealing, interactive way that simulates a standard music player experience.

Alana Vosen: Psychology
Mentor: Keith Hutchinson -- Psychology
False Memory in Older Adults

The present experiment investigates the impact of inserting a phonologically similar word into a list of semantic associates on experiences of illusory recollection during a recall task. This experiment will help explain the misattribution process in which individuals, especially older adults, can misattribute their own internal thoughts for having witnessed an external event. We hypothesize that inserting a phonologically similar word will drastically boost experiences of recollection and to boost people's experience of "remembering" the word in the list. According to the cohort model of word recognition, initial phonemes activate a set of candidates during word recognition and the critical lure should be included in this set of candidates. This initial activation is also guided by

prior context, giving priority to context congruent candidates. Therefore, we also hypothesize that this boost in false memory for critical lures following the presentation of phonologically similar words will be greater when semantically related items are presented first in the list, rather than last. This experiment will use a mixed model design testing for effects of age group (younger vs. older adults), condition (phonologically similar versus semantically similar target), and order of semantically related items (before or after target). Results of this project will be used to draw conclusions about the phenomenology of experiencing false memories and the interactive effects of top-down semantic context and bottom-up word identification in creating vivid false memories.

Cassia Wagner: Chemistry & Biochemistry
Mentor: Mark Young -- Plant Sciences & Plant Pathology
Cryo-electron microscopy and bioinformatic annotation of an archaeal virus reveals a novel viral family

We discovered an archaeal DNA virus from a hot springs (pH 2, 80° C) in Yellowstone National Park. The 9,776 kb genome contains 22 open reading frames with little homology to known proteins. Cryo-electron microscopy reveals a similarly novel morphology, a spherical-like particle with an inner shell of very low density, surrounding tightly packed material, likely DNA. The novel morphology and genes indicate that this virus, whose probable host is *Metallosphaera yellowstonensis*, likely represents a new virus family.

Acknowledgements: Benjamin Bolduc (MSU Postdoc/Research Scientist) - Chemistry & Biochemistry, Martin Lawrence (MSU Faculty Member) - Chemistry & Biochemistry

Jessica Wambeke: Chemistry & Biochemistry
Mentor: Robert Walker, Melissa McIntyre -- Chemistry & Biochemistry
Characterizing materials for high temperature energy conversion

This project looked at characterizing materials used in the high temperature energy conversion of solid oxide fuel cells. Because of the high temperatures required, anode degradation is a concern in maximizing the lifetime and performance of solid oxide fuel cells. For this project, Raman spectroscopy was used to record the vibrational spectra of various materials that have been fabricated by Dr. Sofie's research group (Mechanical and Industrial Engineering) and are designed to help minimize degradation of the cell due to the sintering of Ni catalysts at high temperatures. Of specific interest has been the formation of ZrxTiyOz complexes that appear to play a crucial role in "anchoring" the Ni to the YSZ. The beginnings of a Raman spectral library were formed that included pure sample components, as well as fabricated species samples supplied by the Sophie group and treated in various ways. This spectral library will be used in future work using in situ Raman spectroscopy to observe the stepwise formation of these species.

Robert Watson: Modern Languages & Literatures
Mentor: Ada Giusti -- Modern Languages & Literatures
Preservation of Berber Culture with French Theatre

My project consists of two parts; the first entails researching, collecting and then translating short stories of the indigenous Berber population in Morocco. Each translated short story is introduced by a brief synopsis and followed by reading comprehension questions in order to frame these stories in a pedagogical context. I brought these stories to the village of Zaouiat Ahansal where I implemented them in the fifth grade class as pedagogical tools. The complete resource will be published with illustrations done by the children and donated to the Atlas Cultural Foundation as well as the French department at MSU. The second phase of my project consists of transforming five of these stories into brief theatrical productions. I took these plays back to Zaouiat Ahansal, Morocco and worked with the local teacher, Ismail Fakkak, to teach them to the students, then had the students perform all of the theatrical pieces for the village. The five stories have 25 characters and took two weeks to complete production. Teaching indigenous lore through theatrical production contributes to the preservation of cultural knowledge while improving students' French proficiency. French is an official language of Morocco. It is an essential language to succeed in secondary education, in business, government, scientific study as well as in international communication. I chose to teach these stories through theatre because acting promotes a comfort

with public speaking and social interaction while building self-confidence. I also have had much personal experience in acting and can attest to the social development acting promotes. The Berber origins of these stories will help to ingrain and preserve cultural teachings in the youth for generations to come. The long term objective is to preserve oral Berber folklore by providing students and researchers alike with a culturally appropriate pedagogical resource.

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

Flavins are enzyme cofactors involved in light induced behavior of living organisms. Flavin Adenine Dinucleotide (FAD) is an important model system for how many flavin proteins function. FAD shares a special importance as a photoreceptor due to its existence in a wide variety of photoactive flavoproteins including cryptochromes, BLUF proteins, and DNA-photolyase- enzymes able to photo repair pyrimidine dimers of UV damaged DNA. The photoactive role of FAD in biochemical processes of proteins in the cryptochrome and photolyase family has resulted in great interest in the excited state properties of FAD, specifically its role in DNA repair. The role of FAD in light-activated processes arise from the strong blue light absorption of the flavin (isoalloxazine) ring. In FAD, adenine is covalently linked to isoalloxazine via a flexible link. In aqueous solutions, oxidized FAD exists in two distinct conformations: a closed conformation in which the isoalloxazine and adanine are π-stacked, much like the bases in DNA, and an open conformation in which the isoalloxazine and adanine are unstacked. Although it is generally accepted that adenine quenches the fluorescence of isoalloxazine via electron transfer when the two moieties are π-stacked with one another, there is a lack of consensus in the literature about how to assign and interpret the observed kinetics. In order to try and resolve these discrepancies we have studied the excited state dynamics of FAD using steady-state and time-resolved infrared spectroscopy.

Alysa Yoder: Earth Sciences
Mentor: David Mogk -- Earth Sciences
Characterization of the Chamberlain Formation, Belt Supergroup

The Belt Supergroup (Purcell in Canada) is the dominant sedimentary sequence of northwestern North America in terms of thickness, areal extent, and is a host to a variety of unique mineral deposits (Lydon, 2005). Its origin, tectonic setting, depositional environment, and provenance of the sediments, however, constitute one of the major enigmas of the Precambrian evolution of the northern Rocky Mountains. The primary objective of this research is to conduct an integrated laboratory investigation of core samples obtained from the Black Butte copper deposit near White Sulphur Springs, MT, of the Chamberlain Formation, which represents part of the initial phases of sedimentation of the Mesoproterozoic Belt Supergroup. Systematic characterization of the stratigraphy, sedimentology, major and trace element geochemistry, mineralogy (including detrital) will provide for future geo/thermochronology of the Chamberlain Formation of the Belt Supergroup. Overall, these results will contribute to the understanding of the tectonic setting, processes, and provenance that have controlled the formation and evolution of the Belt Basin.

Ariel Zemlicka: Agricultural Economics & Economics
Mentor: Caroline Graham Austin -- Business
Examining the Role of Fashion Bloggers in the Fashion Industry

What is it that influences consumer purchases? This is obviously an extremely broad and complex question with a multitude of correct answers. In recent years, and particularly in the fashion industry, there has been an increase in social media presence and more specifically, bloggers. Bloggers in the fashion industry, or "fashion bloggers," are quickly becoming one of the most direct channels through which the fashion industry is able to reach consumers. Even more prominent, is the amount of influence these fashion bloggers have on the brands and styles that their followers purchase. So what has caused this trend? How are firms able to capitalize on this relatively new means of marketing? What does this trend mean for the future of the fashion industry and how labels are promoted?

Kevin Zolman: Cell Biology & Neuroscience
Mentor: Susy Kohout -- Cell Biology & Neuroscience
Determination of the Role of the C2 domain of Voltage Sensing Phosphatase

The voltage-sensing phosphatase (VSP) is the first example of an enzyme controlled by changes in membrane potential. VSP has three domains: the transmembrane voltage-sensing domain (VSD), the cytosolic catalytic domain and the C2 domain. The VSD transmits the changes in membrane potential, activating the catalytic domain, which then dephosphorylates phosphatidylinositol phosphate lipids. The role of the C2, however, has not been established. In this study, we explore two possible roles for the C2: catalysis and membrane-binding. The Ci-VSP crystal structures show that the C2 residue Y522 lines the active site suggesting a contribution to catalysis. When we mutated Y522 to Phe, we found a shift in the voltage dependence of activity, suggesting hydrogen bonding as a mechanism of action. Additionally, when we deleted the entire C2 domain, we found voltage-dependent catalysis was no longer detectable. This result indicates the C2 domain is necessary for catalytic modulation. As C2s are known membrane-binding domains, we tested whether the VSP C2 interacts with the membrane. We probed a cluster of four positively charged residues lining the top of the C2 that were suggested by previous studies to interact with phosphatidylinositol 4,5-bisphosphate ($PI(4,5)P_2$). Neutralizing those positive charges significantly shifted the voltage dependence of activity. We tested membrane binding by depleting $PI(4,5)P_2$ from the membrane using the 5HT2C receptor and found that the VSD motions were not changed. These results suggest that if the C2 domain interacts with the membrane to influence VSP function it may not occur exclusively through $PI(4,5)P_2$. Together, this data advances our understanding of the VSP C2 by demonstrating a necessary and critical role for the C2 domain in VSP function.

Acknowledgements: Paul Castle (Research Associate) - Cell Biology & Neuroscience

COLLEGE OF NURSING

Sandy Filesteel: Nursing
Mentor: Elizabeth Kinion -- Nursing
An approach to Integrate American Indian Cultural Strengths with Clinical Best Practice to Prevent Early Childhood Caries on American Indian Reservations

The goal of this project was to identify an approach to preventing Early Childhood Caries (ECC) within American Indian reservation communities, by integrating cultural values and beliefs with oral health care best practices. ECC is a serious infectious disease that causes caries in primary teeth. Caries are painful, and may lead to tooth loss, weight loss, missed days at school, and even death. This research project serves as a platform for future work in remediating oral health disparities on the American Indian reservations. Cultural strengths include understanding the balance of harmony with principles, values, and laws, as the root of all life. Culture is prevention. By recognizing that oral health knowledge is needed as are strategies to address barriers, ECC can be understood by tribal leaders and communities through mutual understanding.

Jessie Hardin: Nursing
Mentor: Amber Wagner – Bozeman Community Health Partners
Reaching Undiagnosed Hypertension patients: Barriers and Results

High blood pressure is one of the leading risk factors for developing cardiovascular disease. The prevalence of hypertension continues to be on the rise due to factors such as age, obesity and sedentary lifestyle. Awareness of high blood pressure and prompt intervention are key to preventing myocardial infarction and stroke. The purpose of this study was to identify clinical patients in Bozeman, Montana with a history of at least two elevated blood pressure readings (>140/90) without a diagnosis of hypertension between May 2013 - September 30th 2014. The identified patients were contacted via telephone and requested to schedule an appointment with their primary care provider. They were tracked for follow up and/or a new diagnosis of hypertension. In collaboration with the clinic, a new protocol will be implemented in an effort to identify and treat patients who have not been diagnosed with hypertension. Clinic educational materials will be updated and other education methods will be explored that are consistent with clinic workflows.

UNIVERSITY STUDIES

Jonathan Yauk: University Studies
Mentor: Hua Li -- Modern Languages & Literatures
Evolution and The Underlying Ideals of China

This research focuses on the acceptance of the theory of evolution in Chinese culture. Understanding how a society responds to evolution, and why it responds in the way it does, is key to understanding its attitude toward the modern world. People react to evolutionary ideas in ways that can be observed qualitatively. Thus, evolutionary ideas can be used as a testing medium for determining societal characteristics. In order to better understand Chinese attitudes toward evolutionary thought, and basic Chinese cultural ideologies, this project engaged students and teachers from a culturally diverse community in Northwestern China. After interviewing 12 individuals from academic backgrounds in Lanzhou China, this project found that a majority accepted a spectrum of evolutionary thinking in relation to national development. Some doubted evolutionary theory as regards human origins. Even though acceptance varied by background, in all cases the theory was first presented and consistently taught in middle school and high school. Results suggested that Chinese attitudes toward evolutionary theory are similar while divergent from those in the west, and that those attitudes fostered strong developmental ideas in relation to economic and social progress. These findings can be directly applied to solving misunderstandings concerning cross cultural notions of social development. Finding common ground between American and Chinese notions of social development might make business exchanges more effective and long lasting, while fostering healthier diplomatic exchanges.

MONTANA INBRE NETWORK STATEWIDE SYMPOSIUM PRESENTERS

Beth Augare: Early Childhood & Elementary Education (Blackfeet Community College)
Mentor: Theresa Pepion, Dee Hoyt -- Health & Education,
Infants and Toddlers, Ages 0 – 3, will have enhanced brain development when they learn through senses; vision, touch, smell, taste and hearing words

Children ages 0 to 3 will enhance brain development via use of the senses. The lesson plan includes methods to teach kids ages 0-3 about the different animals and how they feel. The activity also allows the children to use three out of five senses touch, see, and hear and to use their cognitive skills. The book allows the children to touch and feel each animal texture while we point out each animal when the sound is made. The children were then allowed to point out an animal and make the noise while reading the book to see how well their attention span was the first time the book was read.

Tyler Boucher: Health & Human Performance (Montana State University Billings)
Mentor: Kathe Gabel -- Health & Human Performance
The Effect of Beetroot Crystals on the Oxygen saturation, Blood Lactate, Blood Pressure, Heart Rate and Perceived Exertion in Healthy, Collegiate Students During Intense Exercise

Introduction: Nitrate is a biological vasodilator. Previous research demonstrates that nitrate-rich foods reduce blood pressure (Collofello, et al, 2014) and improve exercise performance. Nitrate is now marketed as a supplement to "improve circulation and support strength, endurance, and recovery." The aim of this research is to identify the effects of a nitrate supplement on oxygen saturation (O_2sat), blood lactate (BLa), blood pressure (BP), heart rate (HR) and rate of perceived exertion (RPE) after intense exercise in young adults. Procedures: Ten University healthy, injury-free and active students were recruited. 30 minutes prior to exercise, control and experimental (BeetElite NeoShot) beverages were provided to the participants. For exercise, participants completed a three minute warm-up at 3.8 MPH (4.1 MET), followed by an 800 m run at 5.3 MPH (9.1 MET). O2sat, BLa, BP, and HR were assessed every two minutes and immediately to assess the participant's recovery. RPE was also estimated at the end of the run. Preliminary results: O2sat (M=98% ±.5) does not appear to change in either groups. Data for five participants indicate that nitrate supplementation prior to exercise aids in reducing HR, BP and RPE. Participants are producing more blood lactate in supplemented trials; however, participants are clearing the lactate more efficiently than the controls. Future Work: Five more participants will be evaluated to complete the study. It is expected that trends will follow the initial results. It is also thought that an increase in exercise intensity may increase oxygen saturation, which could be tested in the future.

Dusti Boyce: Health & Human Performance/Allied Health (Blackfeet Community College)
Mentor: Theresa Pepion, Dee Hoyt -- Health & Education,
Marijuana Use During Pregnancy may cause ADHD in Youth

Marijuana Use During Pregnancy causes ADHD; throughout the project the data was retrieved from prior surveys of mothers ages 19 – 40 on the Blackfeet Reservation and other American Indian Researchers data as well. The results served as a purpose to conclude whether or not the consecutive use of marijuana during pregnancy correlates with the number of children who have a diagnosis of ADHD and/or portray ADHD symptoms. The numbers shown within the research are used to identify whether or not ADHD can be the underline cause by mothers who used marijuana during their pregnancy.

Michael Calhoun: Biochemistry (Montana Tech)
Mentor: Katie Hailer -- Chemistry
Human Exposure Assessment Down-Wind of an Active Open-Pit Copper and Molybdenum Mine in Butte, MT, USA

Butte, Montana, a town of approximately 35,000 residents, is part of the largest superfund site in the continental United States. One of the unique aspects of Butte's mining history is that many residential areas are under superfund designation and have remediation actions determined by the EPA. However, open-pit surface mining continues in close proximity to Butte's urban population. The on-going surface mining introduces particulate matter into the air. Air-samples downwind of the mine regularly measure high levels of PM 2.5 micron particulates. A preliminary study conducted in 2013 found statistically higher levels of copper, manganese, and molybdenum in the hair of residents living in Butte as compared to a control population of volunteers from Bozeman, MT. In addition, microRNA analysis was performed and a number of oncogene and inflammatory miRNA's were found to be statistically higher in the Butte population. In this study, a larger number of volunteers were recruited to submit hair and blood samples (n=67). Having no history of mining activity, Bozeman, MT was again used as the control population (n=32). Hair and blood samples were analyzed for a suite of 36 elements by inductively coupled plasma-mass spectrometry. Total RNA was extracted from a portion of the blood, converted to cDNA, and 27 genes from various oxidative stress and inflammatory pathways were analyzed by qPCR. Preliminary analysis of metal accumulation in hair samples show statistically higher levels of copper, and manganese. This supports the results of the 2013 study. In addition, uranium levels are higher than expected in individuals living in Butte drinking from well water. ICP-MS analysis of metals of the blood samples shows statistically higher levels of copper, manganese, lead, zinc and selenium in the Butte samples. Analysis of 96-well gene plates is on-going. These preliminary data illustrate the need for additional study and data collection of samples from individuals living downwind of an active open-pit copper mine.

Acknowledgements: Samantha Miner

Jehremy Felig: Broadfield Science & Education (Montana State University Billings)
Mentor: Lynn George, Joy Goffena -- Biological & Physical Sciences,
Does codon bias contribute to Familial Dysautonomia?

Familial Dysautonomia (FD) is a devastating disease of the PNS that results from a mutation in the IKBKAP gene and loss of its corresponding protein IKAP, a scaffold that assembles the multi-subunit complex, Elongator[1, 2]. Elongator functions in tRNA modification and is required for efficient translation of AA-ending codons[3, 4]. Our hypothesis is that reduced translation of Elongator dependent transcripts and their corresponding depletion in the cell leads to progressive neuronal death and FD pathophysiology. In this study, we want to isolate key genes that depend on Elongator for normal translation. *Brca2* exhibits an extreme codon bias, consisting of 3328 codons with 425 ending in AA and 280 ending in AG. Analysis of BRCA2 protein levels in wild type and IKAP knockout mouse fetuses using immunohistochemistry with an anti-BRCA2 primary antibody revealed an obvious decrease in the mutant. We are currently in the process of quantifying this reduced expression. To further explore Elongator's function in the translation of codon biased transcripts, we also constructed AA and AG biased versions of GFP in which all lysine, glutamine, and glutamic acid codons end in either AA or AG. These constructs will be expressed in neuronal cultures from wild type and IKAP knockout fetuses. Our hypothesis is that the AA ending construct will be expressed at lower levels in knockout neurons versus wild type, while the AG ending construct will be expressed at normal levels. These experiments are planned for late March, 2015.

Sky Gabel, Anne Wylie: Biology, Psychology (Rocky Mountain College)
Mentor: Cristi Hunnes, Amanda Crandall, Ambrin Masood, Faraz Masood, Gerlinda Morrison, Sarah Young – Biology, Biochemistry, Allied Health, Psychology
Education of Crow Middle School Youth about the Physical and Emotional Impacts of Substance Abuse

Substance abuse is a significant problem among Native American youth. Education about the negative impact resulting from the use of drugs and alcohol and awareness of the positive impact of choosing a life of sobriety is

vital in such communities. This project will bring the message of these impacts of substance abuse to a target group of Crow middle school youth associated with one school on the Crow Reservation on a monthly basis. Undergraduate students at Little Big Horn College in Crow Agency, MT and Rocky Mountain College in Billings, MT will partner together to develop creative approaches to educating these children about the issues and serve as positive mentors. This project will be collaborative not only through the undergraduate students but also with the Crow community, through a community advisory committee, and among disciplines, with two scientists, a psychologist, and a psychiatrist involved. Awareness of substance abuse issues will be assessed through a survey administered at the beginning and end of the series of programs.

Acknowledgements: Payton Robertson, Paytyne Leischner, Shereena Old Elk, Jorie Chavez

Avery Hanson: Biology (Montana State University Billings)
Mentor: Matt Queen, Kurt Toenjes -- Biology,
Molecular Mechanics of the Fungal Morphogenesis Inhibitor, BH3i-1

Candida albicans (*C. albicans*) is an opportunistic pathogen that leads to a broad spectrum of superficial and life-threatening systemic and or invasive infections. *C. albicans* is the most common form of fungal infection in humans and a leading cause of mortality in immunocompromised patients. *C. albicans* undergoes a budded-to-hyphal transition in response to various environmental stimuli. This transition is thought to be an important trait for pathogenicity. The small molecule BH3i-1, which is an inducer of programmed cell death in mammalian cells, has been exceptionally effective at inhibiting the fungal morphogenesis of *C. albicans*. A murine model for disseminated candidiasis was used to evaluate the effect of BH3i-1 and one of its analogs, derivative 54, on the tissue fungal burden and histopathology. Treatment by BH3i-1 resulted in a nearly three-fold reduction of the fungal burden as well as prevention of the severe tissue inflammation observed in samples from the infected but untreated control group. Derivative 54, although very effective during the in vitro analysis, was far less so in vivo. The primary objective of this project was to investigate the source of this change in activity using computational chemistry methods. The optimized molecular geometry and electronic structure of BH3i-1 and four analogs of varying activity were evaluated and compared in order to better understand the key electronic and steric features that influence the molecule's activity. This analysis will provide the valuable chemical insight needed to direct the prediction of the next generation of novel anti-fungal drugs.

Victoria Haugen, Rebekah Threefingers: Associate of Arts (Chief Dull Knife College)
Mentor: Dianna Hooker, Dan Pleier – Math and Information Technology
West Nile Virus Summer Research 2014

The purpose of the West Nile Virus Research study is to assess the prevalence of the West Nile Virus on the Northern Cheyenne Indian Reservation. The first procedural step was selection of the best sites for mosquito traps. After identifying these sites the traps were placed and collection began. Specimens collected were sorted to identify the West Nile Virus (WNV) carrier mosquitos (*Culex tarsalis*) and then processed for presence or absence of WNV. The research teams plan to analyze additional habit and habitat parameters favoring West Nile Virus and its propagation. Lab and field work this coming summer will focus on these habitat variables, the location of samples (GIS) and continuing PCR results. The quantification of locations prone to WNV bearing mosquitos, as well as, temperature and humidity influence factors may aid in producing maps of high and low risk areas across the reservation. Such maps could be used by public health agencies to alert residents of potential risks in the environment.

Tessa Herbert: Biology (Montana State University Billings)
Mentor: Crystal Richards -- Biology
Growth and Survival of Helicobacter pylori in a Dental Biofilm Reactor

Helicobacter pylori is a pathogenic bacteria that infects roughly 50% of the world's population. *H. pylori* infection can lead to gastric and duodenal ulcers, as well as increase the risk of stomach cancer. The purpose of this research is to examine whether *H. pylori* can survive and proliferate in a model dental biofilm system. To assess

the survival of *H. pylori* in a model biofilm reactor, a simulated saliva medium will be inoculated with *H. pylori* and sampled at 24 hours, 72 hours, and 7 days. The cells will be examined directly, first with Baclight which identifies respiring cells, followed by SYBR green, a nucleic acid stain that allows the enumeration of the total number of cells. The cells will also be grown on blood agar to assess culturability. Thus far, experiments have focused on optimization of the biofilm reactor system. This included determining an appropriate starting cell concentration, which is found to be 10^6 cells/ml. This also included finding optimal stain time intervals, this being 60 minutes with the Baclight stain, and 20 minutes with the SYBR green. Currently experiments are ongoing to examine the growth and culturability of *H. pylori* in simulated saliva and on a biofilm substratum. This research has public health implications and will shed light onto a possible route of reinfection after initial treatment for infection via dental biofilms.

Aubree Honcoop: Biology and Chemistry (Montana State University Billings)
Mentor: Tom Lewis, Angela Glassing -- Biochemistry
In-vitro Reconstitution of Sulfite Reductase from Pseudomonas aeruginosa

Recent work has established a link between a ferredoxin: NAD(P)H oxidoreductase (FprA) and sulfite assimilation in members of the genus Pseudomonas. This suggested that FprA is a component of a novel sulfite reductase enzyme. That hypothesis is consistent with the fact that only one component of the well-characterized *E. coli* a8β4 sulfite reductase has been identified in Pseudomonas genomes; i.e the β siroheme subunit CysI is present but not the a flavoprotein subunit CysJ. This led to the hypothesis that FprA is a component of a novel sulfite reductase enzyme. Our aim is to test that hypothesis by in-vitro reconstitution using the purified proteins CysI and FprA. We have successfully overexpressed and purified FprA from *Pseudomonas aeruginosa*. The strategy for production of purified CysI has been complicated by the requirement for concomitant expression of CysG (siroheme synthase). We are also investigating the possibility that a downstream, overlapping reading frame (PA1837) may also be necessary for functional CysI production.

Acknowledgements: Shauna Newton

Kaari Hultgren: Biology (Montana State University Billings)
Mentor: Kurt Toenjes -- Biology
Analysis of BH3I-1 derivatives inhibition of C. rugosa and C. parapsilosis

Background and Objective: Candida species are a major class of fungal pathogens. Although *Candida albicanis* is the most prevalent, *Candida rugosa* and *Candida parapsilosis* are also pathogenic. In previous experimentation, BH3I inhibited the filamentous growth of *Candida albicans*. Current experimentation found that BH3I equally inhibits filamentous growth in *C. rugosa* and *C. parapsilosis* as in *C. albicans*. Filamentous growth is important for Candida species virulence. Small molecule derivatives of BH3I are being tested on *C. rugosa* and *C. parapsilosis* for filamentous growth inhibition.Methods: *C. rugosa* and *C. parapsilosis* are grown in hyphal inducing (starvation) media, under control conditions both species will grow hyphal. Each species is treated with BH3I and BH3I derivatives, hyphal inhibition is observed. Results: BH3I inhibited the filamentous growth of both *C. parapsilosis* and *C. rugosa*. Various derivatives of BH3I were as or more effective for than BH3I for inhibiting filamentous growth. Discussion and Conclusion: Observations advocate that select derivatives inhibit hyphal growth comparative to BH3I. Observations also suggest that BH3I has equal inhabitation effects for other Candida species. Further experimentation with different derived molecules and under different concentrations are ongoing.

Rochelle Johnson: Clinical Laboratory Science (Montana State University Billings)
Mentor: Kurt Toenjes -- Biology
BH3I-1 derivatives inhibit the filamentous growth of the CEA10 strain of Aspergillus fumigatus

Recent and exciting advances in medical therapies for cancer and solid organ failures have greatly extended the life span of afflicted patients. However, these therapies often place the patient at risk for potentially lethal fungal infections. As the number of immunocompromised patients continues to rise, there has been an increase in associated opportunistic fungal infections. Treatment options for invasive mycoses caused by *Candida albicans*,

Cryptococcus neoformans, and *Aspergillus fumigatus* are surprisingly limited. *Aspergillus fumigatus* is the most common Aspergillus species associated with invasive pulmonary aspergillosis, accounting for over 60% of cases. Aspergillus grows as a filamentous mold with true hyphae originating from the germination of asexual conidia. *A. fumigatus* is not a dimorphic fungi as is the case with *C. albicans*, however, as both grow in hyphal form it seems possible that small molecules that inhibit the transition of *C. albicans* budded cells to hyphal growth (often referred to as the germination of blastoconidia by many mycologists) may also inhibit the germination of *Aspergillus conidia*. We tested BH3I-1 and derivatives against *Aspergillus fumigatus* strain CEA10 in YDP media. BH3I-1 and five of the derivatives inhibited *A. fumigatus* at a 200μM concentration based on general observation via microscopy as well as eleven showing promising inhibition at possible different concentrations. Out of these inhibiting molecules, seven also shown inhibition within the prior *C. albicans* assay. We are currently employing a micro-plate reader to obtain quantitative levels of inhibition with several different levels of concentration.

Chyana Johnson, Samantha Biegler: Science (Blackfeet Community College),
Mentor: Jim Kipp, Kim Paul, Betty Matthews -- Research Coordinators
Abstract

This investigation addresses the relationship between stress and higher incidence of both disease and infection, within a Native American tribe in Montana. It is well established that stress hormones can directly suppress immune function, making us susceptible to numerous disease processes. Native communities experience increased frequency of autoimmune disorders, infectious disease, allergies, and cancer. This pilot study is designed to determine whether high levels of stress related hormones can be associated with high-stress exposure, and how this might translate into increased susceptibility to disease. We hypothesize that high stress levels among community members will correlate with increased susceptibility to infection and disease. Initial information will be received from participants through a self-reported survey which is designed to determine levels of stress exposure in everyday life. Serum samples of blood and saliva will also be obtained. Analysis of saliva and blood samples will be completed using Enzyme-Linked Immunosorbent Assay (ELISA) to measure levels of multiple biomarkers, which include cortisol, epinephrine and norepinephrine. Although research has begun with lab technique, ethics of responsibility in research, ELISA, and analysis, surveys and serum draws have yet to be initiated. "Research reported in this publication was supported by the National Institute of General Medical Sciences of the National Institutes of Health under Award Number P20GM103474. The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health."

Shane Johnson: Science (Blackfeet Community College)
Mentor: Jim Kipp, Kim Paul, Betty Matthews -- Research Coordinators
Abstract

We are conducting a study to determine whether high stress levels contribute to disease within a Western Montana tribal nation. Serum sampling will be acquired through blood and saliva collection, and Enzyme-linked Immunosorbent Assay (ELISA) will be performed to determine correlation between prolonged stress and hormone levels such as cortisol. High-stress is associated with increased susceptibility to infection and disease. We hypothesize that high-stress is directly related to health disparities experienced by this Western Montana tribal nation. Our Pilot Project will begin with twenty students from the local tribal community college and graduate to one-hundred residents of this tribal community. As a pilot, only one serum sampling event will take place to provide cursory data that will then afford a foundation for further study. Because we are at the beginning of our project, no sampling events have yet to occur. "Research reported in this publication was supported by the National Institute of General Medical Sciences of the National Institutes of Health under Award Number P20GM103474. The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health."

Cody Kipp: Science (Blackfeet Community College)
Mentor: Jim Kipp, Kim Paul, Betty Matthews -- Research Coordinators
Understanding the Correlation between Stress-Hormone Levels and the Susceptibility to Chronic Disease among Members of a Native American Community

What are stress hormones and how do they keep the body in homeostasis and not in stress? It is important to understand the physiology of stress hormones and that abnormal levels can lead to susceptibility to disease. Members of Native American communities are anticipated to be exposed to high levels of stress. Participants in this study will be given a self-report survey to determine stress levels. Blood and saliva samples will be analyzed to determine whether there is a positive correlation between the stress in their lives and having a disease or autoimmune deficiency. It is hypothesized that there will be high levels of stress-hormones within these community members. This study has the potential to indicate that abnormal stress levels may lead to increased susceptibility to disease. "Research reported in this publication was supported by the National Institute of General Medical Sciences of the National Institutes of Health under Award Number P20GM103474. The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health."

Acknowledgements: Joey Razo

Colbi Kipp: Science (Blackfeet Community College)
Mentor: Jim Kipp, Kim Paul, Betty Matthews -- Research Coordinators
Abstract

The purpose of this study is to understand the link between serum cortisol levels within a Native American community. Stress levels can be determined by serum cortisol, epinephrine and norepinephrine levels, which have a direct impact on the immune system. Historically, Native American communities suffer from various stress disorders related to generational trauma, mental, and substance abuse. This has resulted in increased frequency of infectious disease, autoimmune disease and various cancers. Native American communities, potentially due to high-stress levels affecting their immune systems, suffer from the highest incidence of health disparities. In most cases, significantly higher than other ethnicities. This study seeks to find if there is a direct link between stress-related hormones and an increased vulnerability to disease. This project will fully begin in the summer of 2015, canvassing local students and members of the community to engage in this project. Each participant will be asked to complete a survey, and donate blood and saliva samples for direct cortisol testing. Analysis will be performed of serum and saliva samples via Enzyme-linked Immunosorbent assay (ELISA). The assay is performed and analyzed to see the direct link of specific antigens attaching to the surface of certain wells, within the ELISA test, to view cortisol levels within the system. Though no statistical data has been compiled yet, as we are still in the infancy stages of our study, we feel great, successful conclusions to our work and community is forthcoming. "Research reported in this publication was supported by the National Institute of General Medical Sciences of the National Institutes of Health under Award Number P20GM103474. The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health."

Misty Goings Laplant: Science (Blackfeet Community College)
Mentor: Jim Kipp, Kim Paul, Betty Matthews -- Research Coordinators
Abstract

Today, there are various findings in research that report chronic diseases are more prevalent amongst American Indian populations than any other population in the United States. For example, statistics show that American Indians have a higher rate of obesity, various forms of cancer, diabetes, and heart disease. The goal of this project is to examine the stress levels of American Indian participants by a variety of different methods to determine if there is any direct correlation between stress levels, the immune system, and chronic disease. Data will be gained through a self-report survey, affording investigators the ability to gauge excessive levels of stress being experienced within this population. Additionally, physiological data will be acquired through Enzyme-linked

Immunosorbent Assay (ELISA) techniques, analyzing serum samples of both blood and saliva. We hypothesize that a high stress level among the American Indian participants will correlate with increased susceptibility to diseases.

Acknowledgements: Joe Laplant

Shanna Lewis: Environmental Studies (Montana State University Billings)
Mentor: Susan Gilbertz, Jamie McEvoy, Matthew Anderson -- Environmental Studies, MSU Bozeman, Eastern Washington University
Complications in Field Research: Database Integrity

Eastern Montana is impacted by oil and gas development. Among many concerns, water supplies and water quality are of key importance. Our research team sought to test registered water-wells in this region that were in close proximity to disposal injection wells registered with the Montana Board of Oil and Gas. We identified over 50 water wells in the State of Montana ground water database that met our criteria. The majority of these wells were privately owned and thus we would need permission to test the water. A key function of the field work, then, was the task of securing written permissions. We designed and executed several "permission-gaining" strategies; however, we soon learned that locating registered water wells was also problematic. In the field, the team experienced discrepancies between the databases and the realities of people's lives and properties. This research paper examines our background procedures and our in-field activities with attention to the scientific challenges of informational databases that are seldom ground-truthed.

MyLinda Lovell: Biology (Montana State University Billings)
Mentor: Kurt Toenjes -- Biology
BH3I-1 derivatives inhibit the filamentous growth of the AF293 strain of Aspergillus fumigatus

Immunocompromised patients face several challenges while on their journey to a healthy life. Advanced technology has helped patients to overcome life-threatening illnesses but can leave the patient susceptible to opportunistic fungal infections. Human mycoses such as invasive pulmonary aspergillosis (IPA) caused from *Aspergillus fumigatus* has a profound 90% mortality rate. It is essential that new therapies for human mycoses be further investigated. The most common Aspergillus species is *A. fumigatus* which is responsible for most cases of invasive fungal infections. Aspergillus reproduces asexually through conidia germination to produce filamentous hyphae. Small molecules may inhibit germination of the fungi which will halt the spread of *Aspergillus conidia*. Testing several derivatives of BH3I-1 to observe its effects on hyphal development will help to recognize potential inhibitors. Over a two day period *A.fumigatus* strain 293 (AF293) was grown on YPD plates. The AF293 conidia was diluted and grown in the presence of the small molecules in a well plate over 72 hours. The plates were scanned and the conidia growth was observed under an inverted microscope. The results revealed that some of the small molecules inhibited hyphal growth. The extent of the growth suppression ranged from no inhibition to noticeably suppressed growth. The information from this study will be used to investigate the most efficient, non-toxic method of suppressing fungal infections in immunocompromised patients. The small molecules derived from BH3I-1 are being used to test the efficacy of inhibition which allows us to compare the effects of multiple chemical changes on hyphal suppression.

Tinaya Monroe: Health & Human Performance (Blackfeet Community College)
Mentor: Theresa Pepion, Dee Hoyt -- Health & Education,
Can Genetic Disease be Prevented by a Living Healthy Lifestyle?

When pure water, oxygen and appropriate nutrients nourish the cell, it has what it need to function correctly. Cells mutate when lack occurs or toxins invade the cell nucleus affecting DNA sequencing negatively; and that unhealthy pattern is passed on to the next generation. DNA will respond and mutate without appropriate nutrients, toxins and lack cause negative genetic mutations and nutrients enhance positive genetic mutations. When the cell receives healthy nutrients it heals and sequencing is appropriate for health. Therefore healthy genetic sequencing can be passed on to the next generation..

Scott Ollinger, Dane Main: Science (Blackfeet Community College),
Mentor: Jim Kipp, Kim Paul, Betty Matthews -- Research Coordinators
Abstract

This project investigates serum levels of cortisol, norepinephrine, and epinephrine within a federally recognized tribe. These stress related hormones directly suppress immune function and thereby increase disease susceptibility. Historically, incidence of chronic disease is markedly higher within Native American populations, than other ethnicities. This study seeks to determine whether this federally recognized tribe experiences prolonged high-stress events, and whether or not stress levels are related to increased infection vulnerability and disease. This procedure will begin during the summer months of 2015, engaging twenty local tribal community college student participants. Each participant will be asked to donate both saliva and blood samples for analysis. Analysis will be performed via Enzyme-linked Immunosorbent Assay (ELISA). This biochemical assay is used to detect the presence of substances such as cortisol, norepinephrine, and epinephrine. It is an enzyme immunoassay that allows for an antigen to attach to a surface, and if it is present in sufficient amounts a detectable signal which is commonly seen as a color change, will occur. Because serum sampling events have yet to begin, there is no statistical data to report, therefore major findings and conclusions are forthcoming. "Research reported in this publication was supported by the National Institute of General Medical Sciences of the National Institutes of Health under Award Number P20GM103474. The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health."

Acknowledgements: Dane Main

Mary Owen: Health & Human Performance (Montana State University Billings)
Mentor: Kathe Gabel -- Health & Human Performance
Evaluation of health behaviors and fitness levels of children enrolled in the Active 6 program at the Billings YMCA

Introduction: The YMCA Active 6 program was initiated in response to a study by UM professor, Dr. Steven Gaskill. Results showed that physical activity levels of adolescents dropped dramatically between elementary school and high school. The onset of this decrease happened around 6th grade. Active 6 aims to combat this trend by providing programs to expose sixth grade students to a variety of physical activities and to challenge them to think about health through discussions about healthy behaviors. Methods: Student researcher attended weekly Active 6 sessions to observe and help facilitate activities and discussions. Data was collected on weekly participation rates and children's pre- and post- program fitness levels. Examined components of fitness included cardiovascular fitness, musculoskeletal strength, and flexibility. Additionally, data was collected on children's knowledge of health behaviors. Results: Initial data gathered by YMCA during school visits includes students' maximum performances for sit-ups, pushups, and burpees. Average numbers for these exercises were 23.5, 26.5, and 15.5, respectively. Currently, there are 38 students enrolled in the program, with an average attendance of 12.8. Future Work: Initial assessments administered during YMCA school visits provided an incomplete assessment of student fitness levels and health behavior knowledge. Researcher is implementing new assessments of fitness that include PACER test, standing long jump, hand grip strength, and a sit-and-reach test. Additionally, health behavior surveys are being administered. Both tests are being administered mid-program and post-program to determine success rates.

Kyle Payne: Biology and Chemistry (Montana State University Billings)
Mentor: Rhonda Dillman -- Biological & Physical Sciences
Fluorination of BH3i-1 for use in Anti-fungal Research

In 2012 Dr. Toenjes and Dr. Butler of Montana State University-Billings filed for a patent securing the intellectual rights to a method for controlling the yeast-to-filamentous growth transition in fungi which utilizes the small molecule 5-(p-Bromobenzylidine)-α-isopropyl-4-oxo-2-thioxo-3-thiozolidineacetic acid (BH3i-1) as an antifungal agent1. The purpose of my proposed research project is to replace the bromine atom located on the aromatic ring of the molecule with a fluorine atom. This will be accomplished through an organic synthesis which will begin with a derivative of BH3i-1, BH3i-1''. The synthesis will follow the experimental procedure outlined by Swain and

Rodgers2. The fluorinated derivative of BH3i-1 can then be used in later studies that will track where the molecule resides within yeast cells. A brief summary of the procedure is nitrating the para position of the aromatic ring, followed by a reduction to an amine. The amine will then be converted to a diazonium salt which can be substituted for a fluorine atom from fluoroboric acid. Resulting isomeric compounds will be separated using a silica gel column. The resulting fractions of compounds from the chromatographic column would then be characterized using IR & NMR analyses. So far the synthesis procedure has been tested on two molecules (tert-butylbenzene and p-aminophenyl acetic acid) and positive results have been seen for both the syntheses. Positive ID melting points, Diazonium salts and carbon –fluorine bonds have been seen on IR, and positive results for an H NMR have been obtained. The procedure will be applied to BH3i next week.

Blanca B. Perez: Biology (Montana State University Billings)
Mentor: Matt Queen -- Biology
Chemical characterization of Pyridine-2, 6-bis (thiocarboxylic acid) and its first row transition metal complexes

Carbon tetrachloride (CCl4) is a man-made toxic and predicted to be a carcinogenic chemical compound (4) Previous studies have demonstrated some microorganisms, capable of using CCl4 as an energy source, resulting in CCl4 degradation. Pyridine-2, 6-bis (thiocarboxylic acid) (PDTC) was identified as the extracellular agent responsible for CCl4 dechlorination activity in pseudomonas stutzeristrain KC (2). PDTC has the ability to coordinate transition metals including copper, cobalt, iron, nickel, and zinc. Studies suggest that PDTC complexes play a major role in CCl4 dechlorination, but the reaction pathway by which PDTC metal complexes dechlorinate CCl4 is not completely understood. Understanding the diverse electronic structures of the PDTC coordination complexes is an important step towards understanding the dechlorination reactivity of PDTC metal complexes in, in situ biological conditions. In pursuance of characterizing Pyridine-2, 6-bis (thiocarboxylic acid) (PDTC) free ligand and Fe(III), Cu (II), Co(II), and Ni(II) PDTC metal complexes, the compounds were synthesized. A variety of analytical equipment and techniques were used to compare Ultraviolet-visible spectroscopy (UV-Vis), Infrared Spectroscopy (IR), and Nuclear Magnetic Resonance Spectroscopy (NMR)..Computational chemistry was used to calculate PDTC complexes' orbital coefficients and bond covalency numerical values to later be compared to collected data from the various techniques. Linking the electronic structure of PDTC complexes to their role in the dechlorination mechanism of CCl4 opens the door for potential bioengineered bioremediation of CCl4 contaminated environments.

Matthew Rist: Community Health (Blackfeet Community College)
Mentor: Theresa Pepion, Dee Hoyt -- Health & Education,
When the Inner Environment is Neutralized with Kangan Water (hexagonal shaped water molecules): Muscle Cells have the Power to Ward Off Cancer Growth

There is more benefit to drinking Kangan water than tap water or bottled water. Kangan water filters and changes the shape of the H_2O molecule from octagonal shape to hexagonal shape.(similar to the water that runs off of the Himalayas) The H_2O is more readily absorbed into the cell and also neutralizes the inner environment so it is less acidic and more basic. Cancer and other disease that thrive in an acidic environment may be counteracted; therefore the disease may also be neutralized with Kangan water. When the cell is fed adequate nutrition and pure H_2O, plus oxygen it is less apt to mutate but instead has the power to fight and maintain homeostasis. Cancer Cells lack the ability to invade the body in a neutral environment caused by drinking plenty of Kangan water; that is water that causes a more neutral/basic environment. Disease is thwarted off with healthy cells and a neutral inner environment. Muscles are therefore more able to avoid muscle wasting but instead with continued use and neutralization thrive, heal and repair any damage that may have been done from cell mutation. Drinking plenty of Kangan Water for prevention; this action may help end preventable diseases.

Vincent Siragusa: Biological Sciences (Montana Tech)
Mentor: Amy Kuenzi -- Biological Sciences

Examining the relationship between movement and Sin Nombre Virus infection in the North American Deer Mouse (Peromyscus maniculatus)

The North American Deer Mouse (*Peromyscus maniculatus*) is the primary reservoir host for Sin Nombre Virus (SNV), a Hantavirus responsible for the human disease Hantavirus Pulmonary Syndrome (HPS). Studies have been conducted on the population dynamics and ecology of the deer mouse in order to understand how the virus is maintained and transmitted within deer mice populations. Movement is a key ecological feature that affects the dynamics of deer mouse populations. One factor that may affect deer mouse movement is the presence of an infectious agent. This research was conducted using data from southwestern Montana that was collected as part of a long term SNV deer mice study. Capture history data from individual mice was entered into the geographic information system (GIS) program ArcGIS 10 in order to estimate linear distances moved and minimum convex polygons (MCPs). To analyze the effects of SNV on movement, mice were categorized into two groups: seropositive and seronegative mice. Seropositive mice were positive for SNV antibodies throughout their capture history. Seronegative mice included those that always tested antibody negative, along with mice that passively acquired the antibodies as pups, but later showed no signs of the antibody. Linear distances moved and MCPs were statistically compared between seropositive and seronegative mice. These measures were also compared between male and female mice. Seroprevalence was found to have a negative effect on both the linear distances and the MCPs of deer mice. These results support the idea of SNV having a detrimental effect on its reservoir host.

ALPHABETICAL LISTING OF STUDENTS

Student, Mentor, Project	Session	Poster #	Abstract Page #
John Allemeier: Physics Mentor: Hugo Schmidt -- Physics *Impedance Spectroscopy for Fuel Cell Material Analysis*	pm	49	71
Mary Frances Ambrose: Ecology Mentor: Laura Burkle -- Ecology *Post-wildfire Vegetation Diversity in the Rocky Mountain Ecoregion*	am	78	71
Sara Amish: Ecology Mentor: Jia Hu -- Ecology *Germination Success Rates: Testing the success of an ecosystem to recover post disturbance*	am	90	72
Quinn Andrews: Chemical & Biological Engineering Mentor: Paul Gannon, Phil Himmer -- Chemical & Biological Engineering, Electrical & Computer Engineering *Investigation on Corrosion Behavior of Magnesium Alloys*	am	27	52
MUSE 383: Assessment in Music Education, Danel Chausse, Cassandra Dickerson, Joseph Dresen, Logan Henke, Alexis Hogart, Hannah Lane, Miranda LeBrun, Susan McCartney, Rachel Wambeke: Music Mentor: Kristin Harney -- Music *Rehearsing Research: A Collaborative Exploration of the Arts Without Boundaries Program*	pm	Multi-media C	44
Evan Atchley: Chemistry & Biochemistry Mentor: John Peters -- Chemistry & Biochemistry *Investigating the Substrate Specificity of the 2-KPCC Carboxylation Reaction*	am	4	72
Beth Augare: Early Childhood & Elementary Education (Blackfeet Community College) Mentor: Theresa Pepion, Dee Hoyt -- Health & Education *Infants and Toddlers, Ages 0 – 3, will have enhanced brain development when they learn through senses; vision, touch, smell, taste and hearing words*	pm	52	105
Ryan Bachofer: Chemistry & Biochemistry Mentor: Martin Teintze -- Chemistry & Biochemistry *Mechanisms of Action and Resistance: An Investigation of the Interactions between a Novel Antibacterial (THAM-3φG) and MRSA*	pm	74	72
Katharine Banner: Mathematical Sciences Mentor: Megan Higgs -- Mathematical Sciences *Model Averaging of Regression Coefficients: Considerations and Practical Guidelines*	Math Special Topics	-	32
Liana Bates: Chemical & Biological Engineering Mentor: Ryan Anderson -- Chemical & Biological Engineering *Thermal Energy Storage using Star-CCM+*	pm	57	52
Heather Begger: Plant Sciences & Plant Pathology Mentor: Jennifer Britton -- Plant Sciences & Plant Pathology *Pollinator Garden at Montana State University Horticulture Farm*	am	61	39

Student, Mentor, Project	Session	Poster #	Abstract Page #
Maurisa Bell: History & Philosophy Mentor: David Swingle -- Museum of the Rockies *Cowboys and Indians: A Perpetual Conflict*	am	71	73
Andrew Bender: Mechanical & Industrial Engineering Mentor: Sarah Codd, Joseph Seymour -- Mechanical & Industrial Engineering, Chemical & Biological Engineering *Characteristics of two-phase flow in porous media at low capillary numbers*	am	88	52
Dani Bergey: Cell Biology & Neuroscience Mentor: Frances Lefcort -- Cell Biology & Neuroscience *p53-mediated regulation of neuronal number in Ikbkap-deficient mice*	am	32	73
Emily Berglund: Chemical & Biological Engineering Mentor: James Wilking -- Chemical & Biological Engineering *Force measurements of pluripotent stem cell differentiation in the development of viable three dimensional structures of large intestine organoids*	am	46	53
Emily Bermel: Chemical & Biological Engineering Mentor: Christine Foreman -- Chemical & Biological Engineering *The Effects of UV Light on Biofilm Formation and Pigment Production of Antarctic Janthinobacterium sp. Strain CG23_2 and a non-pigmented mutant*	am	47	53
Timothy Bernard: Psychology Mentor: Matthew Vess -- Psychology *Companion Animal Effects On Mortality Concerns*	pm	124	73
Ashley Berninghaus: Chemical & Biological Engineering Mentor: Brent Peyton, Robin Gerlach -- Chemical & Biological Engineering *Renewable Biogas Production from Algal Biomass using Anaerobic Digestate Cultures Acquired from Municipal Wastewater with Varying Carbon Substrates*	pm	58	54
Peter Billman: Ecology Mentor: Matt Lavin -- Plant Sciences & Plant Pathology *Microsatellite Analysis of the Biogeographical and Phylogenetic Relationships Within Aquilegia flavescens (Yellow Columbine)*	pm	3	74
Nathan Blaseg: Microbiology Mentor: Joshua Obar -- Microbiology & Immunology *Examination of the Leukotriene and Inflammasome Pathways During Invasive Pulmonary Aspergillosis*	am	6	74
Aaron Blaser: Ecology Mentor: Thomas McMahon, Jerry DiMarco -- Ecology, Physics *Examination of the Fukushima Radiation Presence in the Pacific Marine Ecosystem*	am	91	74
Orrin Boese: Chemical & Biological Engineering Mentor: Wataru Nakagawa -- Electrical & Computer Engineering *Optimization of Electron Beam Lithography for Nano-optical Devices*	am	48	54
Tyler Boucher: Health & Human Performance (Montana State University Billings) Mentor: Kathe Gabel -- Health & Human Performance *The Effect of Beetroot Crystals on the Oxygen saturation, Blood Lactate, Blood Pressure, Heart Rate and Perceived Exertion in Healthy, Collegiate Students During Intense Exercise*	pm	55	105
Dusti Boyce: Health & Human Performance/Allied Health (Blackfeet Community College) Mentor: Theresa Pepion, Dee Hoyt -- Health & Education *Marijuana Use During Pregnancy may cause ADHD in Youth*	pm	68	105

Student, Mentor, Project	Session	Poster #	Abstract Page #
Marshall Boyland: Physics Mentor: Hugo Schmidt, Yves Idzerda -- Physics *Impedance Spectroscopy of Thin Films*	am	54	75
Luke Brandenberger: Microbiology Mentor: Ed Schmidt -- Microbiology & Immunology *Gene Expression Analysis on Mice Lacking All Classical Reductase Pathways*	pm	103	75
Joseph Bretz: Physics Mentor: Nico Yunes, Kent Yagi -- Physics *Four-Hair Relations for Differentially Rotating Neutron Stars*	pm	50	75
Lauren Broes: Earth Sciences Mentor: Dave Mogk -- Earth Sciences *Geochemical and Petrographic Study of the Late Precambrian Lahood Formation, Bridger Mountains, Montana*	am	77	76
Michael Broome: Mathematical Sciences Mentor: Tianyu Zhang -- *A Two Species Competition and Mutation Model within a Biofilm*	Math Special Topics	-	32
Cody Brown: Physics Mentor: Neil Cornish -- Physics *Differences Between Averaged and Exact Equations for Spin Procession of Binary Systems*	pm	81	76
Spencer Bruce: Chemical & Biological Engineering Mentor: Stephanie Wettstein -- Chemical & Biological Engineering *Small pore zeolites for biomass upgrading*	am	26	29
Katherine Budeski: Chemistry & Biochemistry Mentor: Brian Bothner -- Chemistry & Biochemistry *Complex Metabolite Analysis in Milk Using Bovine Serum Albumin as a Molecular Sensor*	am	19	76
Evan J. Burnett: Architecture Mentor: Christopher Livingston, Barry Newton, Maire O'Neill -- Architecture *Towards a Restroom Architecture: Existential Understanding from the Toilet Room*	pm	25	26
Jennifer Burns: Microbiology & Immunology Mentor: Valerie Copie -- Chemistry & Biochemistry *Barley Senescence and the HvGR-RBP1 Protein*	am	98	39
Michael Calhoun: Biochemistry (Montana Tech) Mentor: Katie Hailer -- Chemistry *Human Exposure Assessment Down-Wind of an Active Open-Pit Copper and Molybdenum Mine in Butte, MT, USA*	pm	96	106
Nikita Cardenas: Chemical & Biological Engineering Mentor: Ryan Anderson -- Chemical & Biological Engineering *Pore Scale Modeling of Fluid Flow and Heat Transfer Through a Packed Bed*	pm	59	54
Joshua Carter: Microbiology Mentor: Blake Wiedenheft -- Microbiology & Immunology *Modeling the Dynamics of Target Binding in a Type I-E System*	am	7	77
Ian Cavigli: Cell Biology & Neuroscience Mentor: Michelle Flenniken -- Plant Sciences & Plant Pathology *Longitudinal Monitoring of Honey Bee Health and Pathogen Prevalence in Migratory Commercial Beekeeping Operations*	pm	27	77

Student, Mentor, Project	Session	Poster #	Abstract Page #
Katherine Chambers: Modern Languages & Literatures Mentor: Molly Todd -- History & Philosophy *Refugee Issues for Educators*	pm	Multi-media A	78
Bruce Chappell: Physics Mentor: Recep Avci -- Physics *Corrosion of CuNi alloy in a suboxic and sulfidogenic marine environment*	pm	70	78
Reese Christensen: Architecture Mentor: Fatih Rifki -- Architecture *The Space Between Buildings*	am	11	44
Jacob Christenson, Kraig McKernan: Computer Science, Mentor: Clemente Izurieta -- Computer Science *Context Dictionary*	am	17	55
Elizabeth Corey: Sociology and Anthropology Mentor: Cindi Spinelli -- Gallatin City-County Health Department *Risk of Vaccine Preventable Diseases in Gallatin Valley Schools*	am	95	78
Taylor Cornwell: Architecture Mentor: Alexis Pike -- Film & Photography *An American*	pm	48	44
Michael Coryell: Microbiology & Immunology Mentor: Seth Walk -- Microbiology & Immunology *Gut microbiota protect host from exposure to ingested arsenic*	pm	112	32
AnneMarie Criddle: Microbiology Mentor: Matthew Taylor -- Microbiology & Immunology *Using Co-Infection of Fluorescent Herpes to Characterize Viral Exclusion*	am	8	79
Laura M. Dahl: Electrical & Computer Engineering Mentor: Joseph Shaw -- Electrical & Computer Engineering *Modeled visible-to-SWIR spectrum of skylight polarization*	am	53	29
Spencer Dahl: Chemical & Biological Engineering Mentor: Rich Macur, Ellen Lauchnor -- Center for Biofilm Engineering, Civil Engineering *Degradation of Recalcitrant Compounds In Waste Water Using Fungal Strain GS24*	am	57	55
Rebecca Danforth: Chemistry & Biochemistry Mentor: Bern Kohler -- Chemistry & Biochemistry *Elucidation of The Photofenton Reaction Mechanism Using Ultrafast Transient Absorption Spectroscopy*	am	5	33
Katie DesLauriers: Health & Human Development Mentor: Dawn Tarabochia -- Health & Human Development *Grandparents Raising Grandchildren: Perceptions on healthy eating, access and affordability of healthy foods*	am	28	48
Kirkwood Donavin: Agricultural Economics & Economics Mentor: Sarah Janzen -- Agricultural Economics & Economics *The Welfare Impacts of Engineers Without Borders in Western Kenya*	am	1	33
S.P. Dudley: Material Science Mentor: Jerry Downey -- Graduate Departments and Degrees *Rare Earth Element Research and the use of Composite Materials*	am	80	37
Erica Dunn: Psychology Mentor: Ian Handley -- Psychology *Does the tendency to correct against expectation biases reduce the stereotype threat effect?*	pm	125	79

Student, Mentor, Project	Session	Poster #	Abstract Page #
Tracy Echert: Health & Human Development Mentor: Lynn Owens -- Health & Human Development *Motivation for Physical Activity*	am	29	48
Melissa Emery: Chemistry & Biochemistry Mentor: Charles McLaughlin -- Chemistry & Biochemistry *Chemistry Student Perceptions Toward TEAL: Gender and Achievement*	am	23	79
Hannah Estabrooks: Plant Sciences & Plant Pathology Mentor: Mike Giroux, Alanna Oiestad -- Plant Sciences & Plant Pathology *Increasing Plant Productivity via Starch Biosynthetic Specific Transcription Factors*	pm	15	24
Jehremy Felig: Broadfield Science & Education (Montana State University Billings) Mentor: Lynn George, Joy Goffena -- Biological & Physical Sciences *Does codon bias contribute to Familial Dysautonomia?*	pm	26	106
Kevin Ferris: Mathematical Sciences Mentor: Jim Robison-Cox -- Mathematical Sciences *Examining the Spread of Ebola in Western Africa*	Math Special Topics	-	33
Sandy Filesteel: Nursing Mentor: Elizabeth Kinion -- Nursing *An approach to Integrate American Indian Cultural Strengths with Clinical Best Practice to Prevent Early Childhood Caries on American Indian Reservations*	am	30	103
Laura Fisch: Chemistry & Biochemistry Mentor: Deborah Keil -- Microbiology & Immunology *Evaluating Epigenetic Alterations Associated with Immunotoxicity following Complex Metal Exposures*	pm	75	80
Karissa Floerchinger: Cell Biology & Neuroscience Mentor: Jamie Sherman -- Plant Sciences & Plant Pathology *Confirming QTLs for seed size and yield*	am	42	80
Holley Flora: Earth Sciences Mentor: James Hicks -- Education *Developing an Identification Guide for Microfossils in the Hell Creek Formation*	pm	20	80
Korey Flynn: Modern Languages & Literatures Mentor: Ada Giusti -- Modern Languages & Literatures *The Representation of Indigenous Moroccans in Regional Moroccan Museums*	pm	36	81
Amy Fox: Chemical & Biological Engineering Mentor: Connie Chang -- Center for Biofilm Engineering *Cells In Gels: A Microfluidics Study of Alginate Droplets*	am	59	55
Dominic Friedlein, Zachary Fisher: Computer Science, Mentor: Clemente Izurieta -- Computer Science *THEBarcodeScanner*	pm	12	56
Sky Gabel, Anne Wylie: Biology, Psychology (Rocky Mountain College), Mentor: Cristi Hunnes, Amanda Crandall, Ambrin Masood, Faraz Masood, Gerlinda Morrison, Sara Young -- Biology, Biochemistry, Allied Health, Psychology *Education of Crow Middle School Youth about the Physical and Emotional Impacts of Substance Abuse*	pm	108	106
Emma Garcia: Chemical & Biological Engineering Mentor: Michelle Flenniken -- Plant Sciences & Plant Pathology *The Impacts of Viral and Agrochemical Stresses on Honey Bee Health*	am	84	56

Student, Mentor, Project	Session	Poster #	Abstract Page #
Jacob Gardner, Helen Dailey: Earth Sciences, Organismal Biology Mentor: Dale Greenwalt, Colin Shaw -- Smithsonian Institution Research Collaborator, Earth Sciences *Smithsonian Paleobiology Internships: Fossil Insects and Fish from the Kishenehn Formation, Montana*	am	92	81
Robyn Gibbons: Health & Human Development Mentor: J. Mitch Vaterlaus -- Health & Human Development *The Experience of Seeking Emergency Food Relief in the Gallatin Valley*	am	44	48
Jaime Gilden: Psychology Mentor: Colleen Moore -- Psychology *Trust and Uncertainty in Risk Perceptions of Asbestos Contamination in Libby, Montana*	pm	126	81
Merve Gokce, Elif Yagci: Chemical & Biological Engineering, Mentor: James Wilking -- Center for Biofilm Engineering *Extending Colloidal Templating Techniques with New Colloidal Materials*	am	37	56
Julia Goldberg: Chemical & Biological Engineering Mentor: Garth James, Elinor Pulcini, Kelly Kirker -- Center for Biofilm Engineering *Analysis of Gene Expression of Pseudomonas aeruginosa Post Exposure to Atmospheric Plasma Using RNA Sequencing*	pm	60	57
Aubrie Golden: Mechanical & Industrial Engineering Mentor: Erick Johnson -- Mechanical & Industrial Engineering *Validation of a Cross-Flow Water Turbine*	pm	33	57
Joshua Gosney: Chemical & Biological Engineering Mentor: Jeffrey Heys -- Chemical & Biological Engineering *Numerical Prediction of Microbubble Attachment in Biological Flows*	McNair Session	-	58
Carly Grimm: Health & Human Development Mentor: Florence Dunkel -- Plant Sciences & Plant Pathology *Participatory Diagramming to Eliminate Malnutrition in Sanambele*	pm	56	49
Conor Hagan: Physics Mentor: Sachiko Tsuruta -- Physics *Thermal Evolution of Low Mass X-ray Binaries*	am	67	82
Danielle Hanger: Psychology Mentor: Hutchison Keith -- Psychology *Working Memory Capacity and Deception*	am	73	82
Devin Hansen: Physics Mentor: Nicolas Yunes -- Physics *Slowly-Rotating Black Hole Solutions in Dynamical Chern-Simons Gravity with an ADS Background*	pm	71	82
Janet Hanson: Education Mentor: Art Bangert, William Ruff -- Education *Mindset Research - A Comparison of Predictors on Teacher/Administrator Perceptions of School Mindset and School Change*	pm	38	28
Avery Hanson: Biology (Montana State University Billings) Mentor: Matt Queen, Kurt Toenjes -- Biology *Molecular Mechanics of the Fungal Morphogenesis Inhibitor, BH3i-1*	pm	100	107
Jessie Hardin: Nursing Mentor: Amber Wagner -- Bozeman Community Health Partners *Reaching Undiagnosed Hypertension patients: Barriers and Results*	pm	51	103

Student, Mentor, Project	Session	Poster #	Abstract Page #
Shelley Haug: Chemical & Biological Engineering Mentor: Joseph Seymour -- Chemical & Biological Engineering *Self-Diffusion Coefficient Model Development for HPMCAS Polymer/Acetone Binary Mixtures and Polymer Concentration Regime Analysis using Nuclear Magnetic Resonance and Rheology*	am	62	58
Victoria Haugen, Rebekah Threefingers: Associate of Arts (Chief Dull Knife College), Mentor: Dianna Hooker, Dan Pleier -- Math and Information Technology *West Nile Virus Summer Research 2014*	pm	97	107
Julia Hayes: Health & Human Development Mentor: Lynn Owens -- Health & Human Development *Mental Toughness and Coping Strategies in Collegiate Skiers*	pm	66	49
Tamra Heberling: Mathematical Sciences Mentor: Lisa Davis, Tomas Gedeon -- Mathematical Sciences *Incorporating Torque into Transcription Modeling*	Math Special Topics	-	33
Andrew Helming, Amanda Leckband: Chemistry & Biochemistry, Animal Science Mentor: Edward Dratz -- Chemistry & Biochemistry *Study and Isolation of Nontoxic, Plasmid-Curing Agents*	am	36	83
Tessa Herbert: Biology (Montana State University Billings) Mentor: Crystal Richards -- Biology *Growth and Survival of Helicobacter pylori in a Dental Biofilm Reactor*	pm	101	107
Melissa (Rashelle) Herrygers: Animal & Range Sciences Mentor: James Berardinelli, Robert Garrott -- Animal & Range Sciences, Ecology *Metabolites, Metabolic Hormones, and Hematological Variables in Bighorn Sheep (Ovis canadensis) at the End of Breeding Season and the First Trimester of Pregnancy*	am	55	24
Kendra Hertweck: Microbiology Mentor: Michael Giroux -- Plant Sciences & Plant Pathology *Impact of new Rht Alleles upon Plant Height*	pm	104	83
Alexandra Hinchcliff: English Mentor: Allison Wynhoff Olsen, Ada Giusti -- English, Modern Languages & Literatures *The different methodologies between adult and adolescent education with an emphasis in culture*	am	51	83
Trace Hobbs: Chemistry & Biochemistry Mentor: Robin Gerlach -- Center for Biofilm Engineering *Investigation of the Relationship between Biofilm and Mineral Formation in a Clinically Relevant Model Flow System of the Kidney*	pm	76	84
Jacob Hoffman: Land Resources & Environmental Sciences Mentor: Anthony Hartshorn -- Land Resources & Environmental Sciences *The Smell of Gold: Quantifying the Ammonia Off-gassed from an Ore Processing Facility*	am	49	40
Connor Hoffmann: Chemical & Biological Engineering Mentor: Blake Wiedenheft, Ryan Jackson, MaryClare Rollins -- Microbiology & Immunology *Understanding and Engineering CRISPR RNA-Guided Nucleases*	am	63	58
Aubree Honcoop: Biology and Chemistry (Montana State University Billings) Mentor: Tom Lewis, Angela Glassing -- Biochemistry *In-vitro Reconstitution of Sulfite Reductase from Pseudomonas aeruginosa*	pm	118	108

Student, Mentor, Project	Session	Poster #	Abstract Page #
Holly Howe: Psychology Mentor: Rebecca Brooker -- Psychology *Cognitive Control: Physical Responses of At Risk Adults Due to High Allostatic Load*	am	74	84
Jerad Hoy: Computer Science Mentor: Ben Poulter -- Ecology *Developing a Web Application to Visualize Greenhouse Gas Emissions Reductions*	pm	9	59
Kaari Hultgren: Biology (Montana State University Billings) Mentor: Kurt Toenjes -- Biology *Analysis of BH3I-1 derivatives inhibition of C. rugosa and C. parapsilosis*	pm	102	108
Zane Huttinga: Mathematical Sciences Mentor: Tomas Gedeon -- Mathematical Sciences *Admissible Linear Extensions of Function Values in Continuous Time Boolean Networks*	pm	23	85
Ahmed Imtiaz: Mechanical & Industrial Engineering Mentor: Laura Stanley -- Mechanical & Industrial Engineering *An Eye Scanning Approach of Exploring the Experience Level at Which Novice Drivers Exhibit Hazard Perception Skill As Good As Their Experienced Counterparts*	pm	41	29
Kevin Izard: Mechanical & Industrial Engineering Mentor: Sarah Codd -- Mechanical & Industrial Engineering *Flow Condition of Two-Phase Flow in Porous Media*	pm	40	59
Katrina Jackson: Microbiology Mentor: David Ward -- Land Resources & Environmental Sciences *Survey of the Microbial Taxa and Chemical Properties of Mammoth Terraces Hot Springs in Yellowstone National Park*	pm	105	85
Jeremiah Jansen: Animal & Range Sciences Mentor: Mike Giroux, Janice Bowman -- Plant Sciences & Plant Pathology, Animal & Range Sciences *Investigating effect of barley grain hardness on ruminal digestion in cattle*	am	65	40
Sydney Jaramillo: English Mentor: Dave Swingle -- History & Philosophy *Preserving a Museum's Own History: Digitizing the Video Archives of the Museum of the Rockies*	pm	34	85
Jayesha Jayaratne: Chemical & Biological Engineering Mentor: Jennifer Brown -- Chemical & Biological Engineering *Rheological Characterization of worm-like micelle solutions with varied surfactant and counter-ion concentrations*	am	58	60
Shane Johnson: Science (Blackfeet Community College) Mentor: Jim Kipp, Kim Paul, Betty Matthews -- Research Coordinators *Abstract*	pm	83	109
Chyana Johnson, Samantha Biegler: Science (Blackfeet Community College), Mentor: Jim Kipp, Kim Paul, Betty Matthews -- Research Coordinators *Abstract*	pm	84	109
Rochelle Johnson: Clinical Laboratory Science (Montana State University Billings) Mentor: Kurt Toenjes -- Biology *BH3I-1 derivatives inhibit the filamentous growth of the CEA10 strain of Aspergillus fumigatus*	pm	95	108
Briana Jones: Electrical & Computer Engineering Mentor: Kevin Repasky -- Electrical & Computer Engineering *Development of a singly-resonant OPO for carbon cycle science*	pm	7	30

Student, Mentor, Project	Session	Poster #	Abstract Page #
Connor Julien: Electrical & Computer Engineering Mentor: Brock LaMeres -- Electrical & Computer Engineering *Design and Space Flight Testing of a Radiation Tolerant, FPGA-based, Reconfigurable Computer System on the International Space Station*	pm	8	60
Hasan Karadurmus: Chemical & Biological Engineering Mentor: Jovanka Voyich -- Microbiology & Immunology *Rise of the Superbugs: A Survey of the Challenge of Drug Resistance*	pm	61	60
Andrew Kavran: Chemistry & Biochemistry Mentor: Edward Dratz -- Chemistry & Biochemistry *Activating Wnt signaling in Induced Pluripotent Stem Cells by fatty acid supplementation*	pm	77	86
Katherine Kent: Chemical & Biological Engineering Mentor: Jennifer Brown -- Chemical & Biological Engineering *Rheo-NMR Studies of Polymer-Particle Dispersions with Silicon Dioxide Nanoparticles*	pm	62	61
Phyu Pannu Khin: Cell Biology & Neuroscience Mentor: Christa Merzdorf, Jennifer Forecki -- Cell Biology & Neuroscience *The Role of ZIC1 in Cranial Suture Formation*	pm	45	86
Caleb Killian: Architecture Mentor: Selena Ahmed, Fatih Rifki -- Health & Human Development, Architecture *Reconciling Agrarian and Urbanist Ideals Towards Sustainability*	am	13	45
Trisheena Kills Pretty Enemy: Microbiology Mentor: Seth Walk, Susan Broadaway -- Microbiology & Immunology *Molecular epidemiology of Clostridium difficile in Bozeman, MT*	pm	106	86
Cody Kipp: Science (Blackfeet Community College) Mentor: Jim Kipp, Kim Paul, Betty Matthews -- Research Coordinators *Understanding the Correlation between Stress-Hormone Levels and the Susceptibility to Chronic Disease among Members of a Native American Community*	pm	82	110
Colbi Kipp: Science (Blackfeet Community College) Mentor: Jim Kipp, Kim Paul, Betty Matthews -- Research Coordinators *Abstract*	pm	87	110
Gabriel Kletter: Physics Mentor: David Klumpar -- Physics *Nozzle Variations and Paraffin Wax Mechanics in Hybrid Fueled Rocket Engines*	am	68	87
Priyanka Kudalkar: Land Resources & Environmental Sciences Mentor: John Priscu, Cathy Cripps, Gary Strobel -- Land Resources & Environmental Sciences, Plant Sciences & Plant Pathology *STRUCTURE AND FUNCTION OF FUNGI IN ANTARCTIC LAKE ICE*	pm	13	25
Jeffrey Kuntz: Physics Mentor: Dana Longcope -- Physics *Numerical Analysis of Anomalous Solar Flares*	pm	72	87
Ji Kent Kwah: Plant Sciences & Plant Pathology Mentor: Valerie Copie -- Chemistry & Biochemistry *Structural and functional investigations of the Linker-NEAT 2 Domain of IsdB on Staphylococcus aureus*	pm	16	40
Misty Goings Laplant: Science (Blackfeet Community College) Mentor: Jim Kipp, Kim Paul, Betty Matthews -- Research Coordinators *Abstract*	pm	86	110

Student, Mentor, Project	Session	Poster #	Abstract Page #
Nickolas Lapp: Electrical & Computer Engineering Mentor: Joseph Shaw -- Electrical & Computer Engineering *Aurora Alert Notification System for Optical Aurora Detector*	pm	17	61
McLain Leonard: Chemical & Biological Engineering Mentor: Roberta Amendola, Hugo Schmidt -- Mechanical & Industrial Engineering, Physics *Non-planar, BZY Electrolyte Fabrication for Liquid Lithium Proton-conducting Fuel Cell*	pm	63	61
Shanna Lewis: Environmental Studies (Montana State University Billings) Mentor: Susan Gilbertz, Jamie McEvoy, Matthew Anderson -- Environmental Studies (MSU Billings), MSU Bozeman, Eastern Washington University *Complications in Field Research: Database Integrity*	pm	19	111
Neil Liotta, Kirkwood Donavin, Kelly Hendrix, Jake Ebersole, Alexander Paterson: Chemical & Biological Engineering, Agricultural Economics & Economics, Civil Engineering, Business Mentor: Sarah Janzen -- Agricultural Economics & Economics *Assessment of Health Outcomes from Engineers Without Borders' Water and Sanitation Projects in Khwisero, Kenya*	pm	1	62
Neil Liotta, Kirkwood Donavin, Kelly Hendrix, Jake Ebersole, Alexander Paterson: Chemical & Biological Engineering, Agricultural Economics & Economics, Civil Engineering, Business Mentor: Sarah Janzen -- Agricultural Economics & Economics *Assessment of Health Outcomes from Engineers Without Borders' Water and Sanitation Projects in Khwisero, Kenya*	am	1	62
MyLinda Lovell: Biology (Montana State University Billings) Mentor: Kurt Toenjes -- Biology *BH3I-1 derivatives inhibit the filamentous growth of the AF293 strain of Aspergillus fumigatus*	pm	120	111
Kilean Lucas: Chemical & Biological Engineering Mentor: Recep Avci -- Physics *Influence of Material Defects in the Microbially Influenced Corrosion of 1018 Steel in Fuel/Seawater Systems*	am	64	62
Thomas Lund: Chemical & Biological Engineering Mentor: Jennifer Brown -- Chemical & Biological Engineering *Non-Newtonian Fluid Flow in Porous Media*	am	83	62
Sarah Mailhiot: Mechanical & Industrial Engineering Mentor: Ronald June -- Mechanical & Industrial Engineering *In vitro Degradation and In Vivo Deterioration Analysis of a Bioluminescent Cartilage Reporter Mouse Model*	pm	39	30
Andrew Marshall: Art Mentor: Joshua DeWeese -- Art *Accessibility Through Furnace Design- Multi-use and Multi-fuel*	am	15	45
Julia Martin: Film & Photography Mentor: Alexis Pike -- Film & Photography *Altered Realities*	pm	Multi-media B	45
Madison Martin: Microbiology Mentor: Michelle Flenniken, Brian Bothner -- Plant Sciences & Plant Pathology, Chemistry & Biochemistry *Metabolic Signatures of Pathogen and Pesticide Stress in Honey Bees*	am	20	87

Student, Mentor, Project	Session	Poster #	Abstract Page #
Jordan Maxwell: Physics Mentor: Dave Klumpar -- Physics *Calibration of Cube-Satellite Ranging Module*	pm	78	88
Will McGuinness: Microbiology Mentor: Jovanka Voyich-Kane -- Microbiology & Immunology *Analysis of Staphylococcal Virulence Factor Transcription By The SaeR/S Gene Regulatory System In Human Neutrophil Evasion*	pm	113	88
Kathryn McNamee: Microbiology & Immunology Mentor: Blake Wiedenheft -- Microbiology & Immunology *Signaling the CRISPR Alarm*	pm	110	88
Vanessa McNeil: Psychology (Montana State University Billings) Mentor: Sarah Keller, Caroline Graham Austin, Elizabeth Ciemins -- Communication & Theater (MSU Billings), Business (MSU Bozeman), Billings Clinic *Stigma, Stress, and Cowboy-ing Up: A Qualitative Evaluation of Attitudes & Beliefs about Suicide in Montana*	pm	109	38
Michelle Meagher: Chemical & Biological Engineering Mentor: Brent Peyton, Dana Skorupa -- Chemical & Biological Engineering, Center for Biofilm Engineering *Phylogenetic Analysis of Novel Thermophilic Archaea and Bacteria from an Alkaline Spring in Yellowstone National Park*	pm	64	63
Cassidy Medicine Horse: American Studies Mentor: Matthew Herman, Danielle Hidalgo, Julie Wiesler -- Native American Studies, Sociology and Anthropology, Psychology *Displacing Biogendercentricity: Twenty-First Century Transgender Visibility as a Product of Mid Twentieth Century Political Trans-Emergence*	pm	37	34
Addie Melvin: Chemical & Biological Engineering Mentor: Joseph Shaw -- Electrical & Computer Engineering *Measuring Atmospheric Aerosol Optical Absorption*	pm	28	63
Sarah Miller: Chemistry & Biochemistry Mentor: Trevor Rainey -- Chemistry & Biochemistry *Acutumine Synthesis*	pm	91	89
Chazlyn Miller, Alyssa Sferrazza: Psychology, Health & Human Development Mentor: Monica Skewes -- Psychology *The Sexual Experiences, Substance Use, Mental Health and Academic Performance among Montana State University Students: Toward the Development of a Social Norms Intervention*	am	75	89
Cody Minor: Mathematical Sciences Mentor: Ron June -- Mechanical & Industrial Engineering *A Stoichiometric Matrix Model of the Biochemical Network of Central Energy Metabolism in Human Cells for Understanding Chondrocyte Mechanotransduction*	pm	115	89
Rosana Molina: Cell Biology & Neuroscience, Ecology Mentor: Edward Schmidt -- Microbiology & Immunology *Histopathology of Mouse Liver Lacking Major Redox Enzymes*	pm	46	90
Tinaya Monroe: Health & Human Performance (Blackfeet Community College) Mentor: Theresa Pepion, Dee Hoyt -- Health & Education *Can Genetic Disease be Prevented by a Living Healthy Lifestyle?*	pm	53	111
Benjamin Moon: Electrical & Computer Engineering Mentor: Wataru Nakagawa -- Electrical & Computer Engineering *Characterization of Optical Nanostructures using Optimized Measurement System with Phase and Polarization Capability*	pm	18	64

Student, Mentor, Project	Session	Poster #	Abstract Page #
Jonathon Mortenson, Sonja Benton: Physics, Mentor: Sachiko Tsuruta -- Physics *Population III stars as possible progenitors of ultra-long gamma-ray bursts*	pm	79	90
Jonathan Murtaugh: Physics, Philosophy Mentor: Sara Waller -- History & Philosophy *The Social Predator Consortium*	am	69	90
Elizabeth Narigon: Health & Human Development Mentor: Carmen Byker -- Health & Human Development *Strategies to Promote Dietary Adherence of USDA Nutrition Standards in High School Lunchrooms Across Montana*	pm	54	50
Chance Noffsinger: Land Resources & Environmental Sciences Mentor: Lisa Rew -- Land Resources & Environmental Sciences *Quantifying the response of an invasive annual and native perennial grass to different climate and carbon dioxide scenarios: will a changing climate favor Bromus tectorum over Psuedorogenaria spicata?*	am	72	41
Brigit Noon: Chemistry & Biochemistry Mentor: Brian Bothner -- Chemistry & Biochemistry *Real-Time Metabolomics*	am	18	91
Chris ODonnell: Mechanical & Industrial Engineering Mentor: Daniel Miller, Ladean McKittrick, Ed Adams -- Civil Engineering *How Variable Snow Microstructure Affects Gas Diffusion Rates*	am	89	64
Maggie O'Donnell: Agricultural Economics & Economics Mentor: Jason Pearcy -- Agricultural Economics & Economics *Addressing the Validity of Using The Test of Understanding in College Economics to Measure Student Learning*	am	24	91
Taylor Oeschger: Chemical & Biological Engineering Mentor: Joseph Seymour -- Chemical & Biological Engineering *Techniques for Heterogeneous Gelation of Alginate Solutions*	am	82	64
Kaitlyn Okrusch: Health & Human Development Mentor: Seth Walk, Arthur Blum, Joel Weinstock -- Microbiology & Immunology, Tufts Medical Institute, *Investigating the Role of the GI Tract Microbiome in a Murine-Parasite Model of Inflammatory Bowel Disease*	am	45	50
Shereena Old Elk: Mentor: -- *Abstract*	pm	107	-
Scott Ollinger, Dane Main: Science (Blackfeet Community College), Mentor: Jim Kipp, Kim Paul, Betty Matthews -- Research Coordinators *Abstract*	pm	85	112
Dillon Osleger: Earth Sciences Mentor: Dixon Jean -- Earth Sciences *Bathymetric mapping and Geophysical investigation of Rocky Mountain Alpine Lakes*	pm	6	91
Mary Owen: Health & Human Performance (Montana State University Billings) Mentor: Kathe Gabel -- Health & Human Performance *Evaluation of health behaviors and fitness levels of children enrolled in the Active 6 program at the Billings YMCA*	pm	65	112
Lenore Page: Mechanical & Industrial Engineering Mentor: Maria Velazquez, David Claudio -- Mechanical & Industrial Engineering *Ecological Validity is Used but Not Defined in Transportation Safety Research*	am	81	30

Student, Mentor, Project	Session	Poster #	Abstract Page #
John Pankratz: Chemical & Biological Engineering Mentor: Jennifer Brown -- Chemical & Biological Engineering *Rheo-NMR Characterization of Wormlike Micelle Solutions*	pm	29	65
Kenneth Patrick: Computer Science Mentor: Clem Izurieta -- Computer Science *Dynamic Online Course Contrast (DOCC)*	pm	10	65
Kirra Paulus: Biotechnology Mentor: Blake Wiedenheft, MC Rollins -- Microbiology & Immunology *The Subcomponent Interactions of the CSY Complex*	am	43	92
Kyle Payne: Biology and Chemistry (Montana State University Billings) Mentor: Rhonda Dillman -- Biological & Physical Sciences *Fluorination of BH3i-1 for use in Anti-fungal Research*	pm	117	112
Stephen Pedersen: Chemical & Biological Engineering Mentor: John Priscu -- Land Resources & Environmental Sciences *Analysis of Long Term Photosynthetically Active Radiation Data from McMurdo Dry Valley Lakes to Identify Turbidity Stratification Patterns*	am	85	66
Blanca B. Perez: Biology (Montana State University Billings) Mentor: Matt Queen -- Biology *Chemical characterization of Pyridine-2, 6-bis (thiocarboxylic acid) and its first row transition metal complexes*	pm	119	113
Katharine Perz: Animal & Range Sciences Mentor: Jennifer Thomson -- Animal & Range Sciences *Blood Parameters and Respiratory Quotients of Lambs Selected for Divergent Residual Feed Intake*	am	56	25
Randi Phelps: Psychology Mentor: Rebecca Brooker -- Psychology *Composites of neural markers of prediction of risk for anxiety symptoms*	am	76	92
Jenna Pinto: Cell Biology & Neuroscience Mentor: John Peters -- Chemistry & Biochemistry *Oxidative Stress Protection in Clostridium Perfringens*	am	33	93
Kaitlin Poole: Physics Mentor: Rufus Cone, Charles Thiel -- Physics *Laser Spectroscopy of Semi-transparent Rare-Earth-Doped Materials*	pm	80	93
Arielle Potter: Microbiology & Immunology Mentor: Seth Walk, Susan Broadaway -- Microbiology & Immunology *Novel Escherichia Lineages and the Campus Waterfowl Environment*	am	99	93
Shawna Pratt: Center for Biofilm Engineering Mentor: Connie Chang -- Chemical & Biological Engineering *Development and Applications of Double Emulsion Microfluidics Techniques*	am	25	66
Jessica Proctor: Architecture Mentor: Chris Livingston, Bradford Watson, Henry Sorenson -- Architecture *Exploring Responses to Marks Left on a Dwelling by Human Inhabitation*	am	9	26
Justin Provance: Health & Human Development Mentor: Lynn Owens -- Health & Human Development *Impact of the Coach-Athlete Relationship on Athlete Performance & Effort*	pm	67	50
Paul Puettmann: Cell Biology & Neuroscience Mentor: Roger Bradley -- Cell Biology & Neuroscience *NFPC Is required for proper secretion of Wnts during Neural Crest specification in Xenopus*	am	41	94

Student, Mentor, Project	Session	Poster #	Abstract Page #
Varsha Rao: Chemical & Biological Engineering Mentor: Sarah Codd, Joseph Seymour -- Mechanical & Industrial Engineering, Chemical & Biological Engineering *Heterogeneous Gelation of Bacterial Alginate strains FRD1 and FRD1153*	pm	30	66
Anita Ratcliff: Civil Engineering Mentor: Yiyi Wang -- Civil Engineering *A Study of Public Transit in Rural and Small Urban Communities*	am	79	67
Samantha Reap: Chemistry & Biochemistry Mentor: Mary Cloninger -- Chemistry & Biochemistry *Lactose-Functionalized Dendrimers Influence Galectin-3 Meditated Cancer Cell Migration*	pm	92	94
Taylor Reese: Chemical & Biological Engineering Mentor: James Wilking -- Center for Biofilm Engineering *Active Microrheology on Pseudomonas Aeruginosa*	pm	42	67
Mohammed Refai: Chemistry & Biochemistry Mentor: Brian Bothner -- Chemistry & Biochemistry *Proteomics of an archaeal host response to viral infection*	pm	73	34
Steven Rehbein: Chemistry & Biochemistry Mentor: Thomas Livinghouse -- Chemistry & Biochemistry *Development and Synthetic Application of Metalloamination of Zn(II)*	am	35	94
Miriah Reynolds: Animal & Range Sciences Mentor: Bret Olson -- Animal & Range Sciences *Are metabolic rates of beef cattle correlated with feeding level?*	pm	21	41
Amanda Richards: Microbiology & Immunology Mentor: Michael Franklin -- Microbiology & Immunology *Flourescent staining and imaging of the Pseudomonas aeruginosa PAO1 biofilm matrix material*	am	100	94
Heather Ridley, Madi Zahorik, Derrick Krueger, Chad Dalman, Phillip Levy: Business Mentor: Omar Shehryar -- Business *Bozeman Student Affordable Housing 2015*	pm	121	47
Matthew Rist: Community Health (Blackfeet Community College) Mentor: Theresa Pepion, Dee Hoyt -- Health & Education *When the Inner Environment is Neutralized with Kangan Water (hexagonal shaped water molecules): Muscle Cells have the Power to Ward Off Cancer Growth*	pm	99	113
Jamie Ritter: Cell Biology & Neuroscience Mentor: Darcy Hunter -- Gallatin WIC Program *Early Childhood Nutrition*	am	31	95
Joseph Rizzi, Samuel Leuthold: Land Resources & Environmental Sciences, Mentor: Tony Hartshorn -- Land Resources & Environmental Sciences *Effects of artificially warmed soils on carbon residency time*	pm	14	41
Marley Robb: Architecture Mentor: Elisa Renouard -- Architecture *AGUDDIM: PROPOSAL FOR A COMPREHENSIVE ANALYSIS OF PLACE*	am	14	46
Mike Roddewig: Electrical & Computer Engineering Mentor: Joseph Shaw -- Electrical & Computer Engineering *Detection of Lake Trout and Plankton in Yellowstone Lake with a Low-Cost, Miniature Airborne Lidar*	am	52	31

Student, Mentor, Project	Session	Poster #	Abstract Page #
Monica Rodriguez: Earth Sciences Mentor: Cody Warner -- Sociology and Anthropology *Community-based resources in Montana:Locations and neighborhood features*	am	93	95
Colleen Rooney: Chemical & Biological Engineering Mentor: Mark Young -- Plant Sciences & Plant Pathology *Analysis of peptide based targeting of a pathogenetic bacteria within a biofilm*	pm	43	67
Griffin Ruehl: Chemical & Biological Engineering Mentor: Stephanie Wettstein -- Chemical & Biological Engineering *Green Solvents for Biomass Solubilization*	pm	44	68
Rory Running: Art Mentor: Sara Mast, Michelle Flenniken -- Art, Plant Sciences & Plant Pathology *The Effects of the Modern Environment on the Current State of the Honey Bee*	am	Multi-media B	46
Erik Rupert: Mentor: -- *Abstract*	pm	127	-
Magdalena Russell: Cell Biology & Neuroscience Mentor: Frances Lefcort -- Cell Biology & Neuroscience *Neuroprotective effects of BGP-15 on IKAP deficient dorsal root ganglia neurons: increasing lifespan of a Familial Dysautonomia model*	am	40	96
John Ryter: Mechanical & Industrial Engineering Mentor: Roberta Amendola, Paul Gannon -- Mechanical & Industrial Engineering, Chemical & Biological Engineering *Investigating the Influence of Secondary Phases on the Dual Atmosphere Corrosion of Ferritic Stainless Steel 441*	pm	32	68
Daniel Salinas: Computer Science Mentor: Brendan Mumey -- Computer Science *Flux Calculations Based on Metabolomic Data for Human Chondrocyte Central Energy Metabolism in Response to Applied Compression*	pm	11	31
Shari Samuels: Mathematical Sciences Mentor: Beth Burroughs -- Mathematical Sciences *The Evolution of Prospective Elementary Teachers' Competencies*	Math Special Topics	-	34
Diana Schepens: Mathematical Sciences Mentor: Tomas Gedeon -- Mathematical Sciences *Optimization of Metabolic Pathway*	Math Special Topics	-	35
Anna Scott: Chemistry & Biochemistry Mentor: Joan Broderick -- Chemistry & Biochemistry *Mechanistic Studies of Hydrogen Abstraction in the Radical SAM Enzyme HydG*	am	34	96
Kaitlyn See: Microbiology Mentor: Christa Merzdorf -- Cell Biology & Neuroscience *The Role of aqp3b in Convergent Extension in Xenopus Embryos.*	pm	114	97
Alyssa Sferrazza, Chazlyn Miller: Health & Human Development, Psychology Mentor: Monica Skewes -- Psychology *The Sexual Experiences, Substance Use, Mental Health, and Academic Performance among University Students: Toward the Development of a Social Norms Intervention*	am	75	51
Riley Shearer: Agricultural Economics & Economics Mentor: Mark Anderson -- Agricultural Economics & Economics *Raw Milk and Infant Health*	pm	24	42

Student, Mentor, Project	Session	Poster #	Abstract Page #
Alex Sherman: Chemistry & Biochemistry Mentor: Rob Walker -- Chemistry & Biochemistry *Analysis of Secondary Amine 7-(methylamino-4-trifluoromethyl) Coumarin*	pm	93	97
Ty Show: Mechanical & Industrial Engineering Mentor: Laura Stanley -- Mechanical & Industrial Engineering *Peer-to-Peer Effects Amongst Teen Drivers On the Blackfeet Indian Reservation*	pm	31	68
Chelsie Shults: Architecture Mentor: Maire O'Neil -- Architecture *Design for Human Performance*	am	10	26
Vincent Siragusa: Biological Sciences (Montana Tech) Mentor: Amy Kuenzi -- Biological Sciences *Examining the relationship between movement and Sin Nombre Virus infection in the North American Deer Mouse (Peromyscus maniculatus)*	pm	98	114
Roy Smart, Jackson Remington: Physics, Mentor: Charles Kankelborg -- Physics *MOSES Flight Software Design and Development*	pm	88	97
Deann Snyder: Microbiology & Immunology Mentor: Mark Jutila, Jodi Hedges -- Microbiology & Immunology *Consumption of plant-derived agonists that enhance NK cell activity is beneficial in infection- and DSSinduced colitis*	am	97	35
Gage Sowell: Chemical & Biological Engineering Mentor: Rich Macur -- Center for Biofilm Engineering *Determination of optimal aeration rate and shear stress conditions for maximizing growth and lipid production by an extremophilic fungus*	am	86	69
Mallory Spencer: Microbiology & Immunology Mentor: Deborah Keil -- Microbiology & Immunology *Oxidative Stress and Lung Histopathology Following Sub-Acute Exposure to Natural Dust From Nellis Dunes Recreational Area*	pm	111	35
Isaac Stafstrom: Animal & Range Sciences Mentor: Tony Hartshorn, Patrick Hatfield -- Land Resources & Environmental Sciences, Animal & Range Sciences *Test of grazing effects on soil physical and chemical processes*	pm	22	42
Molly Taylor: Sociology and Anthropology Mentor: Jack Fisher -- Sociology and Anthropology *Horsing Around: The Skeletal Analysis of an Excavated Horse*	am	96	98
Kendra Teague: Health & Human Development Mentor: Selena Ahmed, Carmen Byker -- Health & Human Development *Understanding Opportunities and Challenges Associated with Indigenous Food Systems at the Fort Peck Indian Reservation Towards Healthy Communities*	pm	69	51
Brandon Thiesen: Physics Mentor: Hugo Schmidt -- Physics *Effects of Temperature Variation on the Impedance Spectra of Doped Perovskite Ceramics*	pm	89	98
Josh Thornton: Physics Mentor: Randy Babbitt -- Physics *Upgrading Tapered Amplifer Chips*	pm	90	98
Alexandra Thornton: Agroecology Mentor: Fabian Menalled -- Land Resources & Environmental Sciences *Impact of nitrogen availability and time of inoculation on Pyrenophora semeniperda effectiveness as a biocontrol agent of Bromus tectorum*	am	22	42

Student, Mentor, Project	Session	Poster #	Abstract Page #
Tan Tran: Mathematical Sciences Mentor: Mark Greenwood -- Mathematical Sciences *Choosing the number of clusters in monothetic clustering*	Math Special Topics	-	36
Mike Trenk, Adam Koziol, Connor Danelson, Hunter Lapp: Computer Science Mentor: Clemente Izurieta -- Computer Science *Development of Dashboard Management and Monitoring System Technologies in the Software Factory*	am	12	69
Eric Troyer: Chemical & Biological Engineering Mentor: Ellen Lauchnor, Adrienne Phillips, Robin Gerlach -- Civil Engineering, Chemical & Biological Engineering *Method to Measure Biomass Entrapped During Microbial Induced Calcium Carbonate Precipitation*	am	60	69
Will van Gelder: Earth Sciences Mentor: Mark Skidmore -- Earth Sciences *Clay Mineralogy of Subglacial Lake Whillans Sediments*	pm	5	99
Fred Vollmer: Agricultural Economics & Economics Mentor: Eric Hyyppa, Scott Sterling -- Montana PBS *Creating an iOS App to Showcase Montana's Music*	am	Multi-media A	99
Alana Vosen: Psychology Mentor: Keith Hutchinson -- Psychology *False Memory in Older Adults*	am	94	99
Cassia Wagner: Chemistry & Biochemistry Mentor: Mark Young -- Plant Sciences & Plant Pathology *Cryo-electron microscopy and bioinformatic annotation of an archaeal virus reveals a novel viral family*	am	38	100
Jessica Wambeke: Chemistry & Biochemistry Mentor: Robert Walker, Melissa McIntyre -- Chemistry & Biochemistry *Characterizing materials for high temperature energy conversion*	pm	94	100
Robert Watson: Modern Languages & Literatures Mentor: Ada Giusti -- Modern Languages & Literatures *Preservation of Berber Culture with French Theatre*	am	70	100
Mason Weber, Coltran Hophan-Nichols: Computer Science, Mentor: Clem Izurieta -- Computer Science *Mobile Application for Equation Recognition and Manipulation*	am	16	70
Shu Ying Wee: Chemical & Biological Engineering Mentor: Christine Foreman -- Chemical & Biological Engineering *Chemotaxis of Antarctic and Arctic Microbial Life toward Various Carbon Sources Using a Microfluidic Capillary Motility Method*	am	87	70
Martha Welander: Chemistry & Biochemistry Mentor: Bern Kohler -- Chemistry & Biochemistry *Photochemistry of Flavin Adenine Dinucleotide*	am	39	101
Kasey Welles: Architecture Mentor: Fatih Rifki -- Architecture *The Autonomous Automobile and Urban Morphology: How implementation of the autonomous car might change the form and structure of the city*	pm	47	27
Smith Wells: Animal & Range Sciences Mentor: Stuart Challender -- Earth Sciences *LONG-TERM CHANGES IN RIPARIAN AREAS FOLLOWING BEAVER REINTRODUCTION IN THE ABSAROKA-BEARTOOTH WILDERNESS*	am	66	43

Student, Mentor, Project	Session	Poster #	Abstract Page #
Amanda Williams: Mentor: Dave Swingle -- Museum of the Rockies *Jacques-Louis David: Classical Forms and Iconography from Greece, Rome, and France*	McNair Session	-	46
Tino Woodburn: Material Science Mentor: Rufus Cone, Charles Thiel -- Physics *Using Birefringence to Orient Biaxial Crystals for Photonic Applications*	pm	116	37
Jennifer Woodcock-Medicine Horse: American Studies Mentor: Robert Rydell, William Wyckoff, Henrietta Mann -- History & Philosophy, Earth Sciences, Native American Studies *Green Museums Waking up the World: Indigenous and mainstream approaches to exploring sustainability*	am	50	36
Jonathan Yauk: University Studies Mentor: Hua Li -- Modern Languages & Literatures *Evolution and The Underlying Ideals of China*	pm	35	104
Alysa Yoder: Earth Sciences Mentor: David Mogk -- Earth Sciences *Characterization of the Chamberlain Formation, Belt Supergroup*	pm	4	101
Ariel Zemlicka: Agricultural Economics & Economics Mentor: Caroline Graham Austin -- Business *Examining the Role of Fashion Bloggers in the Fashion Industry*	pm	123	101
Kevin Zolman: Cell Biology & Neuroscience Mentor: Susy Kohout -- Cell Biology & Neuroscience *Determination of the Role of the C2 domain of Voltage Sensing Phosphatase*	am	3	102