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Undergraduate Scholars Program

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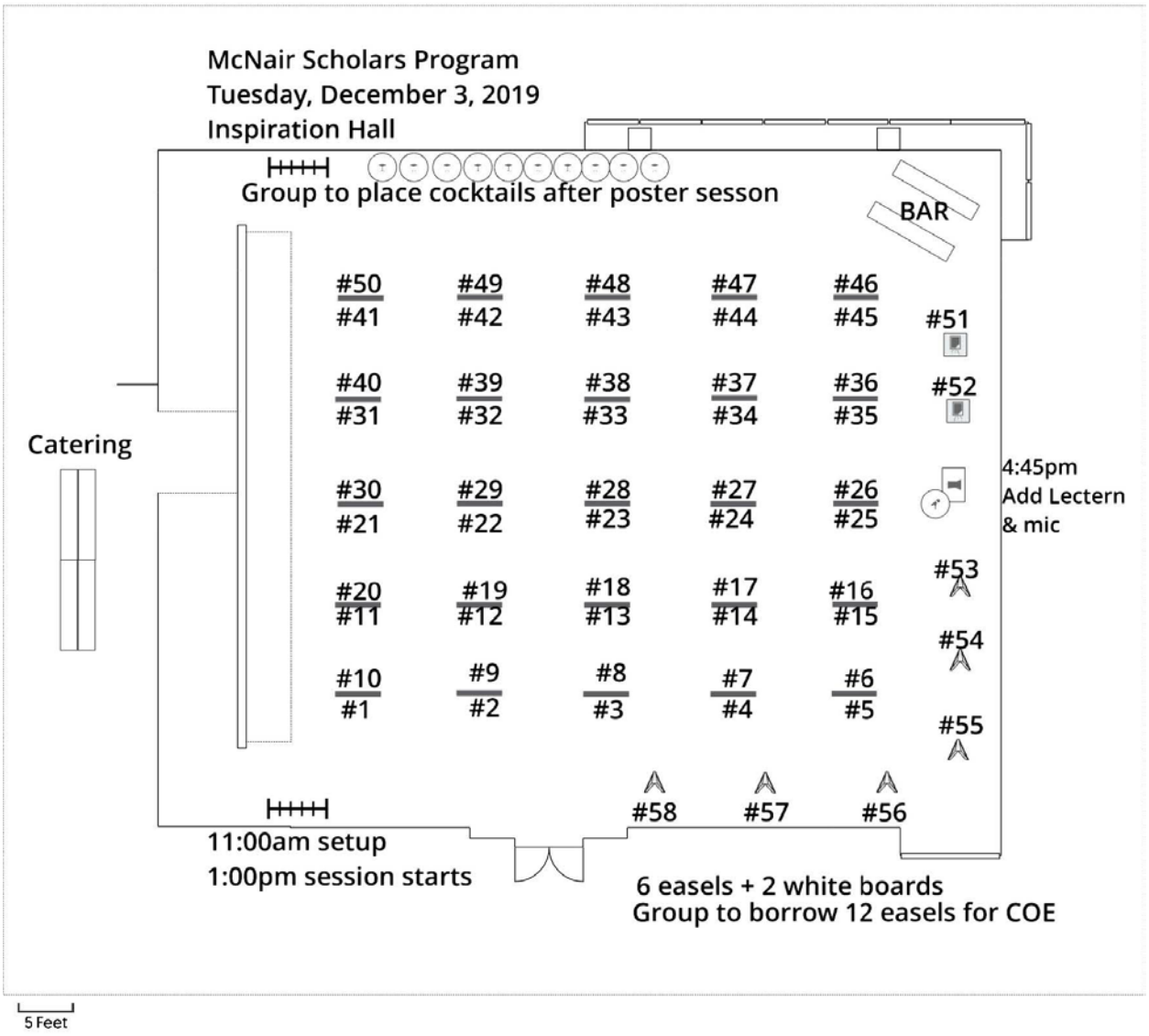

2019 Winter Student Research Celebration

December 03, 2019

POSTER SESSION 1

Inspiration Hall
1:00 - 2:30 pm

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2019 Winter Student Research Celebration

December 03, 2019

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Inspiration Hall
3:00 - 4:30 pm

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Trevor Anderson: Architecture Mentor: Chris Livingston – Architecture *Operation Hybrid*	2
Kelsey Morris, Amalia Cisneros, Vanya Harrold, Jack Swain, Brendan Rust: English, Psychology, Political Science, Business, Cell Biology & Neuroscience Mentor: Margaret Eggers – Microbiology & Immunology *Environmental Health Issues of Off-Campus Living*	3
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Kelly Cannici: Sociology and Anthropology Mentor: Nancy Mahoney – Sociology and Anthropology *Morphological Analysis of Late Pre-Contact Paleoindian Points in Eastern Montana*	5
Holly Old Crow: Sociology and Anthropology Mentor: Jennifer Woodcock-Medicine Horse – Native American Studies *Incarcerated to Integrated: The Good Road Home*	6
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2019 WINTER STUDENT RESEARCH CELEBRATION

GRADUATE ABSTRACTS

Sorted by Student Major

COLLEGE OF AGRICULTURE

Keenan Brame: Land Resources & Environmental Sciences
Mentor: Tim McDermott, Anne Camper – Land Resources & Environmental Sciences, Center for Biofilm Engineering

Temporal and spatial dynamics of coliform, Escherichia coli, and total microbial community composition across river habitats and conditions on the Little Bighorn River: A small-scale river system in southeastern Montana

Flowing from its headwaters in the Bighorn Mountains in Wyoming, the Little Bighorn River runs through the Crow Indian Reservation in southeastern Montana. Swim holes along the river within the Reservation are often used by children for summer recreation and in ceremonial practices water is ingested. This small-scale, discharge driven river system was investigated for fecal indicator organisms (coliform and Escherichia coli) as well as the microbial community composition over a three-year period across varying river conditions. Six sites were routinely sampled. The goals of this study were to monitor and assess the spatial and temporal variability of fecal indicator organisms and characterize the microbial community composition as a function of aquatic habitats (planktonic, suspended particulate associated, sediment). Indicator organism data was quantified as a most probable number and community structure was assessed as 16S rRNA gene libraries sequenced via Illumina MiSeq technology. Statistical analyses compared indicator organism concentrations and community composition variance across categorical variables, showing significant differences between river conditions and location. Both differences in community composition and indicator organism abundances between sites were most distinct on a date specific level. Spatial connectivity played a role in community composition, with upstream sites resulting in similar planktonic and particulate associated community structure, as well as those downstream, exemplified by ADONIS and Random-Forest Classification analyses. These results are significant to the Crow Indian community, highlighting the distribution and patterns of fecal indicator organism occurrence in surface waters. Further, this study contributes to freshwater microbial ecology concerning small-order rivers across constrained spatial scales. Research was made possible through invitation from the Crow Environmental Health Steering Committee.

Acknowledgements: Thank you to John Doyle at Little Big Horn College for all the assistance with site selection and sampling, and to Anne Camper and Mari Eggers for graduate and research funding.

COLLEGE OF ARTS & ARCHITECTURE

Trevor Anderson: Architecture
Mentor: Chris Livingston – Architecture
Operation Hybrid

The project was conceived as a way to begin to understand how urban environments should evolve to catalyst the growing and changing complex world. With a case study of Downtown Bozeman, a site was selected adjacent to the parking garage to be developed as a complex urban habitat. Seven different programs were selected at random to be considered, researched, defined and implemented into a cohesive building type. The project shows an evolved and elaborate building that introduces a sumo training facility, substance abuse center, surf pool, algae technologies, co-housing, public plaza and parking garage into the urban fabric of Bozeman Montana. The increased density of private, and public amenities in downtown Bozeman led to a building typology that is not defined by aesthetic or single cultural forms but as a mixture to highlight how small cities can emerge in the 21st century in a sustainable way. The project also recognizes net-zero energy practices that do not only look at simple sustainable strategies but furthers the dialogue of integrated sustainable techniques. Out of Operation Hybrid was not Bozeman's next downtown building; but an increased understanding of potential trajectory of modern urban development.

Jakub Galczynski: Architecture
Mentor: Ralph Johnson, Henry Sorenson – Architecture
Mixed Resolution : Architectural Expression

My research proposes a shift in western architectural emphasis, spurred by the compromised and a potentially misunderstood architecture. I argue for a mixed resolution aesthetic that counters an abstract paradigm of modern architecture. Although influenced by historic motives, my stance is also related to the new philosophy in object-oriented ontology (OOO). Through this lens of understanding architecture as object, we can focus on the values of complexity and mixed resolution aesthetics. I am currently developing a conceptual building that illustrates my research in mixed resolution aesthetics.

COLLEGE OF EDUCATION, HEALTH & HUMAN DEVELOPMENT

Stephanie Wilson, Jesse Peach: Health & Human Development, Chemistry & Biochemistry
Mentor: Mary Miles, Brian Bothner – Health & Human Development
Temporal response yields a dynamic biosignature of inflammation and discriminative gut bacterial features

Chronic low-grade inflammation is a subclinical condition directly and indirectly linked to the development of a wide range of highly prevalent diseases responsible for the vast majority of morbidity. In healthy populations, body mass index (BMI) has been found to be one of the best predictors of future chronic disease. To examine the possible mechanisms of developing chronic disease, a group of overweight and obese human subjects without known inflammatory diseases were selected. Participants underwent a high-fat meal challenge and blood was drawn before and four times after for a comprehensive time-course. Collected serum samples were then analyzed for inflammatory markers and metabolites. DNA was extracted from self-collected fecal samples for Illumina MiSeq amplicon sequencing of 16S rRNA V4 to determine gut microbial composition. LCMS analysis of serum metabolites grouped by baseline inflammation marker concentrations revealed that single samples had little power in differentiating the groups. However, an analysis that incorporated temporal response separated high and low inflammatory response phenotypes and allowed us to create a metabolic signature of inflammation. Discriminative gut microbial features were additionally found for the temporal triglyceride response to the meal. The use of temporal response rather than absolute concentrations improved clinical diagnostics in this study and suggests that dynamic biosignatures may be a powerful tool for stratifying risk to a wide range of diseases.

Acknowledgements: Logan Gunderson (MSU Undergrad Student) – Chemistry & Biochemistry, Tan Tran (MSU Postdoctoral Researcher) – Mathematical Sciences, Montana State University Research Initiative 51040-MUSRI2015-03 and USDA-NIFA 2017-67018-26367.

COLLEGE OF ENGINEERING

Villő Enikő Bécsy-Jakab: Chemical & Biological Engineering
Mentor: David Hodge – Chemical & Biological Engineering
Relating Lignin Source and Processing History to Solubility in Diverse Solvents

Lignin is an important organic polymer in plant cell walls, and a significant biorefinery residue; but right now the industry only use it as solid fuel. Therefore we plan to utilize this industrial residue for bioproducts by recovering, purifying, and characterizing it. We used corn stover derived lignin to carry out extractions using different conditions to explore the diversity of purified lignins by characterizing with a comprehensive analysis using two-step hydrolysis, UV-Vis spectroscopy, HPLC, GPC, and NMR spectroscopy. The sulfuric acid catalysed ethanol-water extraction after filtration resulted in a mixture containing sugars and inorganic compounds in addition to lignin. We further purified it by evaporating the solvent and then incubating it in water at room temperature. After filtration we obtained a powder with high lignin content. The sodium hydroxide extraction after filtration resulted in a highly alkaline liquor. We used sulfuric acid to precipitate the lignin, and after filtration incubated it in water at room temperature. We obtained a powder with high lignin content after filtration. We determined the solubility of the purified lignins from the two extraction methods in DMSO, methanol, ethyl-acetate, acetone, propylene-carbonate and THF. Further use of the identified bioproducts are lignin-based PF (phenol-formaldehyde) wood adhesives, where the corn stover derived lignin can replace the phenol, thus decreasing the cost and toxicity of the process.

Acknowledgements: USDA - NIF

COLLEGE OF LETTERS & SCIENCE

Alexandra Cheney: Chemistry & Biochemistry
Mentor: Valérie Copié, Frances Lefcort – Chemistry & Biochemistry, Microbiology & Immunology
Exploring the Gut-Brain-Liver Axis in Familial Dysautonomia: How Microbes and Metabolism Exacerbate Neurodegeneration

Microbiome dysbiosis associated with neurodegenerative diseases is of increasing interest, as the impact of the microbiome on neuronal health is becoming more apparent. However, few current studies are taking into account the role that central metabolism, which is regulated by the liver, plays in mediating gut-brain cellular networks. We hypothesize the gut-brain-liver axis is disrupted in the progressive neurodegenerative disease Familial Dysautonomia (FD), which stems from a genetic mutation in the gene encoding the ELP1 protein. Furthermore, we postulate that gut-brain dysbiosis observed in FD triggers metabolic dysfunctions, originating from both gut bacteria and host, which further exacerbate neuronal dysfunction and gut health decline. While FD is a rare disease, its simple genetic origin and shared hallmarks with more complex neurodegenerative diseases such as Alzheimer's and Parkinson's, have made FD a tractable model to characterize the cross-talk between the gut microbiome/metabolism dysbiosis and neuronal health. Our approach integrates next generation microbial DNA with NMR metabolomics and histological analyses of gut tissue to decipher the molecular networks underlying gut-brain-liver dysfunction in FD. Such a systems-level analysis has never been undertaken in FD before, and will enhance our knowledge of regulatory networks mediating gut health issues associated with neurodegeneration in humans. To this end, we have begun characterizing changes in the gut microbiome of FD patients and mouse models, and are designing intervention strategies to establish a cause and effect in FD-associated gut functions, and to establish how bacterial and host-derived metabolites alter the gut-brain axis in FD.

Acknowledgements: Marc Mergy (MSU Postdoc/Research Scientist) – Microbiology & Immunology, Alpha Scheel (MSU Undergrad Student) – Microbiology & Immunology, Annie Waldum (MSU Undergrad Student) – Chemistry & Biochemistry, Anne Parker (MSU Undergrad Student) – Chemistry & Biochemistry, Molecular Biosciences Fellowship, National Institutes of Health

Kirke Elsass: History & Philosophy
Mentor: Tim LeCain, Eric Sproles – History & Philosophy, Earth Sciences
Emerging Chemistries: Concrete and Community in Dillon, Montana c. 1905

During the first years of the twentieth century, residents in many towns in Western Montana experienced something new: cemented pedestrian pathways. Concrete walkways first replaced plank boardwalks, then crossed dirt streets, then became the standard mode of sidewalk construction. The infrastructure emerged along with new sets of both molecular and social relationships; this concrete history is best understood within United States developments both of cement production technology and of municipal conventions. However, national context does not answer all local questions. Like many other municipalities in Montana, and across the country, much of Dillon's concrete sidewalk development came to result from city council decree. Local newspapers told of no controversy from these city mandates. Dillon editors and publishers were unabashed champions of concrete sidewalks. Yet the papers did report controversy in distant Livingston and Billings, where property owners objected to concrete projects ordered by their respective councils. The editors may have simply censored local controversy, but this research suggests otherwise. Thorough accounts of the Dillon projects—which sidewalk blocks were laid when, and at whose behest—allowed for coded mapping of the projects in a geographic information systems (GIS) framework. Historical GIS analysis supports the conclusion that Dillon's concrete sidewalk construction was truly less controversial. The city council's prescribed projects were piecemeal and interspersed, in both space and time, with projects ordered by various community organizations. Cemented infrastructure in Dillon was more group effort than edict.

Acknowledgements: The Ivan Doig Center

Katie Fasbender: Physics
Mentor: David Nidever – Physics
A catalog-based approach to discovering solar system objects

Beyond the main planets, the solar system is full of smaller orbiting bodies called Solar System Objects (SSOs). Despite their relative proximity to Earth, many remain undiscovered and there is still much to learn about their properties and interactions. This project searches the first data release of the National Optical Astronomy Observatory Source Catalog (NSC) for SSOs. The NSC contains 34 billion measurements of 2.9 billion unique objects, which are either "stationary" stars and galaxies, or moving asteroids, comets, and meteors. In an automated process, measurements from the NSC are assigned to their corresponding objects via an iterative clustering method. Measurements pertaining to stationary bodies are identified using a small cluster radius of 0.5'', and are removed. Remaining detections belonging to fast-moving objects are clustered together over single nights to form structures called "tracklets". Tracklets are validated based on their spatial linearity and motion through time. Once validated, their proper motions are calculated and used to connect tracklets and unclustered measurements over multiple nights by predicting their locations at common times to form "tracks". Tracks will be linked together to form possible SSO orbits. We will derive and investigate properties of the final catalog of SSOs, comparing them to those of known objects. I will present the initial results from this work.

William Freimuth, Giulio Panasci: Earth Sciences
Mentor: David Varricchio – Earth Sciences
The rich ichnologic record of Egg Mountain (Two Medicine Formation, MT, USA) provides insight into the environment, sedimentology, and ecology of a dinosaur nesting site

The Upper Cretaceous Egg Mountain locality is a rich dinosaur nesting site that produced the first dinosaur eggs from North America, multiple clutches of the theropod Troodon formosus, and recently, several well-preserved mammals and lizards. In addition to abundant skeletal and egg remains, several kinds of trace fossils indicate abundant biological activity, representing nesting, dwelling, and feeding behaviors. We report the first comprehensive overview of trace fossils from the site. Reproductive traces of both invertebrates and vertebrates are pervasive. Five morphologies of eggshell represent different oviparous vertebrates that bury or partially bury their eggs within the substrate. Additionally, insect pupation structures are abundant and suggest workable soil conditions and relatively low sedimentation rates throughout the time of deposition. Their abundance corroborates semiarid, seasonally dry conditions inferred throughout the Two Medicine Formation. Enigmatic hemispherical structures may represent invertebrate dwelling and feeding traces and add to the diversity of burrowing organisms at the locality. A series of feeding traces are represented by coprolites, fecal pellets, and multi-individual, crania-skewed assemblages of small vertebrates that may represent regurgitated gastric pellets. Though the specific producers of these feeding traces are difficult to determine, they offer unique insight into trophic interactions at the locality. Overall, the striking abundance of trace fossils suggests a suitable environment for both soil-dwelling organisms and nesting vertebrates. The trace fossil assemblage is dominated by in situ terrestrial activity with the majority of traces representing subsurface activity. The record of biotic activity is a unique window into the ecology and environment at a Cretaceous dinosaur nesting locality.

Marziah Hashimi: Microbiology & Immunology
Mentor: Diane Bimczok – Microbiology & Immunology
Recruitment of Dendritic Cells to the gastric epithelium of human gastric organoids during Helicobacter pylori infection

H. pylori is a non-invasive, bacterial pathogen that infects the lumen of the stomach and interacts with epithelial

cells. We here analyzed the interactions between H. pylori-infected gastric epithelial cells and human dendritic cells in a gastric organoid co-culture model. There was a 2-fold increase of dendritic cell (DC) recruitment to organoids microinjected with H. pylori compared to mock-infected organoids in our chemotaxis assays. We have shown that CXCL1, 7, 8, 16, 17, and CCL26 significantly increased in the supernatants of H. pylori infected organoids compared to mock-infected, while there was no difference CXCL17 and CCL20 amounts the either conditions.
We also showed that DCs co-cultured with H. pylori-infected organoids can uptake bacteria from the organoid lumen. Next, we evaluated the maturation state of DCs following their co-culture with _H. pylori-infected or non-infected gastric organoids. We show that the maturation makers CD86, CD83 and CD40 were upregulated in DCs co-cultured with H. pylori infected organoids, whereas non-infected organoids did no alter DC maturation. In conclusion, DC recruitment is significantly increased upon H. pylori infection and this recruitment is chemokine-dependent. We also have shown that recruited DCs show a pattern of maturation upon H. pylori infection.

Acknowledgements: Thomas A. Sebrell (MSU Postdoc/Research Scientist) – Microbiology & Immunology, IDeA Network of Biomedical Research Excellence, McNair Scholars Program, Big Data Summer Institute, Iowa Summer Institute in Biostatistics

Audrey Hood: Psychology
Mentor: Keith Hutchison – Psychology
Providing goal reminders eliminates the relationship between working memory capacity and Stroop errors.

We examined whether goal maintenance explains higher working memory capacity (WMC) individuals' better performance within mostly congruent (MC) Stroop lists. Participants first completed the Automated Operation Span and were then assigned to either a true control, yoked control, or goal-reminder condition. During the Stroop task, the true control group received rest breaks every 60 trials, whereas the goal-reminder and yoked control groups stopped every 12 trials to vocalize either the task goal (i.e., "name the color not the word") or a rehearsed statement (i.e., "this fulfills my psych 100 requirement"), respectively. We regressed Stroop errors on group and WMC, comparing each group to the true control. For the goal reminder comparison, there was an interaction, such that WMC correlated with Stroop errors in the true control, but not in the goal-reminder condition. In contrast, for the yoked control comparison, there was only a main effect of WMC. Thus, providing goal reminders eliminates the relationship between WMC and Stroop interference.

William Johnston: Mathematical Sciences
Mentor: Lisa Davis – Mathematical Sciences
Rational approximations for modeling EM transients in transmission lines

Rational approximations are commonly used in frequency dependent modeling of electromagnetic transients in transmission lines. The most commonly used rational approximation algorithm in this industry is Vector Fitting. A key feature of Vector Fitting is the approximation of multiple inputs over a common set of poles. The common set of poles is important for reducing computation time in the models. However, Vector Fitting is known to have some shortcomings. We propose a new multi-input algorithm based on the AAA algorithm for use in these models. We demonstrate that this approach yields an accurate and robust algorithm and leads to some additional interesting problems.

Acknowledgements: Matthew Reynolds (Non-MSU/Other) – Other, Lucas Monzon (Non-MSU/Other) – Other, National Renewable Energy Lab

Sonja Ring: Microbiology & Immunology
Mentor: Margaret Eggers – Microbiology & Immunology
Hydrogen Sulfide in Water of Three Forks, Montana

High levels of arsenic are known to contaminate groundwater along the Madison River in the western part of Gallatin County. This river flows through Three Forks, Montana, hence families within the Three Forks School District are at risk, if they aren't on the public water supply and aren't testing their well water for arsenic. In this study, MSU and Three Forks High School science students are collaborating to provide free home well water testing for arsenic to local residents. Samples from about 40 wells were submitted, and the water was then brought back to the lab for testing. There is an affordable test kit for arsenic, but the presence of hydrogen sulfide above 2 ppm interferes with the test. As hydrogen sulfide could be coming out of Yellowstone, all water samples were first tested for this contaminant using both high level and low-level hydrogen sulfide test strips. None of the well water samples had detectable hydrogen sulfide, hence the samples were then analyzed for arsenic using the test kit. The recommended levels for hydrogen sulfide is less than 10ppm before the water starts to smell and looks strange. From the data that has been collected so far, there are low levels of hydrogen sulfide. The next steps that will be taken are compiling of the data, doing more research about hydrogen sulfide, looking over the surveys and informing people if they need to go further in water testing.

Katherine Steward: Chemistry & Biochemistry
Mentor: Brian Bothner – Chemistry & Biochemistry
Metabolic Implications of Using Bio Orthogonal Non-Canonical Amino Acid Tags for Tracking Protein Synthesis

BONCAT, or Bio Orthogonal Non-Canonical Amino Acid tags, are powerful for tracking protein synthesis on the level of single cells within communities and organisms. They have been utilized in species from bacteria and archaea to zebrafish, but their effects have only been evaluated using tests such as monitoring growth rate or assessing cell behaviors. If the presence of non-canonical amino acids (NCAA) induce changes in the metabolic state of cells, interpretation of such studies could be challenging. To address this knowledge-gap, we have used a global metabolomics analysis to assess the intercellular effects of NCAA incorporation. Two NCAA were tested: AHA (azidohomoalanine) and HPG (homopropargylglycine) as well as Methionine for a minimal stress baseline control. UPLC-MS and NMR were used to characterize intracellular metabolite profiles of the cell cultures, with multivariate statistical analysis using XCMS and MetaboAnalyst. Results from cells growing in replete conditions indicated metabolic changes resulting from the addition of NCAA, but these changes appear minimal and localized to energy metabolism . A secondary experiment was performed which introduced heat stress to the growth conditions. This second study allowed us to determine that, while energy production pathways were altered due to the incorporation of NCAA in the presence of heat stress, the perturbation seemed limited to few metabolic networks. Globally, only 15% of the metabolome as assessed by fold changes in observed MS spectral features appeared to be altered. This result indicates that cell growth in the presence of NCAA induces minor perturbations in metabolism of E. coli cells.

Acknowledgements: Brian Eilers (MSU Postdoc/Research Scientist) – Chemistry & Biochemistry, Keck Foundation, MJ Murdock Charitable Trust , National Institue of General Medical Scienes, NIH SIG, NSF, Office of the VP for Research and Economic Development at MSU

Matthew Strasbourg: Physics
Mentor: Nicholas Borys – Physics
Unraveling nonlinear formation and relaxation of excitons in atomically thin 2D semiconductors

Transition metal dichalcogenide semiconductors are layered van der Walls materials that exhibit exceptional optoelectronic properties in monolayer form. Their atomically thin nature and reduced long-range dielectric screening make them ideal systems in which to study many-body electronic states. Here, the dynamics of several higher-order exciton states in monolayer-WSe2 are probed using temperature-, energy-, and power-dependent time-resolved optical spectroscopy. These studies reveal a complex interplay between multiexciton states and

single-exciton states in 2D materials that depends on both the density and excitation energy of the initial exciton population. In addition, the presence of defect-bound excitons is found to drastically alter the formation of multiexciton states. This competition between exciton trapping and multiexciton formation highlights the need for high-quality materials to enhance multiexciton physics. Understanding these formation and relaxation dynamics of the rich manifold of exciton states is critical for leveraging this new class of 2D semiconductors for advanced technologies.

Acknowledgements: Cory Johns (MSU Undergrad Student) – Physics, Thomas P. Darlington (Non-MSU/Other) – Physics, P. James Schuck (Non-MSU/Other) – Mechanical & Industrial Engineering, James C. Hone (Non-MSU/Other) – Mechanical & Industrial Engineering

Merrilee Thomas: Cell Biology & Neuroscience
Mentor: Thomas Hughes – Cell Biology & Neuroscience
Bioengineered Cells for a High Throughput Screen of Calcium sensors

Genetically encoded, fluorescent sensors are proving to be powerful tools in neuroscience. There are now many proof-of-principle versions that show promise. Improving on these, however, has been challenging because testing them involves low throughput, labor-intensive processes. We propose a Rube Goldberg like system that is a simple, reproducible, optogenetic process for testing prototypes of genetically encoded biosensors, specifically calcium indicators. The system actuates using a blue light activated adenylyl cyclase enzyme from the soil bacterium Beggiatoia (bPAC) (Stierl et al. 2011). The beauty of using bPAC over other actuators is that it can withstand stimulation from bluelight for several minutes while continuing to actuate the system which means that both red and green sensors can be screened simultaneously.

Acknowledgements: NIH Brain Initiative Grant

Summer Whillock, Ashleigh Poppler, Courtney Sanders: Psychology
Mentor: Benjamin Oosterhoff – Psychology
Longitudinal Associations between Civic Engagement and Character Strengths: A Daily Diary Study

Positive youth development (PYD) models propose that character is an important antecedent to civic action, yet few longitudinal studies have examined links between character strengths and civic behavior. Using a daily diary design, this study tested longitudinal associations between character and civic behavior during the 2018 US midterm elections. Participants (N=235, Mage=19.43) completed seven daily assessments of three character strengths (purpose, future-mindedness, gratitude) and four civic behaviors (community service, environmentalism, standard political behavior, social movement behavior). There were between-person weekly effects and within-person daily effects for most character strengths, community service, and environmentalism. Higher daily purpose was associated with greater daily standard political and social movement involvement. Greater social movement involvement predicted higher next-day purpose and future-mindedness. Greater community service involvement predicted higher next-day future mindedness. Higher purpose predicted greater next-day standard political and social movement involvement. Findings indicate that character and civic engagement are linked across different time scales and bi-directionally associated across days. This supports research that proposes character strengths may contribute to civic development, and that civic engagement may enhance character strengths. Results from this study inform theory on positive youth development and can be used promote civic engagement and character in youth.

COLLEGE OF THE GRADUATE SCHOOL

Cameron Wallace: WWAMI Medical Education Program
Mentor: Ron June – Mechanical & Industrial Engineering
Comparing metabolite profiles of synovial fluid and serum after knee injury: a mouse study for early detection of osteoarthritis

Post-traumatic osteoarthritis (PTOA) results in pain and loss of motion of the affected joint. 50% of people with a diagnosed ACL or meniscus tear will develop PTOA within 20 years. Current diagnosis is made once significant joint damage becomes detectable on radiograph. Treatment includes temporizing measures with joint replacement as a last resort. Recent research suggests that there may be a window period of altered joint biology immediately following injury, setting up permanent damage and progression of OA. The objective of this study was to assess correlations of metabolite levels between synovial fluid (SF) and serum toward developing a panel of metabolite biomarkers of PTOA. A randomly selected knee of adult female C57BL/6 mice (n=13) was subjected to a single ~12N rapid compression. At 1- or 8-days post-injury, serum was harvested before mice were euthanized by cervical dislocation. SF was then collected from the injured joint. Metabolites were extracted from SF and serum using methanol. Ultra-high-performance liquid chromatography was used for metabolomic analysis. 2554 metabolite features were detected across all samples, with 230 significantly correlated ($P<0.05$) between SF and serum. We made putative identification of 58 positive and 16 negatively correlated metabolites. For example, NADPH and steroid hormones were positively correlated while GAG monomers were negatively correlated. Recent studies have shown the promise of metabolomic profiling of synovial fluid for developing biomarkers of OA. These data suggest that a subset of SF metabolites correlate strongly with serum metabolite levels following joint injury. Further exploration may yield serum biomarkers capable of early detection of OA and metabolic pathways as potential targets for intervention.

Acknowledgements: Alyssa Hahn (Non-MSU/Other) – Other, Priyanka Brahmachary (MSU Graduate Student) – Other, Ayten Edrogan (MSU Graduate Student) – Mechanical & Industrial Engineering

2019 WINTER STUDENT RESEARCH CELEBRATION

UNDERGRADUATE ABSTRACTS

Sorted by Student Major

COLLEGE OF AGRICULTURE

Franklin Alongi: Plant Sciences & Plant Pathology
Mentor: Brian Smithers – Ecology
Comparative Drought Response of Pinus flexilis and Pinus longaeva

In much of the western US, limber pine (Pinus flexilis) and Great Basin bristlecone pine (Pinus longaeva) largely compose sub-alpine treelines. As a result of climate change and the increase of growing season temperature, subalpine treelines are expected to move up in elevation. Understanding the limiting factors during germination and the establishment of sub-alpine conifers is critical since their seedlings have an extremely low survival rate, compared to a relatively high survival rate following establishment. The objective of this project was to determine the differential drought responses of limber pine and Great Basin bristlecone pine under controlled greenhouse conditions to limit environmental differences other than drought. This study revealed a varying nature of drought responses within these two sub-alpine species. Both species experiences mortality at different periods in life, varying further by the level of drought induced. Limber pine overall displayed higher resistance to drought, and also displayed the most growth throughout induced drought levels. This varied even further, depending on how long into establishment the seedlings were when drought was induced. These findings will help predict sub-alpine species population distributions through climate change, which is expected to increase drought throughout these western sub-alpine communities.

Acknowledgements: Undergraduate Scholars Program

Nathaniel Barnes: Land Resources & Environmental Sciences
Mentor: Scott Powell, Jenny Watts, Mary Farina – Land Resources & Environmental Sciences, Ecology
Effects of topography on the magnitude of methane flux in a boreal wetland ecosystem

Over half of the world's total soil carbon pool is located beneath northern high-latitude ecosystems. These carbon stocks are thawing rapidly due to rising global temperatures. Warmer temperatures accelerate microbial activity in soils, increasing decomposition of organic material and the emission of greenhouse gases carbon dioxide (CO2) and methane (CH4). Saturated, anoxic soils favor the production and emission of CH4, which has 25 times the global warming potential of CO2. Despite the importance of CH4, there is uncertainty regarding the magnitude and spatial variability of emissions from boreal ecosystems. This research investigates spatial relationships between CH4 flux and variations in microtopography (aspect, elevation, and slope) by combining high-resolution drone imagery with in-situ ground measurements. Our study site was Big Trail Lake (64.919Â°N, 147.822Â°W), a boreal wetland located northwest of Fairbanks, AK. Drone flights were conducted using a high-resolution, multispectral sensor to record the near-infrared and visible reflectance of vegetation and soils in the 50-ha surrounding the lake. A drone-based digital surface model was used to extract elevation, aspect, and slope from sample points along five transects surrounding the lake. Vegetation composition, soil characteristics, and chamber-based CH4 flux were collected from each point to capture the transition from saturated soil to drier, upland areas. This work tests the hypothesis that elevated CH4 flux occurs in local depressions where moisture and surface temperature are high. Ongoing work includes an upscaling analysis to investigate spatially resolved relationships between microtopography and CH4 flux for the 50-ha area around Big Trail Lake.

Acknowledgements: Undergraduate Scholars Program

Lilianna Bento: Plant Sciences & Plant Pathology
Mentor: William Dyer, Barbara Keith – Plant Sciences & Plant Pathology
Glyphosate Contamination in Organic Systems: Exploring Potential Sources of Contamination Through Seed Analysis

Glyphosate (Roundup® and other commercial names) is the most widely used agricultural herbicide in the world as it is highly efficient at controlling grassy and broadleaf weeds. With the recent advent of Roundup Ready® crops, glyphosate use has increased by 15-fold in the United States alone, because the herbicide can now be used to kill weeds without injuring the crop. As a result, glyphosate residues are now commonly found in many food products. In organic systems, farmers are not allowed to use any synthetic chemicals including glyphosate. However, recent shipments of organic wheat and durum from Montana were determined to be contaminated with glyphosate, causing European buyers to reject them. This has created significant economic hardships for producers in Montana and elsewhere. My research project investigates the potential environmental source(s) of glyphosate contamination in organic wheat. Seven contaminated organic wheat samples were separated into three fractions: germ (embryo), endosperm (flour), and bran (seed coat). I propose three potential sources of contamination: 1) direct glyphosate drift from neighbors' non-organic fields, 2) long-distance aerial transport and deposition during the growing season, and 3) glyphosate deposited on grains during shipping and handling. My hypothesis is that contamination from Source 1 or 2 would result in more glyphosate in the seed germ (embryo), while bran fractions would contain the highest residues if contamination occurred from Source 3. Analysis by the Montana Agriculture Experiment Station Analytical Laboratory using LC-ES/MS/MS (reporting limit of 20 ppb) showed that glyphosate was detected in all three seed fractions, indicating that contamination likely did not come from Source 3. Additional research will be needed to distinguish between Source 1 and 2 as the direct cause of glyphosate contamination in organic grains.

Acknowledgements: Bruce Maxwell (MSU Faculty Member) – Land Resources & Environmental Sciences, Jona Verreth (Montana State University) – AES Analytical Lab, Montana Wheat and Barley Committee

Joshua Botti-Anderson: Land Resources & Environmental Sciences
Mentor: Kevin O'Neill, Casey Delphia, Laura Burkle – Land Resources & Environmental Sciences, Ecology
The diversity and abundance of bees and wasps using trap nests in urban environments in Bozeman, Montana

Solitary cavity-nesting bees and wasps construct linear sequences of brood cells in existing aboveground cavities. Because some of the species might benefit humans via plant pollination and pest management, there is a need to understand the composition of such communities in disturbed environments, such as urban landscapes. Cavity-nesting species can be studied by using trap-nests, which provide artificial nesting sites and allow provisioned nests to be collected and their occupants reared in the laboratory. The objective of this project is to use trap-nests to compare the diversity and abundance of solitary cavity-nesting bees and wasps (and their natural enemies) between urban areas and adjacent semi-natural environments. In Spring 2018, we placed eight sets of trap-nests in urban environments (e.g., backyards) within the city of Bozeman, Montana, and another eight in semi-natural parks and surrounding farms. We collected nests from the trap-nests weekly from May to October 2018, yielding 315 nests from urban sites and 385 from semi-natural sites. In the fall, we placed the nests in cold storage to mimic overwintering conditions. In Spring 2019, we returned nests to room temperature to induce development and emergence of the offspring of the nest provisioners and their natural enemies. We identified emerged adult insects to genus, including 822 individuals comprised of 13 genera from urban sites and 976 individuals of 17 genera from semi-natural sites. Future work will include species-level identifications and comparisons of offspring

diversity, abundance, mortality (e.g., natural enemies), body sizes, and sex ratios between urban and semi-natural habitats.

Acknowledgements: Laura Burkle (MSU Faculty Member) – MSU Faculty Member, Kevin O'Neill (MSU Faculty Member) – Land Resources & Environmental Sciences, Undergraduate Scholars Program, Montana Institute on Ecosystems

Daniel Huck: Land Resources & Environmental Sciences
Mentor: Tony Hartshorn – Land Resources & Environmental Sciences
Is Nitrogen the Secret Ingredient to the Soil Remediation Success of Arsenic-Oxidizing Bacteria?

How best to remediate soils contaminated with arsenic along with other heavy metals such as copper and lead? My research explored techniques for increasing the productivity of Leymus cinereus (basin wildrye grass) in Deer Lodge Valley soils with a goal to also increase the phytoextraction rate of metal(loid)s, specifically arsenic. From Anaconda to Deer Lodge, airborne emissions of metal(loids) from the Washoe Anaconda copper smelter rained out over the Deer Lodge Valley, leading to the designation in the 1980s of three Superfund sites stretching ~100 river miles from Opportunity to Milltown, Montana. I ran a greenhouse experiment to test phytoextraction capabilities to remove arsenic in mine tailings along the Clark Fork River. The results were unanticipated. First, my negative control (no amendment) had similar growth relative to the other treatment groups. Second, my nitrogen addition showed the lowest plant performance. Several factors could have influenced these results: over-application of nitrogen, high levels of Iron oxides and hydroxides in the soil, and greenhouse methods. As with any research, these new questions will guide my future investigations into cost-effective soil remediation approaches suitable for the hundreds of contaminated square miles of Deer Lodge Valley.

Acknowledgements: Undergraduate Scholars Program

Emily Lawrence: Animal & Range Sciences
Mentor: Jennifer Thomson – Animal & Range Sciences
Genomic analysis of Argali sheep to define management units

Previous studies suggest that Argali sheep (Ovis ommon) populations are in decline across Asia due to both illegal poaching and trophy hunting practices. However, legal trophy hunting is a vital source of income for conservation efforts. Therefore, it is pivotal to the success of these conservation programs that management units are appropriately defined for these Argali populations. Genetic analysis can be used to define these management units. The objectives of this study were to conduct a genetic analysis of argali sheep from across the region of Kyrgyzstan using a high density Ovine genotyping array, in order to establish herd and population relatedness for the purpose of defining conservation management units. Twelve tissue and blood samples were selected from a larger study set of hunter killed or found carcasses. These samples were selected based on GPS coordinates of where the animal was harvested, or the carcass was found. Similar to the results of Flesch et al. (2018), we expect to detect genomic differences based on geographical features and find evidence of genetically unique isolated herds.

Acknowledgements: Mike Frisina (MSU Faculty Member) – MSU Faculty Member, Bair Ranch Foundation
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Naomi Redfield: Animal & Range Sciences
Mentor: Robert Sager – Medicine Creek Bovine Health
Increasing fertility rates for Yak

The purpose of this research is to test the hypothesis that increased nutrition fed for 45 days before breeding will

increase estrus and therefore, increase fertility rates for a herd of Yak females near Kalispell, Montana. Estrus is a recurring period of sexual receptivity and fertility in females, this is commonly referred to as heat. Previous fertility rates of this Yak herd had a less than 30% success in pregnancy four months after breeding. Pregnancy was determined by progesterone assay at 4-5 months gestation. This year a custom cake ration was formulated to feed the female Yaks'. This custom cake was fed 45 days before breeding and continued throughout the breeding cycle of 50 days. The custom cake fed was formulated with nutrients designed to increase estrus for the females. The cake that was formulated was composed of wheat middlings, corn cracked, DSS (distillers solubles), molasses, a custom mineral, and soy hulls. The custom mineral was formulated by a nutritionist, based on a forage and water analysis from the ranch and designed to supplement the needed requirements of the Yak. Breeding started July 15th and continued until after September 5th. Pregnancy determination by blood progesterone assay will be completed in November 2019.

Acknowledgements: Bob Sager (Non-MSU/Other) – Animal & Range Sciences, McNair Scholars Program

COLLEGE OF ARTS & ARCHITECTURE

Taylor Hosek: Music
Mentor: Gregory Young – Music
Learning by Doing: Composing a Symphony

This research examines composition and the steps involved throughout the process of composing a symphony. To date, there does not exist a guide or manual for composing symphonies. I have discovered through my research that there may be a reason there is not a "manual" for composing. Not because one may not be ready , but rather, it is a different creative journey for each who embark on it. In my research I originally set out to compose a symphony based on my initial perceptions of what a symphony was. I planned to have four movements organized in a standard order consisting of the following: I. Sonata-allegro form, II. A slow movement, III. Minuet and Trio, IV. Rondo form. In my research I discovered that not all symphonies follow the typical format and structure they are so often assumed to have. Upon this realization, the trajectory for my own symphony changed significantly. I instead decided to have one singular movement that combines elements from the standard four. I researched ten substantial symphonies, their composers, and their compositional processes, including how it applied to their non-symphonic works. They span nearly 150 years of musical history from Haydn - the grandfather of the symphony as we know it - to Shostakovich - regarded as one of the greatest composers of the 20th century. The symphony has greatly evolved since its inception in the early eighteenth-century from an increase in instrumentation, to variance in the length, to structural changes.

Acknowledgements: McNair Scholars Program

COLLEGE OF EDUCATION, HEALTH & HUMAN DEVELOPMENT

Emily Brazier: Community Health
Mentor: Mari Eggers – Microbiology & Immunology
The Ebola Outbreak in the Democratic Republic of the Congo: A Public Health Analysis

Background
The Democratic Republic of the Congo (DRC) is experiencing the second-largest Ebola outbreak in history. The World Health Organization declared the outbreak to be of international concern. The affected provinces Ituri and North Kivu are also conflict zones.
Methods
Information was collected and analyzed to determine factors contributing to the current outbreak. The data analyzed includes population surveys, timelines linking social and political events to the number of Ebola Virus cases, and studies on changes in public attitude related to community involvement in containment efforts.
Results
Factors contributing to the outbreak include events social and political violence (etc.), low levels of trust in authority, and circulation of rumors and misinformation. Additionally, the report suggests need for Congolese involvement in outbreak containment efforts. Severe spikes of Ebola cases often followed events of social and political violence on a national and regional level. High levels of distrust in governmental and healthcare authorities were found to be associated with low levels of anti- Ebola precautions. Circulation of rumors was found to be linked to attacks on healthcare professionals as well as treatment centers.
Conclusions
Ultimately, the DRC Ebola crisis is an international concern, with complex contributing factors such as instability, unrest, and violence. Research suggests that further public health approaches with a focus on developing public trust, and community involvement may benefit the containment of the outbreak. The importance of empowerment of communities is a core idea of public health, and in this case- a matter of life and death.

Kevin Bueling: Health & Human Development
Mentor: Mitchell Vaterlaus – Health & Human Development
Technology use and family health: A case study approach

Technological convergence has led to ready access to varied media on one device. Technology has become an important topic during adolescence and within families. The current study was designed to understand the perceived role of technology on health behaviors within families. Using a qualitative case study design, 11 family triads (adolescent, mother, and father) reported their perceptions regarding technology use on their families' health behaviors (i.e., diet and exercise). Three themes were identified: (a) Physical activity and technology, (b) Food choices, information, and technology, and (c) Parental mediation of technology use supports health behaviors. Understanding family perceptions can inform future research of health behaviors within families in a technology saturated world.

Acknowledgements: Danielle Campanella (MSU Undergrad Student) – Human Development & Family Science, McNair Scholars Program

Emily Dummer: Health & Human Development
Mentor: Margaret Eggers – Microbiology & Immunology
Breast Cancer in Uruguay: The Potential Influence of Heavy Metal Pollution

Breast cancer is the second most common form of cancer worldwide and the leading cause of cancer death among women. While South America is considered a low-risk region for the development of breast cancer, Uruguay bears

high rates of the disease, similar to those of developed nations. The purpose of this research is to examine the risk factors behind such high rates of breast cancer in this area, and to propose the potential influence of environmental factors. This research was conducted through literature review and data analysis using global health data available online. Key findings include significant associations between breast cancer and socioeconomic status. The author proposes that these results may be suggestive of underlying environmental risk factors contributing to disease development. Additionally, significant associations were found between meat consumption and breast cancer incidence. While this relationship sustains a causal pathway, this research proposes environmental pollution of heavy metals as a potential confounding factor within this relationship. The presence of heavy metal pollution within the coastal area of Montevideo, home to nearly half the population of Uruguay, has been established. Additionally, some of these heavy metals have been shown to impact the disease progression of breast cancer and may influence the development of the disease. This research concludes that water polluted with these heavy metals, known as "metalloestrogens" may be influencing rates of breast cancer In Uruguay. There is a need for further research and case-control studies examining this relationship.

Samantha Eberhart: Health & Human Development
Mentor: James Becker – Health & Human Development
Changes in Joint Kinetics when Running in Maximalist Footwear

Within the last decade, a new type of running shoe has emerged. Termed maximalist footwear, they feature an oversized midsole design and were developed with the intent of decreasing impact forces and improving shock attenuation, thereby decreasing injury risk. However, little is still known regarding how maximalist footwear distribute load across the various joints when compared to a runner's usual running footwear. The purpose of this study is to determine whether there is a difference in joint moment contribution between maximalist and habitual running shoes. We hypothesized there would be no difference in joint moments between shoe types. Seven trail runners ran on an instrumented treadmill for two five minute sessions using either their habitual shoe or a maximalist shoe at a self-selected pace matching that of an easy run. Kinetics were recorded using a 6-camera motion capture system and the instrumented treadmill. Peak joint moments were calculated for the ankle, knee and hip joints in the sagittal plane. Total support moment was determined by summing each of the peak joint values. Percent contribution for each joint was calculated by dividing the joint moment by the total support moment. Paired t-tests were used to compare the differences between percent contributions and shoe condition. No differences between habitual and maximalist footwear regarding ankle ($p=0.67$), knee ($p=0.82$), and hip ($p=0.37$) moment contributions. These results indicate that the claims that maximalist shoes reduced loads are unsubstantiated and do not vary from a runner's habitual running shoe.

Acknowledgements: Christopher Casillas (MSU Graduate Student) – Graduate Departments and Degrees, New Balance

Megan Hollinger: Liberal Studies Degree
Mentor: Margret Eggers – Microbiology & Immunology
Diarrheal Diseases

This study describes the links among malnutrition, diarrheal diseases and poverty. Globally, diarrheal diseases are the number three cause of death of children under five. In 2007, diarrheal diseases were number one ranked for premature death and by 2017 that ranking had not changed. This research shows that children who live in areas that lack developed infrastructure, health habits and adequate food and water sources are more likely to have diarrheal diseases. The methods used to collect these data were global health data sources and online research articles. The data obtained showed a significant correlation between impoverished countries who lack sanitary water systems and areas that still accept public defecation which causes an increase in the spread of diseases. Global health sources showed that less access to sanitary buildings, food and water sources had a higher prevalence of diarrheal diseases in children. Children who were breastfed, had clean water sources and mothers

who washed their hands more likely to not have diarrheal diseases. The research showed the children under the age of five are most susceptible to diarrheal diseases and have the highest mortality rate. When people do not have access to adequate food and health care systems to fight the diarrheal diseases, they are then vulnerable to other illness and cannot regain nutrients. This is a major health crisis that is challenging to address due to political instability, lack of funding for infrastructure and limited resources for food and water.

Devin Rossie: Health & Human Development
Mentor: James Becker, David Graham – Health & Human Development
Role of Intrinsic Foot Muscles on Stability

Falls account for one-third of injuries in individuals 65-years and older. Poor balance control is a main indicator of increased fall risk. In healthy individuals, stability is passive and subconsciously controlled; however, in injured or older individuals, active stability is required to compensate for lack of balance control. Despite this, the influence of intrinsic foot muscles (IFM) on balance control in the older population is poorly understood. PURPOSE: Determine if a relationship exists between activation of IFM and stability during standing balance tasks in older adults. METHODS: Nine participants (69±3.4yrs) performed two-foot quiet standing and bilateral single limb standing (SLS) balance trials on a plantar pressure mat which recorded center of pressure (COP) movement. Abductor hallucis (AbH) and abductor digiti minimi (AbDM) activations were assessed using surface EMG electrodes. Correlational analysis was used to evaluate relationships between IFM activation and COP movement. RESULTS: There was a strong, positive correlation between AbDM activation and AP excursions for two-foot stance (R^2=0.75, $p<0.05$) and right leg SLS (R^2=0.55, $p<0.01$). There was also a positive correlation between AbDM activation and ML excursion for two foot stance (R^2=0.47, $p<0.01$). Finally, there was a strong, positive correlation between AbDM activation and COP path length during right leg SLS (R^2=0.67, $p<0.05$). CONCLUSION: AbDM activation increases with increases with increasing COP excursion, suggesting this muscle has a role in maintaining or regaining balance. Additional research is required to determine whether the strength of the IFM differs between individuals with good and poor stability or whether strengthening the IFM improves stability in older adults.

Acknowledgements: Wes Goodman (MSU Graduate Student) – Health & Human Development

Ally Stallman: Health & Human Development
Mentor: Margaret Eggers – Microbiology & Immunology
Effectiveness of WHO standard of preventive chemotherapy for Soil-transmitted helminths

There are an estimated 1.5 billion people worldwide infected with soil-transmitted helminths (STH) which equates to 24% of the world's population. The current standard of STH preventative programs is mass drug administration of mebendazole and albendazole, based in schools and clinics to target the vulnerable population of school-aged children. Peer-reviewed research and publications and data from the World Health Organization were used to inform analysis of the current standard of preventative treatment in areas that are endemic with STH. World Health Organization has data on the number of school-age children receiving preventative chemotherapy for STH from 2015 to 2017 and the percent of coverage for school-age children from 2003-2017. These data support the standard method of mass drug administration in school settings as the most effective method of prevention of STH but it may not be the most sustainable way. The majority of mebendazole or albendazole distributed in endemic countries is donated through the philanthropic efforts of pharmaceutical companies like Johnson & Johnson. If donations were to be discontinued in the future there would be a gap in the feasibility of STH prevention programs. Further research should be conducted on alternative financial support for mass drug administration of STH chemotherapy. In conclusion, the WHO standard of mebendazole and albendazole distribution centered in schools is an effective method for the prevention of STH.

COLLEGE OF ENGINEERING

Michael Angyus: Chemical & Biological Engineering
Mentor: Blake Wiedenheft, Calvin Cicha – Microbiology & Immunology
Algae and Virus Hunting in High pH High Alkaline Waters

The use of microalgae as a feedstock for biofuel is primarily inhibited by CO2 supply and culture contamination. A novel growth method has emerged to overcome these issues by utilizing algae that are adapted to high pH and high alkaline environments so that growth media can challenge contaminants and supply ample carbon for rapid photosynthesis. The aim of this project was to search for novel algae that are adapted to these extreme conditions as well as search for novel viruses that infect these algae to further explore the risks of viral contamination. Samples were taken from Soap Lake, Washington (pH 10) and run through a series of filters to obtain virus and algal fractions. Algal fractions were grown in liquid cultures and then streaked onto plates to isolate individual microalgae colonies. Virus fractions were screened for viruses that infect a previous Soap Lake isolate, SLA-04 by means of plaque assays. Six unialgal colonies of green microalgae have been isolated to date and no viruses that infect SLA-04 have been detected in the virus fractions. The isolated colonies will be analyzed for growth rates and lipid content to assess fitness for biofuel production and plaque assays will be run to search for viruses that infect the new isolates.

Acknowledgements: Undergraduate Scholars Program

Emma Annand: Mechanical & Industrial Engineering
Mentor: Bryce Hughes – Education
The Development of Engineering Leadership Identity in Undergraduate Students

Today, leaders of industry and government are calling for increasing numbers of engineering graduates to maintain the nation's economic competitiveness. However, the expected positive impact from increasing the number of engineering graduates will be limited, unless the full capabilities of these graduates are harnessed. Specifically, solving today's complex challenges will require cooperation among experts from many fields. In order for these collaborations to be successful, leaders of these groups must employ the diverse capabilities of their members by being skilled technical leaders. To fill these leadership needs, undergraduate engineering students need to learn how to be effective leaders during their formation as engineers. Unfortunately, many engineers graduate with little development of leadership skills and engineering educators do not currently have sufficient understanding of how engineering students develop into leaders.
This NSF ECE and USP supported project seeks to close that gap by improving our understanding of the interaction between a leadership identity and engineering identity in the formation of undergraduate engineers. This work postulates that an engineering leadership identity should exist at the intersection of this interaction. Now entering its third year, the project has finished its quantitative phase and is in the middle of the qualitative phase of investigation. This poster discusses the process utilized to develop the qualitative research protocols, first phase coding, and the second phase coding. The discussion includes how prior work in leadership and engineering identity constructs from both this project and the literature was leveraged to create the protocol. Then, how the super nodes where decided on and lastly the process for breaking down the super nodes into more specific codes. The findings discovered include evidence of conflict between engineering identity and leadership identity and further evidence of engineering students' compartmentalization of leadership as something outside engineering.

Acknowledgements: Undergraduate Scholars Program

Hannah Flook: Mechanical & Industrial Engineering
Mentor: Chelsea Heveran – Mechanical & Industrial Engineering
The Effect of Familial Dysautonomia on Multiscale Bone Quality

Familial dysautonomia (FD) is a rare neurodegenerative disease. While patients with FD experience bone fragility, the reasons for this are not understood. This project investigates how mechanical properties of bone tissue in mouse models are influenced by the presence of FD. Analyzing FD bone mechanical properties on multiple scales is important in understanding how this disease is associated with bone fragility. Since bone is a hierarchical structure, this work will use innovative techniques to test mouse bone at the microscale using nanoindentation. FD mouse models being used in this study were previously tested in three-point bending to produce stress-strain curves, from which strength and toughness were measured. This previous research has shown that our FD mouse model exhibits a decrease in bone toughness, causing an increase in fragility. However, it is unknown how these whole-bone mechanical properties relate to changes in bone quality at the microscale. It is also unknown how microscale bone quality relates to disease severity. To investigate this, we will be using nanoindentation to map the microscale elastic modulus values of cortical mouse bone. We hypothesize that FD bone will be less stiff at the microscale, as a product of increased remodeling. This project is significant because it is currently unknown how FD causes bone fragility, and how this fragility should be treated in a clinical setting. Our mouse models will provide insights into how and why bone quality changes in FD, and may serve as acceptable models for more detailed analysis in the future.

Acknowledgements: Ghazal Vahidi (MSU Graduate Student) – Mechanical & Industrial Engineering, Undergraduate Scholars Program, IDeA Network of Biomedical Research Excellence

Aidan Higgins: Electrical & Computer Engineering
Mentor: Brock LaMeres – Electrical & Computer Engineering
None

Radiation effects in space are detrimental to electronic hardware and have proven to be a difficult obstacle to overcome for the aerospace industry. The severity of these radiation effects vary from simple “bit flips” to a full crash of an entire system. Space exploration is a very costly business, regardless if the mission is unmanned or manned; even the tiniest glitch that results in data loss means all of the efforts to conduct the mission were wasted. Current radiation hardened processors are thousands of times more expensive than their commercial equivalents and lag the commercial versions in performance by at least a decade. MSU has been developing a radiation tolerant Field Programmable Gate Array (FPGA) based computing system in hopes of replacing the need for custom, radiation-hardened processors. MSU’s fault mitigation strategy utilizes real-time partial reconfiguration of the hardware, triple modular redundancy with spares, error correction codes, and configuration memory scrubbing, which has proven to be successful. Since first established, MSU’s computing system has been subjected to a variety of demonstrations, maturing over the years to ensure that it will meet the demand of future fault-tolerant space computing requirements.

Acknowledgements: McNair Scholars Program

Khristian Jones, Erik Gilbertson: Electrical & Computer Engineering
Mentor: Bradley Whitaker – Electrical & Computer Engineering
Early Detection of Sepsis using Feature Selection, Feature Extraction, and Neural Network Classification

Sepsis is a life threatening illness that is responsible for killing roughly 250,000 people in the U.S. each year. Sepsis is caused when a patient's immune system develops an extreme response to an infection which causes organ damage and eventually death. Early detection of sepsis is vital to a patient's survival, and machine learning is a

powerful tool in this regard. A neural network classification system was designed to detect sepsis within patients before clinical diagnosis. An hourly database of 40,000 patients with 40 biological features was used for training and testing the classification system. The data was preprocessed using feature extraction and feature learning techniques. The feature learning subsystem was implemented by applying principal component analysis (PCA) as well as including previous feature variance. The feature extraction subsystem relied on a modified version of the quick sequential organ failure assessment score (qSOFA) to indicate sepsis. Finally, the outputs of the feature learning and feature extraction subsystem's fed into the classification system.The neural network classification system was trained using the preprocessed features and sepsis indicator values. This trained system can then be used on test data to determine sepsis. A scoring method that rewards earlier detection of sepsis and penalizes late and incorrect detection is being used to calculate the accuracy of the classification system. The model received a score of 0.04, where a score of 1.00 is perfect and where there is no negative bound. Current research is exploring different techniques to improve the utility score.

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Camina Rice, Nada Abdelfatta: Electrical & Computer Engineering
Mentor: Maryam bahramipanah – Electrical & Computer Engineering
Smart Energy Management Control Tools for Battery Energy Storage Systems

In the last several years, the massive connection of Distributed Generations (DGs) caused new operation challenges in distribution networks. Due to the lack of direct control over non-dispatchable DGs, integrating stationary Energy Storage Systems (ESSs) is a promising solution. Existing battery management system controllers don't take into consideration the detailed dynamic model of the battery system, which, if not done properly, can damage the battery. A battery management system (BMS) controller was developed based on the dynamic model of the battery to enhance the battery life and management. As opposed to the available literature, the proposed algorithm merely relies on the detailed dynamic model of the battery. In this respect, an experimentally model-fitted two-time constant (TTC) dynamic model of a lithium-ion battery was used. The controller estimates the State of Charge (SoC) and State of Health (SoH) for the battery through creating profiles of constant- current / constant - voltage charging / discharging. LabVIEW was used to develop the BMS controller and the monitoring system. Then, the model was experimentally validated using a real battery device housed in a climatic chamber. This BMS has a user controller interface that allows users to enter a desired command for battery charging/discharging phases. Behind the interface, there is a supervisory system control including monitoring, estimation of SoC and SoH, and the dynamic battery model. The expected results is that the control coupled with the TTC model leads to slightly better voltage and power profiles.

Acknowledgements: Undergraduate Scholars Program

James Vallie: Chemical & Biological Engineering
Mentor: Brent Peyton – Center for Biofilm Engineering
Cyanobacteria and Biochar: Technology of the Past, for the Future

Current industrial and agricultural practices have encouraged unsustainable technology creating massive amounts of CO2, material waste, and black carbon. Cyanobacteria can colonize most substrates optimizing water and nitrogen usage. Biochar shows promise in curbing pollutants from crop waste and field burning, while displacing fossil fuel usage. If cyanobacteria are used with biochar, an endosymbiotic relationship could form a sustainable source for useable nitrogen and organic matter, while optimizing water usage and plant growth.

To understand cyanobacteria and biochar, a study compared fertilizer and soil amendments on radish plants which was selected for their rapid growth. The efficacy of cyanobacteria, biochar, and a cyanobacteria-biochar mixture, was compared to both a chemical fertilizer and a control group. Only three groups that stood out when comparing average dry weights of the radish. The groups were cyanobacteria (0.598g), cyanobacteria-biochar mix (0.585g), and chemical fertilizer (0.565g). A notable observation is the cyanobacteria-biochar mix performing as well as chemical fertilizer in dry radish weights. Chemical fertilizer had the most elongation or â€œboltingâ€, compared to the cyanobacteria-biochar mix which had none. Bolting could be contributed to nutrient stress and drought since poor watering practices were observed. Since the cyanobacteria-biochar mix performed as well as chemical fertilizer in radish growth, and was the only group lacking bolting and flowers, it is hypothesized, that a cyanobacteria-biochar mix provides ample nutrients, increases water retention, and mitigates plant stress. This study involved only one trial, so further research is needed to increase statistical significance and provide more evidence of this hypothesis.

Acknowledgements: McNair Scholars Program

Xingzi Xu: Electrical & Computer Engineering
Mentor: Dominique Zosso – Mathematical Sciences
Accelerating Graph-based Geometric Data Analysis

In this research effort, we develop a framework and algorithm allowing geometric inferences about the underlying shape, which is helpful for the latter linear regression, polynomial fit or other techniques. We consider “data” in the form of point clouds: A collection of individual samples (documents, images, individuals...) represented as points in a high-dimensional feature space. A fundamental premise of data science is that such high-dimensional datasets consists of simple geometrical shapes. For instance, in linear regression we assume a linear inherent structure within a cloud of high-dimensional points. Our framework studies integro-geometric properties—such as volume, surface area, mean width—of a union of virtual balls placed around each of the data points in the cloud. Estimating these features for a wide range of ball-radii informs us about persistence of geometric properties across scales as a proxy to learn more about the geometry of the structure from which the points were sampled. We have successfully developed an algorithm realizing geometric inferences, but our naive first implementation is too slow to be practical. Here, we utilize the “induction method” to quickly calculate preliminary structures, i.e.the Vietoris-Rips complex of point clouds[1]. Afterwards, considering it is time-consuming to calculate all degrees of Vietoris-Rips complex, we only set up direct connections between Vietoris-Rips complexes of reasonable degrees and parameters of the point clouds by training an artificial neural network. Eventually, we are expecting a significant speed improvement for the overall algorithm.

Acknowledgements: Undergraduate Scholars Program

COLLEGE OF LETTERS & SCIENCE

Molly Adams-Hyde: Cell Biology & Neuroscience
Mentor: Margaret Eggers – Microbiology & Immunology
Dengue's Increasing World Presence

Dengue is an arboviral disease spread by Aedes aegypti mosquitos. Recently, dengue's global presence has increased significantly. Many countries, especially those in tropical or subtropical climates, have been affected by outbreaks and have declared national health emergencies. Understanding why dengue is increasing is essential for preventing, or at least predicting, future outbreaks. This research looked into factors that could be influencing dengue's prevalence in three countries - Bangladesh, Belize and Honduras. To estimate dengue prevalence, data was collected from the University of Washington's VizHub website on dengue related deaths and Disability Adjusted Life Years (DALYs). The factors that were hypothesized to influence dengue were temperature, rainfall, population density and size, and GDP expenditure on health care. To compile these data, many different databases were used including the World Health Organization, Climatic Research Unit and the World Bank. Data were collected from 2000 to 2014, 2016 or 2017, depending on the last reported data point. This allowed for visualization of how dengue has changed over time in relation to various factors. It was initially expected that the main factor influencing dengue's prevalence was annual average temperature and number of rain days. However, temperature and number of rain days stayed fairly consistent in the past 14 years in these three countries and cannot be definitely linked to dengue's increasing prevalence. Population size and density did seem to correlate with dengue prevalence, since dengue's prevalence has increased as the countries' populations have grown. Further research is required to better understand how population affects dengue. Additionally, better monitoring and treatment of dengue is necessary to reduce the disease's prevalence.

Abigail Ator: Microbiology & Immunology
Mentor: Margaret Eggers – Microbiology & Immunology
Alcohol: The Silent Epidemic

This study was conducted to explore the global health impacts of abusive alcohol consumption. Alcohol presents itself in many cultures and therefore, its negative impacts are often overlooked. Cohort studies and review analyses were reviewed using databases such as PubMed. Keywords used for reference included: alcohol, alcohol dependency, liver cancer, alcoholic cirrhosis, and alcoholic liver disease. To assess the global impact, effort was made to find studies conducted in diverse countries including Australia, Finland, Korea, and several broad geographic areas. Looking at cause-specific death statistics, alcohol alone only accounts for 0.33% of all global deaths. However, a large number of chronic illnesses that affect the world can be linked back to prolonged alcohol use. Alcohol abuse was found to be one of the largest common factors among study participants with observed illnesses. Alcohol alone is not a strong cause of death, however the diseases that arise from the abuse of alcohol have much higher fatality rates. Furthermore, alcohol dependency was considered to be a mental health disorder in a number of studies. Hence, intervention methods must be approached differently than finding a cure or a vaccine for a disease. Alcohol dependency is dangerous to the health of society, and therefore mental health intervention must be studied further for incorporation into treatment. These data provide evidence that alcohol abuse indirectly is one of the top causes of death in the world.

Dominic Bair: Mathematical Sciences
Mentor: Dominique Zosso – Mathematical Sciences
Spatial Statistics in Histology Images

Understanding the regulation of dendritic cell distributions in the body has major implications in disease modeling and treatment prescriptions. "Dendritic cells are antigen-presenting cells that induce adaptive T cell responses,"

[3]. In this project, we shall focus exclusively on the distribution of dendritic cells in the gastric mucosa and the course of H. pylori infections. Manual analysis has shown "that dendritic cells (DCs) are present in the gastric mucosa of healthy subjects and are more prevalent and more activated in the gastric mucosa of H. pylori-infected subject" [2]. Logically, the next step is to determine whether these cells are structured in some manner. If it is shown that the DCs tend to stay near the epithelium, or in proximity to one another that would not be expected from random distribution, claims can be made about the DCs interactivity, both with each other, and with the epithelium. The goal of this project is to find evidence for or against a preferred non-isotropic distribution of DCs is the gastric mucosa. Using an image processing pipeline, DC nuclei are located; then the distance of each nucleus to the epithelium and distance to nearest neighbor is calculated. These data are compared to the same test-statistics, but gathered from a 2-Dimensional Monte-Carlo simulation [1] assuming the DCs are randomly distributed in the tissue. We have found evidence suggesting that, based on these test-statistics, the DCs are not randomly distributed in the gastric mucosa. The new objective is to automate the analysis process to make it more efficient, robust, and reproducible.

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Rebecca Boylan: Cell Biology & Neuroscience
Mentor: Cara Palmer – Psychology

Gender Moderates the Relationship Between Youth Slow Wave Sleep and Emotional Symptoms

Introduction: Altered sleep architecture has been associated with emotional disorders (e.g., anxiety and depression). However, research on sleep architecture and symptoms in youth is limited, with inconsistent results (Ivanenko, Crabtree, & Gozal, 2005; McMakin & Alfano, 2015). Adult studies have found reliable gender differences, with a greater decrease in slow-wave activity for depressed men but not women (Armitage & Hoffmann, 2001). Research has yet to examine gender differences in child samples.
Methods: Participants were 30 healthy pre-pubertal children with no psychiatric disorders (ages 7-11; M = 9.33, SD = 1.24; 70%girls). Participants completed a psychiatric diagnostic interview, a semi-structured sleep interview to screen for sleep disorders, and one night of at-home polysomnography. Children also reported on their anxiety and depressive symptoms using the Revised Child Anxiety and Depression Scale (Chorpita & Spence, 1998).
Results: Preliminary analyses suggested that there was no difference in sleep architecture or symptoms between boys and girls. Regressions controlling for age and gender indicated that greater non-rapid eye movement stage 3 sleep (N3) was associated with lower overall symptoms (Beta = -.42, p = .03), depressive symptoms (Beta = -.41, p = .04), and anxiety symptoms (Beta = -.40, p = .03). Several significant interactions with gender and N3 sleep emerged. An interaction between gender and N3 (p = .01) indicated that less N3 predicted more overall symptoms, but only for boys (p = .001). A marginal interaction (p = .06) indicated that less N3 was associated with more depressive symptoms for boys only (p = .01). When predicting anxiety symptoms, an interaction between gender and N3 (p = .01) indicated that less N3 was associated with greater anxiety for boys only (p = .001). Conclusion: Results suggest that the relationship between sleep architecture characteristics and emotional symptoms may differ for pre-pubertal boys and girls, with lower levels of N3 sleep being most problematic for boys. These findings support research suggesting that the pathogenesis of psychopathology may differ for males and females.

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Dianna Brown: Psychology
Mentor: Margaret Eggers – Microbiology and Immunology
Effects of HIV, Diarrheal Diseases, and Dietary Iron Deficiency on the Maternal Hemorrhage Mortality Rate of South Sudan

Inadequate sanitation and the rates of maternal hemorrhage mortality are associated. South Sudan has a maternal mortality rate of 2054.0 maternal deaths for every 100,000 live births. The ubiquity of this issue could prove detrimental to the progression of South Sudan as a nation. Situational factors have a basal effect on the mother during gestation; factors like poor sanitation have an umbrella effect. Diarrheal diseases are one of many environmental determinants that exacerbate conditions like anemia and HIV, providing an ideal environment for clandestine abortions and fatal miscarriages. OBJECTIVES: The purpose of this study was to pinpoint major conditions within South Sudan that increase the probability of miscarriage. A distinct association between rates of women in their childbearing years fostering particular conditions and rates of miscarriage could illustrate a pressing need for sanitational reform. METHODS: Data were transferred from GBD Vizhub comparative graphs and charts to excel. Graphs compare DALYs (Disability Adjusted Life Years) per 100,000 women from ages 15 to 49 in South Sudan, Sudan, Niger, Cambodia, US, Canada, and Switzerland for HIV, diarrheal diseases, and anemia with the number of deaths, within the same demographics, associated with maternal hemorrhage. RESULTS: South Sudan has more than triple the number of miscarriages compared to other countries. South Sudan's rates of HIV, diarrheal diseases, and anemia follow this same pattern. Countries like Niger, Sudan, and Cambodia have higher maternal hemorrhage mortality rates, and like South Sudan, they have comparably increased rates of DALY diarrheal diseases, HIV, and anemia.

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

Messengers for Heath is a nonprofit organization based on the Apsáalooke (Crow) reservation that uses a community based participatory research approach to address health issues on the reservation. Project partners designed a culturally consonant intervention for community members to assist with chronic illness (CI) self-management. The key to improving CI management is the capacity for effective self-care, as most people with CI's spend more time managing their care in the community, as compared to time in spent in the hospital or ambulatory care setting. As a part of a community-based and community-led CI self-management program developed for community members, we developed incentives related to the different topic areas of the program. A couple of the incentives given out included the Counting Coup Journal, exercise bands, Living a Healthy Life book. These incentives were distributed during the program gathering. Participants completed an evaluation of the different incentives, indicating how often they used the incentive (ranging from not at all to all the time) and adding comments about the incentives. Some incentives were used more than others and participants offered helpful comments about the use and helpfulness of the different incentives. A limitation of this evaluation was that not all participants completed the evaluation of incentives and some of the participants did not receive all of the incentives. Conducting an evaluation of the usefulness of these incentives can help to improve our program and be used for other CI self-management programs in the future. All the incentives and incentive surveys will be provided.

Acknowledgements: Alma McCormick Knows His Gun (Non-MSU/Other) – Other

Jacqueline Burgara: Psychology
Mentor: Sally Moyce – Nursing
Provider Cultural Competency Evaluations from the Perspective of Latino Patients Living in Montana

Cultural competency can lead to positive effects on minority health disparities, as can language concordance between patient and provider. Current evidence suggests that due to the social desirability bias, a provider may score him/herself higher than what their patients may perceive. Limited evidence exists about the perception of provider cultural competency from the patients' point of view. Therefore, we used the Perceived Cultural Competency Measure, an adaption of the Language Experience and Proficiency Questionnaire, and a language concordance and interpreter utility questionnaire on a convenience sample of Latinos, a significantly growing US minority population. The combination of these questions was used to determine the perception of cultural competency of providers from the Latino patient perspective. Results will be used to inform potential workshops designed to improve provider cultural competence.

Acknowledgements: McNair Scholars Program

Kelly Cannici: Sociology and Anthropology
Mentor: Nancy Mahoney – Sociology and Anthropology
Morphological Analysis of Late Pre-Contact Paleoindian Points in Eastern Montana

The nature of the Late Pre-contact Paleoindian tribes of the northern Great Plains is currently poorly understood, due largely to the dearth of research regarding the typology and use of lithic artifacts in the region. This project aims to fill a critical gap in that knowledge by creating a reference collection of relevant lithic points with known provenience. Lithic points collected from the Bergstrom Bison Kill site in Judith Gap, Montana, are analyzed through a variety of metric standards and categorized according to professionally accepted typologies in order to provide accurate morphological analysis of the types of late pre-contact Paleoindian lithic points common to eastern Montana and southern Alberta. While the project is specifically focused on Avonlea and Besant points due to the nature of the assortment, the analysis of less commonly encountered point types is an important element in the ongoing investigation of Late Pre-contact movement patterns and technological transfers. The ultimate aim of the research is to create a comprehensive database that includes as many points as possible in order to provide future researchers with a foundational body of comparative materials.

Cassidy Catron: Microbiology & Immunology
Mentor: Margaret Eggers – Microbiology & Immunology
Peptic Ulcer Disease in Greenland

Peptic Ulcer Disease is a break in the inner lining of the stomach, the first part of the small intestine, or sometimes the lower esophagus. Peptic ulcers resulted in 267,500 deaths globally in 2015; notably, the mortality rate of Peptic Ulcer Disease in Greenland is the second highest in the world. The study conducted sought to determine why Greenland has such a high rate of Peptic ulcer disease. By looking at Helicobacter pylori prevalence along with other risk factors such as smoking, alcohol abuse, and use of nonsteroidal anti-inflammatory drugs, the study attempted to determine why inhabitants of Greenland are at such a high risk. Data were gathered from peer reviewed literature and global data sources. This study found that Greenland has an abnormally high rate of H. pylori infection in its population at 77%, compared to a global average of roughly 50%. In addition to this, Greenland has the highest daily smoking prevalence in the world, which is a known contributor to Peptic Ulcer Disease. This leads to the conclusion that these two factors significantly contribute to why so many individuals in Greenland are dying from Peptic Ulcer Disease. Action needs to be taken to reduce smoking prevalence in Greenland, potentially through policy change. In addition, citizens need to be better educated on proper hygiene to reduce the spread and infection of H. pylori.

Strother Cooper: Physics
Mentor: Shannon Willoughby, Philip Eaton, Barrett Frank – Physics
Generating a Partial Credit Model for the Conceptual Survey of Electricity and Magnetism

The Conceptual Survey of Electricity and Magnetism (CSEM) is a multiple-choice introductory college-level test designed to assess a student's knowledge and understanding of electricity and magnetism. This test is commonly used in Physics Education Research but little is known about how it functions psychometrically. The main purpose of this study is to develop a partial credit scoring model for this test and to use it to flag potentially malfunctioning questions and responses. Traditional analysis of multiple-choice tests only considers whether the correct response was chosen. However, by building a partial credit scoring model, a student's misconceptions and overall understanding can be further explored. This partial credit scoring methodology was developed at Montana State University by the Physics Education Group and utilizes Polytomous Item Response Theory to rank the incorrect response options for each question. This analysis allows for informed amendments to the CSEM, and provides researchers with a more accurate measure of students' understanding.

Acknowledgements: McNair Scholars Program

Cullen Cunningham: Chemistry & Biochemistry
Mentor: Deborah Keil – Microbiology & Immunology
Occurrence and Removal of Drugs of Abuse in Wastewater Processes

This study investigated the behavior of a variety of drugs of abuse, both pharmaceutical and illicit, in response to the wastewater treatment process. Wastewater samples were collected from two different communities across a 12-week period and analyzed for the concentration of 62 drugs and metabolites using LC/MS analysis. Influent and effluent concentrations were compared at each location as well as treatment efficacy between each plant. A broad range of treatment efficacies were observed, ranging from no removal to treatment to complete removal (to detection limits). A series of grab samples at one of the sites indicated that the biological component of wastewater treatment is the most significant source of removal for the drugs of interest.

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Karenna Doctor: Cell Biology & Neuroscience
Mentor: Margaret Eggers – Microbiology and Immunology
Relationship between endometrial cancer and Lynch syndrome globally

Lynch syndrome (LS) is an autosomal dominant gene that increases the risk of developing endometrial cancer in females by up to 60%. Because LS is a genetic condition, it is important to identify in patients, especially those with children. The Bethesda guidelines have been established to identify potential cases of LS to undergo further genetic testing. Unfortunately, there is a vast under referral of patients for testing, meaning that Lynch syndrome could be a more common cause than the estimated 2-5% of endometrial cancer cases. Background research was gathered from various peer reviewed sources and data were collected from the World Health Organization. It was found that Bolivia, Samoa, and Japan have the highest age-standardized incidence rates per 100,000 women from ages 0 -49. Bolivia had a rate of 8.4, Samoa had a rate of 9.5, and Japan had a rate of 7.7. High rates of endometrial cancer in Samoa have been previously acknowledged and there have been intervention attempts. Japan and Bolivia, however, have not been focused on. Nuclear radiation incidents, which are confirmed to increase endometrial cancer rates, have occurred in both countries. The mutagenic effects are heritable and could cause an increase in cases; however, this link has not been studied. In the highest incidence parts of the world, the contribution of Lynch syndrome to endometrial cancer cases is unknown. Appropriate diagnostic guidelines of

Lynch syndrome in endometrial cancers should be used to increase available genetic data and learn more about the burden of the disease globally.

Katharyn Dolan: Microbiology & Immunology
Mentor: Margret Eggers – Microbiology & Immunology
Potential Spillover and Causative Agents for Chronic Wasting Disease in the American Northwest

This study aims to identify factors contributing to the recent uptick in cases of Chronic Wasting Disease (CWD) and the likelihood of spillover into human populations. Using both data analysis and literature reviews it was found that CWD is spreading rapidly throughout the American Northwest, and it has now been identified in 26 states and 3 Canadian provinces. Prion diseases are notoriously fatal due to the difficulty of deactivating the prion molecules which cause the mutation of the PrP proteins in brain cells. Bovine Spongiform Encephalitis (Mad Cow Disease) had a serious impact when it spilled over into human populations in the United Kingdom, and similarities between BSE and CWD has led to concerns about potential CWD spillover in the future. In rural states where CWD has been identified such as Montana, Wyoming, and Colorado, many people come into contact with potentially infected meat while hunting recreationally which in turn increases the chance of spillover. There is also a chance of interspecies contamination due to environmental reservoirs such as mineral licks. Although there have been no cases of CWD in humans yet the possibility of human exposure increases with each new case of CWD.

Faith Ellis: Psychology
Mentor: J. Mitchell Vaterlaus – Health & Human Development
Perceived Gender Roles in Heterosexual Adolescent Romantic Relationships

Romantic relationships are an important developmental experience during adolescence. The relationships are significant in cognitive and relational development, but there is still an empirical need to better understand adolescent romantic relationships. The current qualitative study explored high school students' (n= 81) perceptions of gender roles in heterosexual adolescent romantic relationships. Three major themes emerged through conventional qualitative content analysis: (1) traditionally held views of male and female gender roles, (2) gendered perspectives regarding interpersonal interactions, and (3) roles that indicate relational maturity.

Acknowledgements: McNair Scholars Program

Chris Erlenbaugh: Cell Biology & Neuroscience
Mentor: Margaret Eggers – Microbiology & Immunology
Why are Multiple Sclerosis DALY's higher in Canada, the US and Northern Europe compared to the rest of the World.

INTRODUCTION: Multiple Sclerosis is a disabling disease affecting the brain and spinal cord. With MS, the immune system attacks the myelin sheath that covers nerve fibers causing communication problems between your brain and the rest of your body. With this disease having the possibility to attack anyone, why is it primarily located in the regions of Canada, the northern US and northern Europe? If we can determine why it affects these regions, could a prevention or cure be discovered? OBJECTIVES: To see if the causes of developing MS could be regionally or environmentally based, or if there are other factors involved? METHODS: The methods used were studying and comparing different sets of cohort studies that investigated the causes, development, and effects of MS on differing sets of people in the designated regions compared to regions with less prevalence of the disease. There was also a DALY's comparison by country. RESULTS: There were no definitive results that would give an answer to the why, where, and how MS affects people. DISCUSSION: Theories generated from existing research lead to further research into MS, ways to help people with the condition and the discovery of new ways to treat and diagnosis MS. CONCLUSION: With MS breakthroughs and discoveries increasing, we are close to finding more

answers to the questions we have regarding MS. Further studies could lead to answers as to why MS hits these regions more than others.

Kyle Evans, Klara Aspelin: Microbiology & Immunology
Mentor: Margaret Eggers – Microbiology & Immunology
Investigating Water Quality in Three Forks' School District

The goal of this study is to compile groundwater water quality data from the Three Forks School District and compare it with publicly accessible data from the Montana Bureau of Mines and Geology (MBMG). While there are some data regarding elevated levels of arsenic in home wells in the Gallatin County part of the District, there is little public information on the counties of Jefferson and Broadwater, which are both part of the Three Forks School District. MBMG data on standard conductivity, iron, pH, sulfates, and arsenic will be analyzed to assist in understanding arsenic distribution and risk. Standard conductivity is a great first measurement, as it directly relates to how much total dissolved solids, including metals, are in solution. These data will be sorted by their watershed. These subsets will then be compared and used for spatial analysis of contaminated waters. The quality of water being consumed by the community should be public knowledge. Not having access to water quality information can lead to families and individuals drinking toxic home well water without them being knowledgeable of it.

Acknowledgements: Garret Oksness and Steven Hamilton, Three Forks High School science teachers, and their science students.

Laura Evans: Liberal Studies Degree
Mentor: Margaret Eggers – Microbiology & Immunology
Gender Differences in Parkinson's Disease from a Global Perspective

For the fastest growing neurological disease, there seems to be a dearth of research concerning the effects of Parkinson's Disease (PD) on women. Most available data support that men are more likely to suffer from PD, with some exceptions. However, even this widely accepted ratio is not carried out in the research and women's health suffers in consequence because there are differences in the symptoms experienced. I conducted a literature review of the research concerning PD and gender differences from a global perspective. Countries where women have a higher prevalence of PD than men and the possible factors contributing to those exceptions were examined, drawing on data from The Institute for Health Metrics and Evaluation (GBD Compare and Epi Visualization options). PD risk factors were investigated. The countries found fitting that criteria were Russia and Japan. The main factor investigated was the possible use of pesticides and their effects on female agricultural workers. This possible hypothesis seemed stronger in Japan than in Russia from available information. This possible correlation will hopefully elicit further research as well as research into the overall gender differences in symptoms of Parkinson's Disease.

Annie Ferguson: Microbiology & Immunology
Mentor: Margaret Eggers – Microbiology & Immunology
The Ticking Time Bomb of Groundwater Contamination

Three Forks, Montana was incorporated in 1911 and is currently home to about 1,900 residents. In some sections of town, families rely on septic systems for their wastewater treatment. If these septic systems are not properly maintained, the septage can contaminate groundwater. This is a concern in Three Forks because many of the residents use well water and do not have the adequate equipment to test or treat their water to protect themselves from microbial contaminants. In order to determine the potential risk of water contamination, the condition of septic systems in relevant areas needs to be examined. The most practical way to find the condition of septic systems is to evaluate the septic system permits within the area, using Gallatin County's on-line database.

Although the law (MCA 50) requires all new septic systems to have permits, many systems that were built before this do not have a permit and have not been inspected in decades. If there was a permit available for a septic system the purpose, system type, use, inspection date and issue date are being recorded. Septic systems only have a "life expectancy" of 30 years. If no permit was found for a septic system only the location was recorded. These data are being compiled to provide insight of the potential risk the Three Forks community faces of home well contamination due to malfunctioning septic systems.

Marisa Flores: Mathematical Sciences
Mentor: Katharine Banner, Dominique Zosso – Mathematical Sciences
Quantifying Public Health: An Undergraduate's Perspective of Biostatistics

There are only 10 colleges in the United States offering undergraduate degrees in biostatistics (Pierson 2017). Biostatistics is the application of statistics to data relating to human biology, health, and medicine. Since it's rare to obtain a bachelor's degree in biostatistics, the graduate level is extremely competitive for those want to obtain a higher education in the field. Although this is the case, there are many summer programs across the United States that offer opportunities to conduct research in biostatistics. This allows for students to get hands-on research experience as well as networking opportunities with faculty and graduate students within the field of biostatistics. This presentation is an overview of two summer projects and a year-long continuation of one of those projects. Logistic regression is the foundation of both projects. In one project, logistic regression with ridge and lasso penalization was used to classify skin lesions as melanoma or benign. In the other project, survey logistic regression was used to profile high school student's youth violence and mental health with an additional analysis on bullying legislation. These are two applications of statistics on biological data that provide some insight into the biostatistical field from an undergraduate's perspective.

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Madysen Gromer: Cell Biology & Neuroscience
Mentor: Margaret Eggers – Microbiology & Immunology
Analysis of Environment and Behavior on Heart Health in Ukraine

Ukraine has extreme rates of cardiovascular disease and deaths associated with this disease. From VizHub, it was noted that Ukraine has the most extreme rate of deaths due to this disease in the region. This research investigated why this disease is so prevalent in Ukraine and to find a probable cause or link. Finding the connection is critical in understanding potential sources that contribute to the problem globally and how to correct the problem to prevent further issues in Ukraine. Information was obtained through literature reviews and data analysis from VizHub and real time air quality maps. There appears to be a significant connection between air pollution and smoking rates to cardiovascular diseases in Ukraine. It was found that 10% of women and 57% of men are smokers in Ukraine and 7% and 21% of were former smokers, respectively, ranking Ukraine at 5th place in countries with the highest tobacco use. Ukraine was also found to have air quality that ranges from moderate to unhealthy due to burning organic materials directly in the city, increased humidity, and many industrial factors. Looking at the data, it is apparent that these two factors in Ukraine begin to explain the prevalence. It is pertinent to continue finding explanations behind the extreme rates, but it does give researchers and health care professionals a great starting point. Through education and putting policy in place to better air pollution by regulating industry and smoke pollution, this problem may begin to be resolved.

Laina Hall: Chemistry & Biochemistry
Mentor: Blake Wiedenheft – Microbiology & Immunology
Bacterial Defense against Viral Invasion

Bacteria get infected by viruses, and like humans, they have evolved immune systems to fight off infectious agents. CRISPR, which stands for clusters of regularly interspaced palindromic repeats, is a famous example of an adaptive immune system in bacteria. Another system in bacteria relies on a protein called Argonaute (Ago) and it is hypothesized that this system is similarly involved in defense. Like CRISPRs, Argonautes rely on guides to find, bind and cleave nucleic acid targets (RNA or DNA). It is not understood how guides are created and loaded or if all argonautes utilize the same pathways to destroy target nucleic acids. The goal of this research is to investigate eight different prokaryotic argonautes, each from a different prokaryotic organism. We are testing if these pAgos have the ability to cleave or degrade a DNA plasmid when expressed in E. coli Bl21 (DE3) cells. This will provide insight into which pAgo are active in E. coli, if they can provide defense against foreign nucleic acids, and if they could be repurposed as biotechnological tools similar to CRISPR-Cas systems. An improved understanding of immune systems in bacteria could possibly the creation of new genome engineering tools for treating disease.

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Benjamin Hunthausen: Cell Biology & Neuroscience
Mentor: Margaret Eggers – Microbiology & Immunology
A Surprising and Alarming Epidemic: Meningitis in Sub-Saharan Africa

Introduction: Meningococcal disease (bacterial meningitis) is a rarity in the world today, with efficient vaccines and treatments the average prevalence in the world is very low. Why then is there an extremely high prevalence in Sub-Saharan Africa? Meningococcal disease is an infection in the spinal cord and brain caused by the bacteria Neisseria meningitidis and is highly debilitating and deadly if not treated early. This isolated region is an outlier in a world where meningitis is not a common problem.
Methods: Information on this subject was collected from a variety of peer-reviewed papers and data sites. This information was then analyzed in order to make connections to discover the underlying cause of these increased rates.
Results: It was found that the dry windy climate leads to increased spread of the disease, and that vaccines although cheap and efficient are in limited supply in this region. Additionally, individuals already infected with HIV have an increase in susceptibility and severity. Increased resistant strains and increased populations living in unsanitary conditions were found to be other contributing factors.
Conclusion: A lack of resources, poor living conditions, having a weakened immune system, exposure to resistant strains of Neisseria meningitidis, inadequate vaccination and the climate all impact susceptibility to meningitis in this region of the world. These factors give an explanation of increased prevalence in this region, and can be used to find a solution to drastically lower the rate of those affected.

Quinn Krause: Cell Biology & Neuroscience
Mentor: Bernadette McCrory – Mechanical & Industrial Engineering
Integration of Currently Available and Emerging Intracorporeal Imaging Technologies in Medicine

Background: Current intracorporeal imaging technologies are not sufficient. Many research studies have developed ways to integrate alternate technologies into existing procedures. To understand the use of these different intracorporeal imaging technologies a systematic literature review was performed to formulate alternative technology-based medical device designs. Methods: Using the keywords of “Ultrasound Vascular Access” a total of 6,402 articles were found. Further refinement using “Intravenous, cannulation, augmented reality, virtual reality, mixed reality, and peripherally inserted catheters” narrowed the results to 200 articles. Conducted observations of Orthopedic Surgeries in Colorado Springs and interviewed surgeons about current technologies in use. Results: Two major themes were identified: advanced intracorporeal imaging used during surgical procedures and those used only to acquire vascular access during a variety of simpler medical procedures

(n=35). Examining the operating room led to critical observations of tremendous physiological workload impairing the efficiency and comfort of surgeons. Surgeons agree that upcoming augmented reality technology may be the future of surgery. Conclusion: Based on these initial findings, integrated augmented reality system for radiography appears to be the most promising technology that is effective, reduced cognitive workload and has adequate usability in clinical environments. Augmented reality has huge promise in revolutionizing the operating room..

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Pushya Krishna: Cell Biology & Neuroscience
Mentor: Blake Wiedenheft – Microbiology & Immunology
Identifying and Understanding the function of CRISPR Leader-Repeat Sequences

Clustered Regularly Interspersed Short Palindromic Repeat (CRISPR)-Cas (CRISPR-associated) systems defend bacteria and archaea from viral and plasmid infection. Defense occurs in a three-phase process that starts with the integration of foreign DNA into a CRISPR locus. New spacers are preferentially added to the Leader-end of the CRISPR locus in a process called adaptation. The CRISPR locus is then transcribed into a primary transcript which is ultimately processed into a mature CRISPR RNA (crRNA). The mature crRNA guides Cas nuclease to selectively degrade complementary targets. The CRISPR locus consists of repeating, palindromic DNA sequences interspersed with unique DNA fragments. Furthermore, the upstream DNA sequence (Leader) contains potentially important elements for CRISPR adaptation and regulation. We hypothesize that the Leader sequence is an important regulator of CRISPR function. To test our hypothesis, we are using an array of bioinformatic methods to analyze all bacterial and archaeal genomes for conserved protein binding motifs. Preliminary results reveal several highly conserved, overlapping protein binding sites across specific CRISPR-Cas subtypes. In the future, we will then test the function of these newly identified motifs in bacterial defense against viruses.

Acknowledgements: Undergraduate Scholars Program

Thomas LaBarge: Earth Sciences
Mentor: David Varricchio, Chris Organ – Earth Sciences
The Interrelationhips of Phorusrhacidae and the Evolution of Gigantism

Phorusrhacids, commonly referred to as “Terror Birds”, are an extinct group of large, flightless, predatory birds. The derived members of this group represent a unique example of birds evolving to sizes and ecologies similar to their theropod dinosaur ancestors. However, the evolutionary means by which they achieved these enormous sizes remains largely unstudied. We hypothesize that midway through this group’s evolution, these animals experienced a period of rapid diversification correlated with an overall increase in body size. To test our hypothesis, we created a revised evolutionary tree for the family Phorusrhacidae with analyses on body size evolution. Using past analyses as a framework, we formed a new composite matrix of diagnostic traits and constructed a Bayesian phylogeny, an evolutionary tree calculated using Bayesian statistics. We then used this tree to test for variability in the rate of body size evolution across the group and determine if these rates are associated with species divergence. The new phylogeny indicates that gigantism occurred in multiple lineages within Phorusrhacidae, to varying degrees. Extreme examples, however, appear to have occurred solely in the subfamily Phorusrhacinae, where the rate of body size evolution was found to be the highest. Additionally, recent analyses suggest the largest of these species form a distinct subgroup within Phorusrhacinae. Overall, this revised Phorusrhacid tree clarifies how this group evolved and with additional inquiry may have further implications regarding Phorusrhacid ecology.

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Shelian Lame Bull: Political Science
Mentor: Kristin Ruppel – Native American Studies
Indian Land Management and Ownership Processes

This research is a part of an ongoing applied research program that was initiated in 2017 by Montana State University's Native Land Project (NAS) team, in which they began developing a series of guides to help Indian landowners visualize the land management processes within their reservation. As part of this project, I have focused on, 1) demonstrating the long history behind the struggles of Indian land management and ownership on allotted reservations and, 2) helping with further development of educational materials focused on the processes of managing individually owned Indian 'trust' land. The detailed history and educational materials will provide a greater understanding of the complex processes imposed on Indian landowners and tribes by the United States government. To develop the process guides, we met monthly with individual Indian landowners, tribal land managers, and BIA officials from the Blackfeet Nation. They provided constructive feedback on the visual process guides to ensure that they are as accurate and effective as possible. With the products of this applied research, we hope to alleviate some of the frustration caused by having to navigate these complex processes, and eventually to provide decision support for tribal leaders interested in modifying the processes all together.

Acknowledgements: McNair Scholars Program, Native Land Project, and Blackfeet Nation Agriculture Resource Management Plan Office

Michelle Leonard: Microbiology & Immunology
Mentor: Margaret Eggers – Microbiology & Immunology
Manganese Poisoning: Its Effects on Neurodevelopment

The goal of this research is to answer the question of whether or not manganese poisoning or overexposure in drinking water is causing neurodevelopmental problems within the United States. This is an important research question because if manganese poisoning is leading to neurodevelopmental problems, then something will need to be done to fix the problem before numerous people are affected. The methods included reviewing nine peer reviewed articles looking at several different studies that all relate back to manganese exposure through drinking water. Additionally, data from the US Geological Survey and the World Health Organization document where manganese comes from and the positive and negative effects it has on the body. These results show that overexposure to manganese in the brain is causing less focus, language proficiency problems and overall less ability to learn, in short, extreme neurodevelopmental issues. . Even though more research is needed, many actions can be done now to improve outcomes. For instance, policy changes to create clear and effective procedures to reduce exposures to manganese could be instituted. Additionally, further research must be done to help create a better environment in which drinking water is safe to all and doesn't cause neurodevelopmental problems.

James Loftis: Psychology
Mentor: Cara Palmer – Psychology
Sleep and Risk-Taking in Early Adolescents

Sleep is critical for maintaining psychological health, yet research shows that as many as 50% of children are not obtaining adequate sleep. A number of studies in adults and adolescents suggest that poor sleep patterns are associated with a greater likelihood of engaging in dangerous behavior. However, research has yet to examine these associations in younger samples. The current study seeks to better understand the relationship between sleep and risk taking in a sample of children (8-12 years). Participants underwent comprehensive sleep assessments, including a semi-structured sleep interview, questionnaires, one night of polysomnography sleep monitoring, and one week of actigraphy. Children also completed a questionnaire to assess their impulsivity, risk-

taking, and sensation seeking, and completed a lab-based task to assess their risk-taking propensity. Although data collection is still underway, we expect the findings of this research to parallel that of past work on adolescents and adults, such that poorer objectively measured sleep patterns will be associated with greater risk taking among children. Data from this study will provide more information about how sleep patterns can increase vulnerability for riskier decision-making in late childhood, when neurological regions implicated in risk-taking are undergoing rapid development.

Acknowledgements: McNair Scholars Program

Jazlyn Lynch: Liberal Studies Degree
Mentor: Margaret Eggers – Microbiology & Immunology
Higher Prevalence of Asthma in Women in Papua New Guinea

Asthma is a common, chronic non-communicable disease that is present in adults and children all over the world. It is a condition characterized with airflow limitations caused by airway irritation that can be both genetically and environmentally induced. This study examines why there is a high prevalence of asthma in both men and women in Papua New Guinea. As a country, Papua New Guinea has more rural and tribal communities where women and children usually cook and live in a hut with the family pigs. Global health data were obtained which showed women having a higher prevalence of asthma than men. In developing countries, open fires and wood stoves are commonly used for cooking and heating. Reviewing literature about open fires being used in developing countries, it was found that women are more likely to develop respiratory infections as well as other health issues due to constant exposure to these airborne particles. With women cooking, there is much more airborne particulate matter in the confined space of the household that is being inhaled into the lungs on a daily basis. Based on the global health data and literature obtained, it is likely that the high prevalence of asthma in women in Papua New Guinea is correlated to an increased exposure to airborne particulate matter such as smoke and dust inside the homes. Recognizing this as a global health issue, countries around the world have been working together to distribute cleaner cookstoves to these developing countries.

Katrina Lyon: Microbiology & Immunology
Mentor: Diane Bimczok – Microbiology & Immunology
Evaluating the therapeutic potential of black raspberries against stomach cancer using a human gastric organoid model of Helicobacter pylori infection

Infection with Helicobacter pylori can have damaging effects on the gastric mucosa, leading to complications such as gastritis, ulceration, MALT lymphoma, and gastric adenocarcinoma. Gastric organoids are three-dimensional, primary epithelial cell cultures that closely reflect the microanatomy and physiology of the stomach and may serve as preclinical models for gastric cancer–a disease caused by uncontrolled gastric epithelial cell proliferation. Furthermore, epithelial cells are known to proliferate and become resistant to natural cell death when undergoing carcinogenic transformation, such as with cancer-causing Helicobacter pylori infection. It has been reported that berry extracts have chemopreventive and antimicrobial properties as a result of high anthocyanin content--the phytochemicals responsible for the dark pigments in berries. We here used gastric organoids to explore the potential of black raspberry extract (BRB-E) for gastric cancer prevention and treatment. Specifically, we tested the hypothesis that BRB-E will have an antiproliferative effect on H. pylori-infected gastric epithelial cells. 5-ethynyl-2'-deoxyuridine (EdU) is a thymidine analog that can be incorporated into the DNA of proliferating cells. We showed that flow cytometric analysis of proliferation using the EdU assay is an effective method for measuring organoid cell proliferation. In the absence of treatment, 45% of cells showed proliferative activity within an 18-hour period. BRB-E at a concentration of up to 0.8 μg/mL did not negatively affect organoid viability. Surprisingly, BRB-E did not have a significant antiproliferative effect on either untreated or H. pylori-infected gastric organoids, which may be due to high concentration of growth factors in the culture medium. However, BRB-E was able to reduce H. pylori

colonization following 4-day and 10-day infection, showing potent antimicrobial activity. The role of growth factor Wnt3a in organoid proliferation as well as the apoptotic behavior of the organoids will be considered in future experiments exploring the effects of BRB-E on H. pylori-infected gastric organoids.

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Monica Martinez: Agricultural Economics & Economics
Mentor: Margaret Eggers – Microbiology & Immunology
Ending the Gang Crisis in the Northern Triangle

Central America's Northern Triangle, consisting of Guatemala, Honduras, and El Salvador, has some of the highest rates of homicide, drug trafficking and gang violence in the world. The presence of gang activity and drug trafficking has significant implications on the number of deaths in these countries that are caused by firearm assault. This project aimed to conclude whether the increasing presence of gang activity is correlated with an increase in the number of firearm deaths. Guatemala and El Salvador were the two countries studied. They were chosen because I visited Guatemala in 2018 and my personal experiences contributed greatly to the purpose of the project. El Salvador has the highest murder rate in the world and the data from that country produced significant results for the research question. Data collection came primarily from analysis of University of Washington's online VizHub graphs and past research on how gang violence has caused forced displacement and a surge of migrants to the U.S. border seeking asylum. Research results indicate that gang activity is the leading cause of firearm death in Guatemala and El Salvador, and these gangs are responsible for the presence of drug trafficking and other forms of violence. A leading factor in gang activity is that minors and children are becoming gang members at an early age, and they remain in those gangs for the rest of their lives. Efforts to reduce the number of firearm-related deaths in Guatemala and El Salvador are focused on removing children from those environments where gang activity is prevalent.

Kaitlin McCormack: Psychology
Mentor: Ben Oosterhoff – Psychology
The costs and benefits of adolescent political engagement

Civic engagement entails both costs (e.g., stress) and benefits (e.g., empowerment). Recent research suggested that the costs of politics may be amplified in marginalized populations, yet little research has empirically examined the costs and benefits of political engagement for adolescents from different demographic backgrounds. The goal of this study was to explore the costs and benefits of adolescent political engagement and whether these costs and benefits vary for youth from marginalized backgrounds. Participants were N=1,054 adolescents aged 13-18 years. The sample was primarily 11th and 12th graders, White/Caucasion, identified as heterosexual, and identified as libral. Participants rate their agreement with statements asking how politics has negatively (e.g., 30 items; "politics has caused me stress") and positively (e.g., 11 items; "politics makes me feel empowered") affected their lives on a scale from 1 (strongly disagree) to 7 (strongly agree). Participants also reported their age, gender, race/ethnicity, sexuality, and political ideology . After accounting for political interest, ideology, anxiety, and depression, Structural Equation Modeling (SEM) found that adolescent females and those who identified as gay/lesbian had higher political costs and benefits compared to males and those who identified as heterosexual. Younger youth reported more political costs and less political benefits compared to older youth. No significant effects for income or race were found. This study adds to burgeoning research examining how political engagement affects adolescent well-being. Future research should examine ways to minimize the costs and maximize the benefits of youth political engagement.

Acknowledgements: McKenna Fromm – (MSU Undergrad Student) – Psychology, McNair Scholars Program

Enzo Mejia: Microbiology & Immunology
Mentor: Margaret Eggers – Microbiology & Immunology
Outreach in Rural Communities

When it comes to an environmental problem in a community, what are the most effective outreach solutions to raise awareness in a rural Montana community with a population Less than 2,500? Western Gallatin County is known to have high arsenic levels in groundwater. Free home well water screening for arsenic was offered to local residents by Montana State University students with Three Forks High School science teachers and their students, using community engaged research. With approval of the MSU IRB a survey was offered to the community participants, including questions about outreach. The relevant outreach questions were "How would you like to receive your water test results?" "How did you hear about this free service?" "What neighborhood do you live in?" followed by appropriate multiple choice answers. These questions were voluntarily answered by 41 Three Forks residents with preliminary results showing about 90% acted on free well testing after hearing by word of mouth and/or local high school sporting event announcements. Other early results show that most participants wanted their feedback delivered through email, and tied for second was by phone or by postal mail. These preliminary results can possibly conclude that in smaller rural Montana communities such as Three Forks it is best to create outreach using social events instead of newer forms of social media such as Facebook. Correlation can be found between older populations and low income communities preferring traditional methods, though results are still being finalized. Further research awaits as we enter our final stages of recording data and calculating statistics from all surveys.

Acknowledgements: Thank you to collaborators Garret Oksness and Steven Hamilton, science teachers at Three Forks High School, and their students, who conducted the great majority of the outreach for this project.

Alessandra Miller: Cell Biology & Neuroscience
Mentor: Margaret Eggers – Microbiology & Immunology
Rising Prevalence of Meningitis in Algeria: An Investigation into Possible Bacterial Related Explanations

Meningitis is a bacterial, viral, and or fungal infection in which infected people experience swelling of meninges surrounding the brain and nervous system. Complications arising from meningitis range from headaches and memory loss to death. Meningitis prevalence in deaths globally and in the Meningitis Belt have been trending downwards; however, in Algeria, the prevalence of meningitis related deaths appears to be trending upwards. In this investigation, both online literature and Global Health data were reviewed. Research by various universities and Algerian hospitals explored antibiotic resistance, bacterial vectors, and vaccine prevalence in Algeria as possible explanations of the increasing prevalence of meningitis. Various strains of Staphylococcus and of Listeria monocytogenes were shown to be antibiotic-resistant while dairy products distributed through Algeria tested positive for antibiotic-resistant meningitis-causing bacteria. Further, Algeria has not purchased the PVC13, Meningitis A, and PCV vaccines in recent years. The results suggest that antibiotic-resistant bacteria could be linked to increased infections and thus deaths related to meningitis. The bacteria are resistant to the major antibiotics used. Furthermore, the bacteria may be spread to the population through dairy product vectors. Finally, inadequate vaccination could be linked to the increase of meningitis related deaths. The proper vaccines needed to combat meningitis antibiotic-resistant bacteria and other bacteria are not being circulated among the population, thus making infection and death more likely. The rise in meningitis prevalence in Algeria could be the result of increased prevalence of antibiotic-resistant bacteria, bacterial dairy vectors, and inadequate vaccination.

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

During the last few years, e-cigarette usage has increased in student populations across the United States. There is a misperception by the public that e-cigarettes are "safe", but many studies have found negative health effects caused by exposure to and inhalation of nicotine and other chemicals. These products are not regulated by the FDA and, therefore, are not required to list all ingredients or accurate percentages on the labels. Due to this, many users are not aware of the ingredients of the products. This project was submitted to MSU's Institutional Review Board and deemed exempt. The MSU Office of Health Advancement and the Tobacco Expert at the Gallatin City-County Health Department were consulted throughout this process. A report will be submitted to both organizations. An online anonymous survey was adapted from the Center for Disease Control's National Adult Tobacco Survey to focus on MSU students' motivations for using and perceptions of e-cigarettes. It was distributed to 1500 randomly selected MSU undergraduate students with the help of MSU's Office of Planning and Analysis. Students were offered the opportunity to submit their name and last four of their GID to receive 1000 Champ Change points for completing the survey. Their responses are not linked to their name. This data will be used to assess MSU students' habits and knowledge of e-cigarettes before the cases of lung illness and deaths linked to e-cigarettes. MSU's "Tobacco Free Campus" physical signs and "We're Tobacco Free" digital campaign signs were mapped to determine the visual feedback to students of MSU's policies.

Kelsey Morris, Amalia Cisneros, Vanya Harrold, Jack Swain, Brendan Rust: English, Psychology, Political Science, Business, Cell Biology & Neuroscience
Mentor: Margaret Eggers – Microbiology & Immunology
Environmental Health Issues of Off-Campus Living

At Montana State University (MSU), a large population of students live in off-campus housing. The present study has two goals. The first is to assess off-campus MSU students' awareness of housing related environmental health issues (for example: radon, black mold, asbestos, fire safety, well water safety, mouse infestation, etc.). The second goal is to gather statistics on how prevalent these environmental health issues are in off-campus rental housing. A two-page, reward-incentivized Qualtrics survey will be emailed to 750+ undergraduate and graduate students who live off campus. Survey data will be analyzed and presented using Qualtrics and Tableau. The results will help student and staff advocates develop information and resources about off-campus living for MSU students, so we can understand and avoid or mitigate these environmental health issues. The research team will then develop educational materials on the most common issues, to be included in MSU's Off Campus Living Guide, presented at Renterpalooza, and disseminated via social media. This project is a collaborative effort with Dean of Students Matthew Caires and Director of Planning & Analysis Dr. Chris Fastnow, as well as members of the Bozeman Good Neighbor Committee.

Meghan Muench: Microbiology & Immunology
Mentor: Alice Running, Bernadette McCrory – Nursing, Mechanical & Industrial Engineering
Light Therapy as a Potential Treatment for Onychomycosis

Onychomycosis is a fungal infection of the nail that causes disfigurement and thickening of the nail plate. Current oral and topical prescriptions require long treatment periods, ranging from months to years, and may not completely eliminate the fungus. Onychomycosis is an important public health problem due to its high prevalence, and development of a treatment that is easy to use and shortens the treatment period would benefit affected patients. Preliminary research has shown that laser and light therapies have the potential to be efficacious, low-maintenance treatments for onychomycosis, with minimal side effects. The aim of this research was to complete a systematic review using the Cochrane review standard on laser and light therapies for onychomycosis. Randomized

and non-randomized controlled trials in which patients with onychomycosis received laser therapy, light therapy, or another novel treatment were included in the systematic review. The software "Review Man" was used to compile data from selected clinical trials and to perform a meta-analysis. Initial results have shown that at least three low-level laser therapy devices have been tested in clinical trials and approved by the Food and Drug Administration for the treatment of onychomycosis. These devices have been shown to shorten treatment periods with minimal side effects.

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Shannon Murphy: Mathematical Sciences
Mentor: Tomas Gedeon – Mathematical Sciences
Mathematical Modeling of a Disease Detection Assay

Disease detection is greatly aided by detection of biomarkers specific to that disease. In the past decade a new class of biomarkers has been discovered. These microRNA (miRNA) are RNA molecules that consist of only about 22 nucleotides. Because of their small size and very low concentration in the bloodstream, it is necessary to first amplify it i.e make a large number of copies. A new amplification method called UDAR was created to detect these biomarkers, and it is necessary to create a mathematical model of the reaction to quantify the process and understand what levels correlate with the presence of a biomarker. Through the composition of a system of differential equations and the use of Matlab, reaction rates are being fit to experimental data.

Acknowledgements: Undergraduate Scholars Program, IDeA Network of Biomedical Research Excellence

Gavin O'Boyle: Chemistry & Biochemistry
Mentor: Jennifer DuBois – Chemistry & Biochemistry
Bioconverting Lignin to Renewable Products

Lignin is a heterogeneous biopolymer that is the 2nd highest source of non-fossil carbon on the planet, existing as a possible repository for renewable carbon. However, this resource is burned a majority of the time once cellulose and lignin have been chemically separated. The heterogeneity of the molecule cannot be understated as any attempt to synthesize it will produce a different structure every time. In conjunction with this fact, it means that when attempting to break down the molecule, there is a smorgasbord of phenolic products that are cleaved. Imagine the variety of products being separated into different flasks, the goal is to convert all of the different phenols into a common product, a bottleneck of those various sources. To accomplish this, a bacterial P450 CYP255A oxidase (GcoA) and its 3 domain reductase component was initially shown to demethylate a lignin product, guaiacol, and a variety of other monomers. To expand on the promiscuity of this enzyme, collaborators made single point mutations to the enzyme to aid in the flexibility of the enzyme binding pocket. Biochemical assays were performed on these enzymes to assess how well they bind to and demethylate their phenolic substrates.

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Holly Old Crow: Sociology and Anthropology
Mentor: Jennifer Woodcock-Medicine Horse – Native American Studies
Incarcerated to Integrated: The Good Road Home

The purpose of this research is to identify the environmental and cultural factors that influence recidivism rates

among Native American habitual offenders. The preliminary research will focus on analyzing the data available for Crow and Northern Cheyenne Native American offenders. A second focus will be on understanding the reasons for a lack of data on the subject with an emphasis on clarifying the importance of having better data available. Through the process of utilizing the snowball interview technique to find subjects, I will interview reintegrating offenders. They will be provided open-ended questions that will allow offenders to speak freely of their own experiences and the factors that contributed to returning to prison more than once. Interviewees will have the ability to also speak about solutions that have been successful in their reintegration. This information can be used by those in the judicial system and by social workers who are specifically working with Native American offenders to understand the influence and contribution Native American culture has on the current recidivism rates.

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Savanah Ontiveros: Microbiology & Immunology
Mentor: Benfang Lei – Microbiology & Immunology
The Roles of the speB Locus of Group A Streptococcus in Throat Colonization, Neutrophil Response, and Infection of Cultured Human Epithelial Cells

Group A Streptococcus (GAS) is capable of causing a variety of diseases ranging from acute infections to secondary immune-mediated infections and may be as mild as strep throat or severe as necrotizing fasciitis. Mediation into systemic disease is thought to be initiated by migration from epithelial borders into circulation. Previous studies found high expression of conserved protease SpeB in wt GAS to be associated with clearance in alveolar infection, but permanence in both upper respiratory tract in wt mice and bronchioles of neutropenic mice. Decreased SpeB levels in GAS2740 containing G-to-T mutation of the ribosomal binding site (RBS) of previously unrecognized myr gene, permit tissue invasion in alveoli and bronchioles of wt and neutropenic mice, respectively. Interactions between SpeB, myr loci, and PMN response remain to be understood. Attainment of ΔspeB and ΔmyrΔspeB mutants were inoculated intratracheally into wt mice and analyzed. Intratracheal inoculation of ΔmyrΔspeB, but not ΔspeB, led to pulmonary infection with compromised PMN response. Wt GAS caused 105 fold higher throat colonization than ΔspeB and ΔmyrΔspeB on day 1 and day 2 after intranasal inoculation. Lastly, 10-fold decrease in invasion of cultured A549 human epithelial cells was observed for ΔspeB compared to wt GAS. We tentatively conclude that SpeB positively contributes to epithelial invasion and oropharyngeal infection and that myr expression acts as an agonist in enhancing localized neutrophil activity as illustrated in vivo.

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Jonathan Owen: Microbiology & Immunology
Mentor: Matthew Taylor – Microbiology & Immunology
Characterizing multiple mechanisms of superinfection exclusion in pseudorabies virus infection

Pseudorabies Virus (PRV) is a neuroinvasive herpesvirus capable of infecting many lower-order mammals. Infection can cause severe neurological damage in host species but normally results in the establishment of a lifelong, latent viral reservoir in host neuronal ganglia. PRV also serves as a model organism for Herpes Simplex Virus (HSV) in humans, as it shares many of the same behaviors, gene functions, and tropisms. It is thus a virus of importance to both animal and human health. HSV and PRV are both capable of establishing superinfection exclusion, or SIE, in host cells. SIE is a virally mediated process by which an already-infected cell becomes refractory to a second infection, or superinfection, by another virus. This process is of great interest, as it exerts a strong influence on the rate of viral recombination and thereby the genotypic diversity of the viral population within a given host. SIE also presents intriguing prospects for treatment and control of an HSV or PRV infection – if its underlying mechanisms can be understood, it may be possible to harness them to prevent an initial infection event. PRV and HSV possess two known mechanisms for establishing SIE – one mediated by the viral glycoprotein gD, and a gD-independent

mechanism whose effector proteins are unknown but are likely transcribed from immediate-early gene products. However, the interactions between these two mechanisms are poorly understood, and the relative importance of each is unclear. We hypothesized that the effects of the two mechanisms depend on the multiplicity of infection (MOI – the number of virions attempting infection per cell), and sought to obtain a better understanding of SIE – and the processes underlying its establishment – by varying the MOI of the initially-infecting and superinfecting viruses in cell culture experiments. Our results indicate that SIE becomes saturated when the MOI of superinfection is greater than the MOI of the initial infection, regardless of the primary or secondary MOI. We also determined that the predominant mechanism by which PRV establishes SIE may vary across MOIs.

Acknowledgements: Undergraduate Scholars Program, IDeA Network of Biomedical Research Excellence

Rachel Park: Cell Biology & Neuroscience
Mentor: Margaret Eggers – Microbiology & Immunology
Primary Health Concerns for Migrants in the Middle East

There are currently over 70 million people worldwide that have been forcibly displaced from their homes- more than ever before. With so many people displaced, understanding the physical and mental health effects of these experiences and how better to address them have never been more important. To explore this, data were compiled from both an online global health database and previous research projects. This gave a holistic view regarding the most common health problems, including both communicable and noncommunicable diseases, faced by refugees in the Middle East. It appears that diarrheal diseases, acute and chronic respiratory diseases, fever, acute malnutrition, hypertension, musculoskeletal disease, and diabetes are the most common ailments that refugees suffer from. Contributing factors to the increase in prevalence of these conditions with refugee populations include inconsistent access to medical care, language barriers, lack of cultural sensitivity, and the added mental and emotional stress from the nature of refugee situations. Current literature suggests that various humanitarian organizations can improve in areas such as preparing for chronic disease treatment as well as acute care, assisting with cultural and language sensitivity, and easing transitions into hold countries whenever possible.

Erin Peck: Cell Biology & Neuroscience
Mentor: Margaret Eggers – Microbiology & Immunology
Analysis of Trump Administration's Approach to US Opioid Epidemic

This research compares data regarding opioid abuse and public health emergencies to the approach to the opioid epidemic taken by the current United States presidential administration. From 1999 to 2017, overdose deaths caused by opioids rose by almost 600% in the United States. In response to this trend, President Donald Trump directed for a national state of public health emergency to be declared in late 2017. This classification showed promise for change regarding the escalating opioid epidemic. However, it remains crucial to analyze the administration’s approach to the issue holistically. To do this, information was collected through a comprehensive literature review on previous approaches to public health crises and an analysis of global health data on opioid use. While Trump has done more to address the public health crisis than previous presidents, misdirected statements and approaches to the issue continue to incorrectly convey the root of the issue and potential solutions. By identifying the strong and weak points of the Trump Administration’s approach to one of the deadliest public health crises in recent American history, it is possible to initiate a change at the citizen-level and direct improvements in American health from the bottom up. With nearly 50,000 deaths due to opioid use occurring in 2017, a number 3.5 times higher than most other high-income countries, there is a clear call for change at the national level in order to save hundreds of thousands of lives in the coming years.

Avital Pelakh: Psychology
Mentor: Steven Kalinowski, Keith Hutchison – Ecology, Psychology
Heuristics and Biases in Scientific Reasoning

The present research project aims to explore the role of automatic heuristic driven thinking as it relates to students' scientific reasoning ability and ultimately, their learning outcomes. A key factor in letting go of misconceptions and understanding non-intuitive scientific concepts is reasoning ability. Specifically, it is the capacity to critically and objectively consider the evidence at hand, rather than relying on intuitive beliefs and assumptions. We propose that this requires the ability to recognize and override automatic, heuristic and bias driven responses. Furthermore, we propose that this ability is a construct which is distinct from fluid intelligence and can be developed as a skill. This is an important question because if we can tease apart the mechanisms that underly reasoning ability, we can target those skills with instruction and design more effective teaching strategies. Following this logic, we developed an instrument based on existing measures of formal operational reasoning, cognitive reflection, and heuristics and biases. We administered our instrument to students enrolled in an introductory biology course at MSU and found it to have good psychometric properties. Additionally, we measured domain-general reasoning ability using Raven's Progressive Matrices (RPM) and conceptual learning gains with a pre and post-test on natural selection, one of the most difficult concepts in biology. Results and directions for future study are discussed.

Acknowledgements: Undergraduate Scholars Program

Allison Perez: Microbiology & Immunology
Mentor: Ed Schmidt – Microbiology & Immunology
Synthesis of L-(34S)Cysteine, a Stable Isotope of the Central S Metabolite, for Tracking S Utilization

Metazoans utilize the sulfur (S) containing amino acid, cysteine (Cys), to drive a diverse array of cellular processes and produce S-containing molecules. Cys is indispensable to cellular life, both as a metabolic hub for S metabolites and as a vital antioxidant. Alterations of S metabolism have been demonstrated in many disease states that are associated with aberrant oxidation and oxidative stress, such as pancreatic, lung, and breasts cancer, most likely due to Cys and Cys-derived metabolites being the primary mechanism for cellular oxidant management. Synthesizing a Cys molecule that contains a S isotope which is two atomic units heavier than common 32S allows for rapid identification of S-metabolites by mass spectrometry (MS). Using isotopic labeling and MS, it is possible to track the usage of Cys throughout the various pathways it travels through within a cell to help maintain redox homeostasis. In this research, the most naturally abundant 32S isotope has been replaced with an isotopically pure 34S to yield L-(34S)Cys. Human Embryonic Kidney (HEK) cells were grown with L-(34S)Cys as the only source of Cys in order to confirm the biological function of L-(34S)Cys. The Schmidt lab has generated several mouse lines with livers genetically altered to have disfunction disulfide reductase systems. L-(34S)Cys can be used to track the utilization of S in these livers, as well as in other systems that possibly have altered S metabolism.

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Amanda Ruckey: Microbiology & Immunology
Mentor: Margaret Eggers – Microbiology & Immunology
Age Distribution and Permit Status of Septic Systems in Old Town Three Forks, Montana

Septic Systems are a necessity and requirement for many homeowners. It is common for older homes to have older systems that may or may not be maintained regularly. It is also possible that older systems may not be permitted. The purpose of this research is to determine the age distribution of septic systems and the percentage

of non-permit systems in Old Town of Three Forks, Montana. A properly constructed and maintained septic system is important for protecting the health of homeowners, neighbors, pets, and livestock. Failing or improperly constructed septic systems can cause contamination of groundwater which can then adversely affect private wells throughout a community. The Gallatin County Interactive Map and the Gallatin County Wastewater Permit Records Search are being used to collect data on the age and permit status of septic systems in Old Town. Collection and analysis of the data are currently being performed and results will be presented at the MSU Undergraduate Research Celebration.

Emma Sihler: Cell Biology & Neuroscience
Mentor: Margaret Eggers – Microbiology & Immunology
Income Inequality and Maternal Mortality in High Income Countries

Despite significant advancements in the last few decades towards decreasing maternal mortality, 810 women around the world still die every day as the result of often preventable maternal disorders and the complications of childbirth. The mortality rate is much lower in high income countries than anywhere else in the world, but significant disparities remain even among these countries. In fact, as maternal mortality rates decrease around the world, the maternal mortality rate in the United States has more than doubled since 1990. It was hypothesized that the disparities in maternal mortality rates among high income countries stem from varying levels of income inequality. An extensive review of the literature, as well as maternal disorder data sourced from the Institute for Health Metrics and Evaluation (IHME) and UNICEF, and GINI index rankings, which measure the level of income inequality in a country, were used to examine the relationship between inequality and maternal health in 20 high income countries. It was found that although there is no correlation between income inequality and the prevalence of maternal disorders, there is a correlation between high income inequality rankings and higher maternal mortality ratios (MMRs) in high income countries. This research aims to provide a better understanding of a possible underlying social cause of the disparity in maternal mortality rates among high income countries.

Haylee Sleeman: Psychology
Mentor: Laura Larsson – Nursing
Is Xylitiol the savior of oral health?

Abstract: Background/Introduction: Tooth decay (caries) in children is the most prevalent disease of childhood. Sugar-sweetened foods in the cariogenic diet are implicated along with inadequate home-care behaviors for the high caries rates in children. Consequently, sugar-substitutes have been promoted as ingredients in food and dental products to help reduce the growth of the causative bacteria Streptococcus mutans. One sugar substitute, Xylitol, showed signs of decreasing plaque scores, but the public health community has been uncertain what role Xylitol should play in interventions to reduce the oral health crisis. Purpose: To conduct a review of the literature to inform a public health dental intervention with a rural, American Indian community in Montana. Method: A review of literature was conducted searching for peer-reviewed studies in the health sciences databases (Cochrane, Up-to-Date, CINAHL, PubMed). The author originally located five studies that focused on the creation, use, and efficay of Xylitol. A cited reference search of those five articles produced a sixth peer-reviewed article. An MSU Research Librarian assistant was consulted in the completion of this approach. Results: In one study using Xylitol infused gum, the experiments showed that children given 5g Xylitol a day for 4 weeks had reduced plaque, and S. mutan levels compared to the baseline. However, one long term study was inconclusive as to the benefits of Xylitol and no research team has designed a study to adequately differentiate the benefits of Xylitol from the increased saliva production from gum-chewing. The research on Xylitol is still very new and the research that has been submitted is very short term and vague on amounts needed for different ages and their exact benefits Conclusions: The evidence in support of using Xylitol is inconclusive. Studies varied among gum, mouthwashes and toothpaste products and most were short-term studies. Community Advisory Board members in the intervention

setting support the use of Xylitol gum in the early childhood classrooms as it gives them an opportunity to discuss oral health and is well-received by the children.

Acknowledgements: Undergraduate Scholars Program – Empower

Susanna Sovde: Cell Biology & Neuroscience
Mentor: Margaret Eggers – Microbiology & Immunology
Opioids in Ohio: Following Canada's Lead

Could a supervised injection site (InSite) like the one in Vancouver, British Columbia, be helpful in reducing opioid use disorders in Dayton, Ohio? Dayton has one of the highest opioid use disorder rates in America. Vancouver, BC, had a similar issue ten years ago. This paper looks into how Vancouver used a controversial idea to make progress with their community overdose issue, and how the same idea could be implemented in Dayton. The methods used to conduct this research were a detailed literature review and data analysis using several different types of sources. This includes peer reviewed journals, news articles, and raw opioid use data. The findings of this analysis were that this InSite could be effective in Dayton, but it all depends on how it well it is executed by the project planners and organizers. The supervised injection site is great in theory, but very specific requirements need to be met in order to make it effective. These requirements are different for each city, so more research would need to be conducted in order to truly map this out in a way that would be cost effective.

Uve Strautmanis, Alex Lloyd, Klara Aspelin: Microbiology & Immunology
Mentor: Margaret Eggers – Microbiology & Immunology
Coliform and E. coli Testing on Localized Water Samples from Three Forks, MT

Coliforms are a group of gram-negative, rod-shaped bacteria that inhabit most mammalian intestines and are commonly found in soil and groundwater. The Environmental Protection Agency (EPA) recognizes coliform in groundwater as an identifier of fecal contamination risk, and E. coli, a subgroup of coliform bacteria, as confirmation of fecal contamination. The city of Three Forks, Montana and surrounding communities within their school district, are at higher risk for coliform and E.coli groundwater contamination due to flooding risk, aging septic systems, small lot sizes, high agricultural land use, and limited public wastewater services. Three Forks High School (TFHS) students and their science teachers publicized a free well water testing service to families in their school district. Coliform and E. coli testing of home well water samples was done concurrently with arsenic testing, by both TFHS and MSU science students. Results from an MSU Institutional Review Board (IRB) approved survey were compared to results from the EPA approved Colilert Quanti-Tray 2000 test (Idexx Corporation) for coliform and E. coli, to determine which risk factors are highest for concern. Preliminary results suggest a potential link between water that smells like sewage and an older wellhead cap that lacks a watertight seal and higher risk of positive coliform results. With data analysis still in progress, further results will be presented in December. This project aims to further expand the community of Three Forks' awareness of the safety of their household water.
Acknowledgements: Thank you to collaborators Garret Oksness and Steven Hamilton, science teachers at Three Forks High School, and their students, who conducted the great majority of the community outreach and were partners in the planning, execution and analyses of samples for this project.

Zariah Tolman: Cell Biology & Neuroscience
Mentor: Frances Lefcort, Martha Chaverra – Cell Biology & Neuroscience, Microbiology & Immunology
The Vagal Phenotype of Familial Dysautonomia in Conditional Knock-out Mouse Models

Familial Dysautonomia (FD) is a hereditary disorder that is both developmental and progressive in neuronal degeneration. FD results in a vast array of phenotypes due to widespread sensory and autonomic loss in multiple organ systems, including cardiovascular instability, decreased gut motility, and eventual blindness. Sensory vagal

afferent neurons, with cell bodies located in the nodose ganglion (NG), are known to be compromised in FD. To investigate the cellular mechanisms causing these system dysfunctions, we investigated the vagal phenotype of FD conditional knock-out mice to investigate the above problems currently surrounding FD, with the intention of using the data to determine if the vagus is a viable candidate for gene therapy to treat the disease. NG of conditional knock-out mice (Tuba1a-cre;ELP1LoxP/LoxP, Phox2B-cre;ELP1LoxP/LoxP, and Wnt1-cre;ELP1LoxP/LoxP) were harvested and embedded in OCT. Tissue was then cryo-sectioned, immunolabeled using immunofluorescent chemistry, and imaged with a confocal microscope at 20x and 63x. Preliminary data of floxed Phox2B-cre mice, which do not live past 18 days, shows decreased nerve size and a reduction in NG neuron number at 9 days old. Experiments with gene therapy demonstrate the NG as a target candidate. AAV-9 expressing GFP was injected into the facial vein of P1 mice and were harvested 5 weeks later. Out of eight mice, two resulted in gene incorporation into 50% of NG neurons; however, two were GFP positive in only 20% of the cells. In contrast, AAV-2-GFP did not infect nodose neurons. Future experiments will inject AAV9 expressing ELP1 into the conditional knock-out Phox2B-cre mice in an effort to extend their lifetime and provide evidence of neuron rescue with gene therapy.

Acknowledgements: IDeA Network of Biomedical Research Excellence

Mary Valenzuela, Terah Rash, Ryan Sather: Microbiology & Immunology
Mentor: Margaret Eggers – Microbiology & Immunology
Arsenic Levels in Three Forks, Montana

Due to previous data suggesting high levels of arsenic in Three Forks, Montana, this research was conducted to expand on current data. Arsenic is a known carcinogen and has been proven to affect every system in the human body. Chronic exposure increases these risks. Three Forks is susceptible to arsenic contamination because it is located on a floodplain next to the Madison River, a water system with historically high levels of arsenic. With the help of Three Forks Highschool, well water samples were collected from the community. Samples from the following Three Forks neighborhoods were taken: Old Town, Rolling Glenn, Toston, Central Three Forks, South Three Forks, Clarkston, Willow Creek, Upper Madison, Harrison, Hilltop Vista, Millgan Canyon, Headwaters Pyrfer, Yellowstone Drive, Birch St., Larch Place, and Broadwater County. One sample was taken from Wheatland as well. A Quick Arsenic in Water Test Kit from Industrial Test Systems, Inc. was utilized to test the samples for arsenic. Of the 39 wells tested during the project, 61.5% contained fewer than 2ppm of arsenic, 17.9% contained between 2 and 10 ppm, and 20.5% contained more than 10 ppm of arsenic. In partnership with Montana Well Educated Program, additional test kits were given to community members whose wells tested above 10 ppm.

Mary Valenzuela: Microbiology & Immunology
Mari Eggers – Microbiology & Immunology
Prevalence of Ischemic Heart Disease in China and Sweden

Ischemic Heart Disease, also known as cardiovascular disease or coronary heart disease, accounts for 31% of all global deaths, making it the top cause of death globally. In this research, the rise of ischemic heart disease in China is explored. In previous years, cardiovascular disease was rare in China, but recent trends show an increase in its prevalence and data suggests that these trends will continue to increase. As a comparison country, Sweden was chosen because its country's ischemic heart disease trends have been decreasing due to successful intervention programs. Visualized data from the University of Washington's Vizhub (vizhub.healthdata.org), previous research, risk factors, and current trends regarding ischemic heart disease in China and Sweden have been analyzed in order to assess potential causes and intervention programs. Poorer diet, limited physical activity, extreme temperatures, healthcare limitations, air pollution, and increasing age are risk factors for ischemic heart disease in China. However, successful intervention programs such as primary care, secondary care, easy access to fitness places, less pollution, and public awareness have been proven to decrease ischemic heart disease in Sweden.

Annie Waldum: Cell Biology & Neuroscience
Mentor: Valérie Copié, Frances Lefcort – Chemistry & Biochemistry, Cell Biology & Neuroscience
Analysis of Systemic and Local Metabolism and the Effects of Succinate on Familial Dysautonomia

Familial Dysautonomia (FD) is an autosomal recessive disease resulting from a mutation in a gene encoding the ELP1 protein, which is part of the Elongator complex and is involved in the expression of proteins from mRNA transcripts. This multi-subunit complex modifies wobble uridines in tRNAs during protein translation. Loss of ELP1 leads to a decrease in the expression of certain proteins, which in turn leads to cell stress and neurodegeneration. A major hallmark of FD, observed both in FD patients and mouse models of FD, is a major dysfunction of central metabolism, as FD patients and FD mice struggle to maintain a normal weight and to generate energy (ATP) from nutrients. Of interest is the mitochondrion, a powerhouse of central metabolism. Dr. Lefcort's group has reported significant reductions in mitochondrial structural integrity, membrane potential, and function within retinal ganglion cells and dorsal root ganglia neurons in ELP1 knock-out mice, which may be the root cause of neuronal cell death. The goal of our research is thus to better understand the molecular mechanisms underlying the mitochondrial dysfunction observed in FD. Furthermore, it has been reported that the metabolite, succinate, may slow the degeneration of neurons in other neurodegenerative diseases that share hallmarks with FD, including Parkinson's disease. We hypothesize that succinate may help restore mitochondrial function and as a result, may improve neuronal heath in FD. We have thus begun to characterize the global metabolic changes occurring in FD mice as a result of succinate dietary supplementation, in an effort to assess whether this metabolite can improve metabolic functions found to be dysregulated in FD, and whether it can restore healthy crosstalks between the cellular networks intersecting the gut-brain-liver axis. Using NMR metabolomics, we expect to generate new knowledge and an in-depth analysis of systemic and local metabolic changes within the liver, serum and the brain in our FD mouse models following succinate dietary supplementation. In the long term, this work may help develop new therapeutics to treat FD patients including designing metabolic interventions that may delay or prevent neuronal degeneration in FD, and could be applied to other neurodegenerative diseases.

Acknowledgements: Alexandra Cheney (MSU Graduate Student) – Chemistry & Biochemistry, IDeA Network of Biomedical Research Excellence

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

The high specificity of DNA recognition in CRISPR-Cas systems has allowed it to be used as a cutting-edge genetic engineering tool to silence, degrade, or edit disease causing genes. The discovery of small viral proteins that block CRISPR function (anti-CRISPRs) provides a way to regulate the CRISPR system's genetic engineering activity by acting as an off switch. It is known that the anti-CRISPR, AcrF9, prevents binding of dsDNA to the Type IF CRISPR interference complex, Csy. However, the location of binding and the mechanism of Csy inhibition is currently not understood. Our working hypothesis is that Csy exists as an ensemble of conformations in solution, a subset of which are competent for AcrF9 binding. To test this, various mass spectrometry experiments including Protein Chemical Crosslinking Mass Spectrometry (XL-MS), Differential Scanning Fluorimetry (DSF), and Intact Protein Hydrogen Deuterium Exchange Mass Spectrometry (HDX-MS) were performed. These experiments have given us insight into the conformation of AcrF9 bound Csy and the dynamics of unbound Csy in solution. We also used DSF to determine the thermal stability of bound and unbound Csy. From these experiments, we identified possible AcrF9 binding sites on the Csy complex and we confirmed that AcrF9 bound Csy adopts a different conformation than unbound Csy. Future work includes peptide level HDX-MS and Native Mass Spectrometry to determine higher resolution conformational changes and how many AcrF9s are binding per Csy complex. With this knowledge, we can understand the mechanism that allows AcrF9 to control Csy activity. We believe that having the ability to

regulate CRISPR activity inside a cell will expand the use, precision, and safety of this powerful gene editing technology.

Acknowledgements: Aidan White (MSU Undergrad Student) – Chemistry & Biochemistry, Angela Patterson (MSU Graduate Student) – Biochemistry, IDeA Network of Biomedical Research Excellence

Erica Wiley: Liberal Studies Degree
Mentor: Margaret Eggers – Microbiology & Immunology
Water Pollution in Southeast Asia

Developing countries all around the world are constantly searching and struggling to find clean water to drink or for sanitation and hygiene. Poor sanitation and hygiene alone hospitalize 250,000 people in Vietnam each year. There are over 6 million tons of sewage that go into their water resources annually, and as of right now, there is no effective way of solving this issue. Many factors play a part such as climate change, poverty, and plastic pollution. Around 1,900,000 people in Southeast Asia alone are burdened with diarrheal disease caused by the environment (including water). The Mekong River is one of the largest rivers that flows through Southeast Asia, and one of the main water sources for these countries. Unfortunately, it has become one of the major garbage dumping grounds and waste deposits making it now one of the most polluted rivers in the world. Much of this pollution is not on purpose, but it is the only option for many families. The goal of this research is to raise awareness of the increasingly worsening issue, as well as potentially find a long-term solution to water pollution everywhere, but specifically in Southeast Asia. Some actions have been taken already, such as the River of Life project cleaning up the Mekong River to make it an attraction. Based on past data and research on the causes of water pollution, and effects of the poor water quality, I plan to collect and brainstorm new innovative ways for recovery or prevention.

Max Yates: Chemistry & Biochemistry
Mentor: Margaret Eggers – Microbiology & Immunology
A Glimpse Into Healthcare and Education for Native American Communities in Montana

Native Americans face disproportionate healthcare disparities in Montana and medical infrastructure on reservations is often described as defunct. The educational systems in tribal communities are also faced with high dropout rates and underfunding. This project explores the empirical data to search for a connection between these pillars of contemporary indigenous life in the United States. Looking at the county that contains the majority of each of the seven reservations in the state, statistics were collected from federal and state sources that glean information on the status of healthcare and education. Upon compilation and analysis of these data, a clear trend is found between the percent of Native Americans in the county and health outcomes, health factors, and life expectancy. Additionally, in counties with higher portions of indigenous individuals, the percentage of middle school students that are at or above proficient in math and English is markedly lower than counties with a smaller Native population. From these data a dive into primary literature shall be taken, supplemented by anecdotal evidence, to search deeply for a connection between health and education in reservations beyond simple correlation. From this work, further investigations can be performed to intentionally look at the link between education and healthcare for Native Americans in rural Montana.

Trevor Zahl: Chemistry & Biochemistry
Mentor: Douglas Kominsky – Microbiology & Immunology
Ablation of Aryl Hydrocarbon Receptor Disrupts Intestinal Epithelial Cell Differentiation

Intestinal epithelial cells (IECs) form a barrier that protect the host from luminal content and microorganisms. IECs include self-renewing stem cells and differentiated lineages that provide crucial physiologic and metabolic functions. These lineages work in a coordinated fashion to maintain digestion and mucosal homeostasis.

Breakdown in IEC function can lead to injury, dysregulated inflammatory responses, and gastrointestinal diseases such as colorectal cancer and inflammatory bowel disease (IBD). Canonical pathways regulating IEC differentiation are well described. However, it is unclear if noncanonical signaling pathways shape IEC lineage fate and subsequent intestinal function. Aryl hydrocarbon receptor (AHR) is a transcription factor that has been shown to mediate IEC function, particularly by dampening inflammation and promoting wound healing. AHR activation is also shown to modulate differentiation of several immune cell lineages, but little is known about the role of AHR in IEC lineage fate. Thus, we hypothesized if AHR signaling influences cell fate specification, then ablation of AHR will alter the relative ratios of the two prominent lineages, absorptive enterocytes and mucus-secreting goblet cells, under homeostatic conditions. To test this, AHR signaling was ablated in a human colon epithelial cell line and in the intestinal epithelium of mice. Experiments utilizing these models have demonstrated that AHR knockout IECs exhibited skewed differentiation towards an absorptive phenotype, with increased enterocyte markers and diminished goblet cell markers. These findings represent a novel perspective of how noncanonical pathways shape IEC differentiation, and have larger implications for elucidating the underpinnings of intestinal diseases.

Acknowledgements: Brittany Jenkins (MSU Graduate Student) – Microbiology & Immunology, Undergraduate Scholars Program, IDeA Network of Biomedical Research Excellence

COLLEGE OF NURSING

Jordyn Ontiveros: Nursing
Mentor: Sally Moyce – Nursing
Prevalence of Metabolic Syndrome: A Pilot Study

Metabolic syndrome (MS) is a cluster of risk factors that increases a person's risk of heart disease, stroke, myocardial infarction, and diabetes. One third of the U.S. population meets the criteria for MS. Evidence of the prevalence of MS in rural populations is lacking. The purpose of this study was to estimate the prevalence of MS in a rural sample of participants in West Yellowstone, Montana. We measured waist circumference, height, weight, and blood pressure. We also drew a venous blood sample to estimate triglycerides, high-density lipoprotein, and hemoglobin A1C. We classified participants as having MS if they met at least three of the American Heart Association criteria: waist circumference >102cm in men and >88cm in women, triglyceride level ≥ 150 mg/dL, high-density lipoprotein <40mg/dL in men and <50mg/dL in women, blood pressure ≥ 130/85 mmHg, and a hemoglobin A1C ≥6.5%. We used chi-square tests to estimate differences in demographic variables in participants with MS versus without MS. Out of 15 participants, five met the criteria for MS (33.3%). Demographic variables collected did not significantly differ between those who had MS and those who did not, based on chi-square results. We estimated the prevalence of MS in a rural population, and our results were consistent with estimates from urban settings. MS is a preventable condition, and nursing interventions aimed at improving risk factors in a rural population may help reduce the prevalence.

Acknowledgements: McNair Scholars Program

Alphabetical Listing of Students

Joshua Botti-Anderson: Land Resources & Environmental Sciences Mentor: Kevin O'Neill, Casey Delphia, Laura Burkle – Land Resources & Environmental Sciences, Ecology *The diversity and abundance of bees and wasps using trap nests in urban environments in Bozeman, Montana*	26	1-2:30pm
Rebecca Boylan: Cell Biology & Neuroscience Mentor: Cara Palmer – Psychology *Gender Moderates the Relationship Between Youth Slow Wave Sleep and Emotional Symptoms*	38	1-2:30pm
Keenan Brame: Land Resources & Environmental Sciences Mentor: Tim McDermott, Anne Camper – Land Resources & Environmental Sciences, Center for Biofilm Engineering *Temporal and spatial dynamics of coliform, Escherichia coli, and total microbial community composition across river habitats and conditions on the Little Bighorn River: A small-scale river system in southeastern Montana*	15	1-2:30pm
Emily Brazier Mentor: Mari Eggers – Microbiology & Immunology *The Ebola Outbreak in the Democratic Republic of the Congo: A Public Health Analysis*	30	1-2:30pm
Dianna Brown: Psychology Mentor: Margaret Eggers – Center for Biofilm Engineering *Effects of HIV, Diarrheal Diseases, and Dietary Iron Deficiency on the Maternal Hemorrhage Mortality Rate of South Sudan*	39	3-4:30pm
Kevin Bueling: Health & Human Development Mentor: Mitchell Vaterlaus – Health & Human Development *Technology use and family health: A case study approach*	30	3-4:30pm
Brianna Bull Shows: Microbiology & Immunology Mentor: Suzanne Held – Health & Human Development *Evaluation of culturally consonant incentives used in a community-based chronic illness self-management program*	39	3-4:30pm
Jacqueline Burgara: Psychology Mentor: Sally Moyce – Nursing *Provider Cultural Competency Evaluations from the Perspective of Latino Patients Living in Montana*	39	3-4:30pm
Kelly Cannici: Sociology and Anthropology Mentor: Nancy Mahoney – Sociology and Anthropology *Morphological Analysis of Late Pre-Contact Paleoindian Points in Eastern Montana*	40	3-4:30pm
Cassidy Catron: Microbiology & Immunology Mentor: Margaret Eggers – Microbiology & Immunology *Peptic Ulcer Disease in Greenland*	40	3-4:30pm

Alexandra Cheney: Chemistry & Biochemistry Mentor: Valérie Copié, Frances Lefcort – Chemistry & Biochemistry, Microbiology & Immunology *Exploring the Gut-Brain-Liver Axis in Familial Dysautonomia: How Microbes and Metabolism Exacerbate Neurodegeneration*	19	1-2:30pm
Strother Cooper: Physics Mentor: Shannon Willoughby, Philip Eaton, Barrett Frank – Physics *Generating a Partial Credit Model for the Conceptual Survey of Electricity and Magnetism*	41	3-4:30pm
Cullen Cunningham: Chemistry & Biochemistry Mentor: Deborah Keil – Microbiology & Immunology *Occurrence and Removal of Drugs of Abuse in Wastewater Processes*	41	1-2:30pm
Karenna Doctor: Cell Biology & Neuroscience Mentor: Margaret Eggers – Health & Human Development *Relationship between endometrial cancer and Lynch syndrome globally*	41	1-2:30pm
Katharyn Dolan: Microbiology & Immunology Mentor: Margret Eggers – Microbiology & Immunology *Potential Spillover and Causative Agents for Chronic Wasting Disease in the American Northwest*	42	1-2:30pm
Emily Dummer: Health & Human Development Mentor: Margaret Eggers – Microbiology & Immunology *Breast Cancer in Uruguay: The Potential Influence of Heavy Metal Pollution*	30	3-4:30pm
Samantha Eberhart: Health & Human Development Mentor: James Becker – Health & Human Development *Changes in Joint Kinetics when Running in Maximalist Footwear*	31	1-2:30pm
Faith Ellis: Psychology Mentor: J. Mitchell Vaterlaus – Health & Human Development *Perceived Gender Roles in Heterosexual Adolescent Romantic Relationships*	42	3-4:30pm
Kirke Elsass: History & Philosophy Mentor: Tim LeCain, Eric Sproles – History & Philosophy, Earth Sciences *Emerging Chemistries: Concrete and Community in Dillon, Montana c. 1905*	19	3-4:30pm
Chris Erlenbaugh: Cell Biology & Neuroscience Mentor: Margaret Eggers – Microbiology & Immunology *Why are Multiple Sclerosis DALY's higher in Canada, the US and Northern Europe compared to the rest of the World.*	42	1-2:30pm
Kyle Evans: Microbiology & Immunology Mentor: Margaret Eggers – Microbiology & Immunology *Investigating Water Quality in Three Forks' School District*	43	3-4:30pm

Laura Evans: Liberal Studies Degree Mentor: Margaret Eggers – Microbiology & Immunology *Gender Differences in Parksinson's Disease from a Global Perspective*	43	3-4:30pm
Katie Fasbender: Physics Mentor: David Nidever – Physics *A catalog-based approach to discovering solar system objects*	20	1-2:30pm
Annie Ferguson: Microbiology & Immunology Mentor: Margaret Eggers – Microbiology & Immunology *The Ticking Time Bomb of Water Quality*	43	1-2:30pm
Hannah Flook: Mechanical & Industrial Engineering Mentor: Chelsea Heveran – Mechanical & Industrial Engineering *The Effect of Familial Dysautonomia on Multiscale Bone Quality*	34	1-2:30pm
Marisa Flores: Mathematical Sciences Mentor: Katharine Banner, Dominique Zosso – Mathematical Sciences *Quantifying Public Health: An Undergraduate's Perspective of Biostatistics*	44	3-4:30pm
William Freimuth, Giulio Panasci: Earth Sciences Mentor: David Varricchio – Earth Sciences *The rich ichnologic record of Egg Mountain (Two Medicine Formation, MT, USA) provides insight into the environment, sedimentology, and ecology of a dinosaur nesting site*	20	1-2:30pm
Jakub Galczynski: Architecture Mentor: Ralph Johnson, Henry Sorenson – Architecture *Mixed Resolution : Architectural Expression*	16	1-2:30pm
Madysen Gromer: Cell Biology & Neuroscience Mentor: Margaret Eggers – Microbiology & Immunology *Analysis of Environment and Behavior on Heart Health in Ukraine*	44	3-4:30pm
Laina Hall: Chemistry & Biochemistry Mentor: Blake Wiedenheft – Microbiology & Immunology *Bacterial Defense against Viral Invasion*	44	1-2:30pm
Marziah Hashimi: Microbiology & Immunology Mentor: Diane Bimczok – Microbiology & Immunology *Recruitment of Dendritic Cells to the gastric epithelium of human gastric organoids during Helicobacter pylori infection*	20	1-2:30pm
Aidan Higgins: Electrical & Computer Engineering Mentor: Brock LaMeres – Electrical & Computer Engineering *None*	34	1-2:30pm
Megan Hollinger: Liberal Studies Degree Mentor: Margret Eggers – Microbiology & Immunology *Diarrheal Diseases*	31	1-2:30pm

Audrey Hood: Psychology Mentor: Keith Hutchison – Psychology *Providing goal reminders eliminates the relationship between working memory capacity and Stroop errors.*	21	3-4:30pm
Taylor Hosek: Music Mentor: Gregory Young – Music *Learning by Doing: Composing a Symphony*	29	3-4:30pm
Daniel Huck: Land Resources & Environmental Sciences Mentor: Tony Hartshorn – Land Resources & Environmental Sciences *Is Nitrogen the Secret Ingredient to the Soil Remediation Success of Arsenic-Oxidizing Bacteria?*	27	1-2:30pm
Benjamin Hunthausen: Cell Biology & Neuroscience Mentor: Margaret Eggers – Microbiology & Immunology *A Surprising and Alarming Epidemic: Meningitis in Sub-Saharan Africa*	45	3-4:30pm
William Johnston: Mathematical Sciences Mentor: Lisa Davis – Mathematical Sciences *Rational approximations for modeling EM transients in transmission lines*	21	3-4:30pm
Khristian Jones, Erik Gilbertson: Electrical & Computer Engineering Mentor: Bradley Whitaker – Electrical & Computer Engineering *Early Detection of Sepsis using Feature Selection, Feature Extraction, and Neural Network Classification*	34	3-4:30pm
Quinn Krause: Cell Biology & Neuroscience Mentor: Bernadette McCrory – Mechanical & Industrial Engineering *Integration of Currently Available and Emerging Intracorporeal Imaging Technologies in Medicine*	45	3-4:30pm
Pushya Krishna: Cell Biology & Neuroscience Mentor: Blake Wiedenheft – Microbiology & Immunology *Identifying and Understanding the function of CRISPR Leader-Repeat Sequences*	46	3-4:30pm
Thomas LaBarge: Earth Sciences Mentor: David Varricchio, Chris Organ – Earth Sciences *The Interrelationhips of Phorusrhacidae and the Evolution of Gigantism*	46	1-2:30pm
Shelian Lame Bull: Political Science Mentor: Kristin Ruppel – Native American Studies *Indian Land Management and Ownership Processes*	47	3-4:30pm
Emily Lawrence: Animal & Range Sciences Mentor: Jennifer Thomson – Animal & Range Sciences *Genomic analysis of Argali sheep to define management units*	27	3-4:30pm
Michelle Leonard: Microbiology & Immunology Mentor: Margaret Eggers – Microbiology & Immunology *Manganese Poisoning: Its Effects on Neurodevelopment*	47	1-2:30pm

James Loftis: Psychology Mentor: Cara Palmer – Psychology *Sleep and Risk-Taking in Early Adolescents*	47	3-4:30pm
Jazlyn Lynch: Liberal Studies Degree Mentor: Margaret Eggers – Microbiology & Immunology *Higher Prevalence of Asthma in Women in Papua New Guinea*	48	1-2:30pm
Katrina Lyon: Microbiology & Immunology Mentor: Diane Bimczok – Microbiology & Immunology *Evaluating the therapeutic potential of black raspberries against stomach cancer using a human gastric organoid model of Helicobacter pylori infection*	48	1-2:30pm
Monica Martinez: Agricultural Economics & Economics Mentor: Margaret Eggers – Microbiology & Immunology *Ending the Gang Crisis in the Northern Triangle*	49	3-4:30pm
Kaitlin McCormack: Psychology Mentor: Ben Oosterhoff – Psychology *The costs and benefits of adolescent political engagement*	49	3-4:30pm
Enzo Mejia: Microbiology & Immunology Mentor: Margaret Eggers – Microbiology & Immunology *Outreach in Rural Communities*	50	3-4:30pm
Alessandra Miller: Cell Biology & Neuroscience Mentor: Margaret Eggers – Microbiology & Immunology *Rising Prevalence of Meningitis in Algeria: An Investigation into Possible Bacterial Related Explanations*	50	1-2:30pm
Hannah Monaghan: Microbiology & Immunology Mentor: Margaret Eggers – Microbiology & Immunology *A Comprehensive Study of E-Cigarette Use on a College Campus*	51	1-2:30pm
Kelsey Morris, Amalia Cisneros, Vanya Harrold, Jack Swain, Brendan Rust: English, Psychology, Political Science, Business, Cell Biology & Neuroscience Mentor: Margaret Eggers – Microbiology & Immunology *Environmental Health Issues of Off-Campus Living*	51	3-4:30pm
Meghan Muench: Microbiology & Immunology Mentor: Alice Running, Bernadette McCrory – Nursing, Mechanical & Industrial Engineering *Light Therapy as a Potential Treatment for Onychomycosis*	51	3-4:30pm
Shannon Murphy: Mathematical Sciences Mentor: Tomas Gedeon – Mathematical Sciences *Mathematical Modeling of a Disease Detection Assay*	52	3-4:30pm
Gavin O'Boyle: Chemistry & Biochemistry Mentor: Jennifer DuBois – Chemistry & Biochemistry *Bioconverting Lignin to Renewable Products*	52	1-2:30pm

Holly Old Crow: Sociology and Anthropology Mentor: Jennifer Woodcock-Medicine Horse – Native American Studies *Incarcerated to Integrated: The Good Road Home*	52	3-4:30pm
Jordyn Ontiveros: Nursing Mentor: Sally Moyce – Nursing *Prevalence of Metabolic Syndrome: A Pilot Study*	62	3-4:30pm
Savanah Ontiveros: Microbiology & Immunology Mentor: Benfang Lei – Microbiology & Immunology *The Roles of the speB Locus of Group A Streptococcus in Throat Colonization, Neutrophil Response, and Infection of Cultured Human Epithelial Cells*	53	3-4:30pm
Jonathan Owen: Microbiology & Immunology Mentor: Matthew Taylor – Microbiology & Immunology *Characterizing multiple mechanisms of superinfection exclusion in pseudorabies virus infection*	53	1-2:30pm
Rachel Park: Cell Biology & Neuroscience Mentor: Margaret Eggers – Microbiology & Immunology *Primary Health Concerns for Migrants in the Middle East*	54	3-4:30pm
Erin Peck: Cell Biology & Neuroscience Mentor: Margaret Eggers – Microbiology & Immunology *Analysis of Trump Administration's Approach to US Opioid Epidemic*	54	1-2:30pm
Avital Pelakh: Psychology Mentor: Steven Kalinowski, Keith Hutchison – Ecology, Psychology *Heuristics and Biases in Scientific Reasoning*	55	3-4:30pm
Allison Perez: Microbiology & Immunology Mentor: Ed Schmidt – Microbiology & Immunology *Synthesis of L-(34S)Cysteine, a Stable Isotope of the Central S Metabolite, for Tracking S Utilization*	55	3-4:30pm
Naomi Redfield: Animal & Range Sciences Mentor: Robert Sager – Medicine Creek Bovine Health *Increasing fertility rates for Yak*	27	1-2:30pm
Camina Rice, Nada Abdelfatta: Electrical & Computer Engineering Mentor: Maryam Bahramipanah – Electrical & Computer Engineering *Smart Energy Management Control Tools for Battery Energy Storage Systems*	35	3-4:30pm
Sonja Ring: Microbiology & Immunology Mentor: Margaret Eggers – Microbiology & Immunology *Hydrogen Sulfide in Water of Three Forks, Montana*	21	3-4:30pm
Devin Rossie: Health & Human Development Mentor: James Becker, David Graham – Health & Human Development *Role of Intrinsic Foot Muscles on Stability*	32	1-2:30pm

Amanda Ruckey: Microbiology & Immunology Mentor: Margaret Eggers – Microbiology & Immunology *Age Distribution and Permit Status of Septic Systems in Old Town Three Forks, Montana*	55	3-4:30pm
Emma Sihler: Cell Biology & Neuroscience Mentor: Margaret Eggers – Microbiology & Immunology *Income Inequality and Maternal Mortality in High Income Countries*	56	3-4:30pm
Haylee Sleeman: Psychology Mentor: Laura Larsson – Nursing *Is Xylitiol the savior of oral health?*	56	3-4:30pm
Susanna Sovde: Cell Biology & Neuroscience Mentor: Margaret Eggers – Microbiology & Immunology *Opioids in Ohio: Following Canada's Lead*	57	1-2:30pm
Ally Stallman: Health & Human Development Mentor: Margaret Eggers – Microbiology & Immunology *Effectiveness of WHO standard of preventive chemotherapy for Soil-transmitted helminths*	32	1-2:30pm
Katherine Steward: Chemistry & Biochemistry Mentor: Brian Bothner – Chemistry & Biochemistry *Metabolic Implications of Using Bio Orthogonal Non-Canonical Amino Acid Tags for Tracking Protein Synthesis*	22	3-4:30pm
Matthew Strasbourg: Physics Mentor: Nicholas Borys – Physics *Unraveling nonlinear formation and relaxation of excitons in atomically thin 2D semiconductors*	22	3-4:30pm
Uve Strautmanis, Alex Lloyd: Microbiology & Immunology Mentor: Margaret Eggers – Microbiology & Immunology *Coliform and E. coli Testing on Localized Water Samples from Three Forks, MT*	57	3-4:30pm
Merrilee Thomas: Cell Biology & Neuroscience Mentor: Thomas Hughes – Cell Biology & Neuroscience *Bioengineered Cells for a High Throughput Screen of Calcium sensors*	23	3-4:30pm
Zariah Tolman: Cell Biology & Neuroscience Mentor: Frances Lefcort, Martha Chaverra – Cell Biology & Neuroscience, Microbiology & Immunology *The Vagal Phenotype of Familial Dysautonomia in Conditional Knock-out Mouse Models*	57	3-4:30pm
Mary Valenzuela, Terah Rash, Ryan Sather: Microbiology & Immunology Mentor: Margaret Eggers – Microbiology & Immunology *Arsenic Levels in Three Forks, Montana*	58	3-4:30pm
Mary Valenzuela: Microbiology & Immunology Mari Eggers – Microbiology & Immunology *Prevalence of Ischemic Heart Disease in China and Sweden*	58	1-2:30pm

James Vallie: Chemical & Biological Engineering Mentor: Brent Peyton – Center for Biofilm Engineering *Cyanobacteria and Biochar: Technology of the Past, for the Future*	35	3-4:30pm
Annie Waldum: Cell Biology & Neuroscience Mentor: Valérie Copié, Frances Lefcort – Chemistry & Biochemistry, Cell Biology & Neuroscience *Analysis of Systemic and Local Metabolism and the Effects of Succinate on Familial Dysautonomia*	59	1-2:30pm
Cameron Wallace: WWAMI Medical Program Mentor: Ron June – Mechanical & Industrial Engineering *Comparing metabolite profiles of synovial fluid and serum after knee injury: a mouse study for early detection of osteoarthritis*	24	3-4:30pm
Elizabeth Waymire: Chemistry & Biochemistry Mentor: Brian Bothner – Chemistry & Biochemistry *Characterization of the Effects of anti-CRISPR AcrF9 Binding to the CRISPR Type IF Surveillance Complex*	59	3-4:30pm
Summer Whillock, Ashleigh Poppler, Courtney Sanders: Psychology Mentor: Benjamin Oosterhoff – Psychology *Longitudinal Associations between Civic Engagement and Character Strengths: A Daily Diary Study*	23	1-2:30pm
Erica Wiley: Liberal Studies Degree Mentor: Margaret Eggers – Liberal Studies Degree *Water Pollution in Southeast Asia*	60	3-4:30pm
Stephanie Wilson, Jesse Peach: Health & Human Development, Chemistry & Biochemistry Mentor: Mary Miles, Brian Bothner – Health & Human Development, Chemistry & Biochemistry *Temporal response yields a dynamic biosignature of inflammation and discriminative gut bacterial features*	17	1-2:30pm
Xingzi Xu: Electrical & Computer Engineering Mentor: Dominique Zosso – Mathematical Sciences *Accelerating Graph-based Geometric Data Analysis*	36	1-2:30pm
Max Yates: Chemistry & Biochemistry Mentor: Margaret Eggers – Microbiology & Immunology *A Glimpse Into Healthcare and Education for Native American Communities in Montana*	60	1-2:30pm
Trevor Zahl: Chemistry & Biochemistry Mentor: Douglas Kominsky – Microbiology & Immunology *Ablation of Aryl Hydrocarbon Receptor Disrupts Intestinal Epithelial Cell Differentiation*	60	1-2:30pm