UM GradCon - A Graduate Student Research Conference

The UM Graduate Conference (GradCon) will be held in the University Center (3rd floor) on Friday, February 28, 2020. The UM GradCon is interdisciplinary and welcomes presentations from all disciplines and departments. GradCon is organized by the UM Graduate and Professional Student Association and graciously sponsored by the UM Graduate School. The conference is free and open to the public. All members of the UM campus community are encouraged to attend and participate.

GradCon Schedule Overview

<table>
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<tr>
<th>Time</th>
<th>Description</th>
<th>Location</th>
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</thead>
<tbody>
<tr>
<td>7:30-8:45am</td>
<td>Day of Questions, Oral Presentation Uploading (Poster/Visual Arts Display Set-up until noon)</td>
<td>UC Ballroom &amp; 300 rooms</td>
</tr>
<tr>
<td>9:00-12:00pm</td>
<td>15 minute Oral Presentations Blocks (9:00-10:00am, 10:00-11:00am, 11:00-12:00pm)</td>
<td>UC 300 rooms</td>
</tr>
<tr>
<td>12:00-12:30pm</td>
<td>Lunch Sponsored by the Institute of Health and Humanities (Grab &amp; Go lunch provided for all participants &amp; attendees)</td>
<td>UC North Ballroom</td>
</tr>
<tr>
<td>12:30-1:20pm</td>
<td>Ridge Scholars Panel Discussion &quot;Body, Mind &amp; Spirit - A Conversation on Health &amp; Humanities&quot; (All are invited)</td>
<td>UC North Ballroom</td>
</tr>
<tr>
<td>1:30-3:30pm</td>
<td>15 minute Oral Presentations Blocks (1:30-2:30pm &amp; 2:30-3:30pm)</td>
<td>UC 300 rooms</td>
</tr>
<tr>
<td>3:30-4:30pm</td>
<td>Performing and Visual Arts Presentations</td>
<td>UC North/South Ballroom</td>
</tr>
<tr>
<td>5:00-6:30pm</td>
<td>Poster Presentation Session (5:00-6:00pm) &amp; &quot;Best of GradCon&quot; Awards (6:00-6:30pm) Hors d’oeuvres and a no-host cash bar will be available during this time (please bring cash &amp; your ID).</td>
<td>UC North Ballroom</td>
</tr>
</tbody>
</table>
CALL FOR JUDGES
Please consider volunteering to judge at the 2020 Montana Science Fair on March 30th. Please also encourage your colleagues (including retirees), graduate students, and science majors to volunteer.

All judging for the 2020 Montana Science Fair will occur from 11:10am – 6:00pm on Monday, March 30th in the Adams Center at the University of Montana. This is a valuable service to the students and is an excellent opportunity to engage youth in discussions about science. Please follow the link to the Montana Science Fair website for more information and to register.

hs.umt.edu/mtsciencefair

Join the GPSA Senate!
The GPSA is building a Senate with representatives from all graduate and professional programs at UM. Senators work to improve the graduate school experience for themselves and others while gaining insight into how the university works and forging valuable connections with students and faculty across the university. Senators serve as ambassadors between GPSA and individual graduate programs and students. Senators must attend monthly GPSA meetings.

Visit: UM Graduate and Professional Student Association Website to learn more on how to join the Senate or serve on a UM Committee today!
# GradCon Oral Presentations

The Oral Presentation block schedule is listed by:

- block number & name, presentations room, time, primary presenter, and title of presentation.
- **It is requested that all presenters be present as audience members for the entire block.

(Please see the Abstract/Artist Statement Section for the complete list of co-authors and faculty mentors).

<table>
<thead>
<tr>
<th>Block</th>
<th>Time (9:00-10:15am)</th>
<th>Room</th>
<th>Presenters</th>
<th>Title</th>
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<tr>
<td>1</td>
<td>9:00-9:15am</td>
<td>UC Room 326</td>
<td>Patrick Wurster</td>
<td>&quot;Trees, Crops, and Metals, Oh Mine!: Examining Human/Environment Interactions&quot;</td>
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<tr>
<td></td>
<td></td>
<td>UC Room 327</td>
<td>Damian Specht</td>
<td>&quot;US and Global Politics&quot;</td>
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<td>UC Room 330</td>
<td>Qipei Shangguan</td>
<td>&quot;Chemistry: The Habulous World of Bonds and Reactions&quot;</td>
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<td></td>
<td></td>
<td>UC Room 331</td>
<td>Zachary Lauffenburger</td>
<td>&quot;What Does it Mean to be a Scientist? The Truth is Out There&quot;</td>
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<tr>
<td></td>
<td>9:20-9:35am</td>
<td>UC Room 332</td>
<td>Grayson O'Reilly</td>
<td>Enhancing the Impact of Behavioral Activation via Prospection</td>
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<td></td>
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<td>UC Room 333</td>
<td>Chelsea Maxson</td>
<td>&quot;Are We Human or Are We Dancers?: Understanding Behavior and Social Choice&quot;</td>
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<td></td>
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<td>UC Room 327</td>
<td>Quincy Riordan</td>
<td>Applying Structural Realism and Political Liberalism to Regime Interference in Latin America</td>
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<td></td>
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<td>UC Room 330</td>
<td>Yan Li</td>
<td>Highly Reactive Colll,IV2(μ-O)2 Diamond Core Complex That Cleaves C-H Bonds</td>
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<td></td>
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<td>UC Room 331</td>
<td>Joseph Vanderwall</td>
<td>Physical and chemical constraints on emergent aquatic ecosystem metabolism</td>
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<td></td>
<td>UC Room 332</td>
<td>Henry Kramer</td>
<td>What is Wonder?: A Phenomenological Investigation</td>
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<td></td>
<td>UC Room 333</td>
<td>Jennifer Lippold</td>
<td>College Students’ Social Media Uses and Emotional Correlates</td>
</tr>
<tr>
<td>3</td>
<td>10:00-10:15am</td>
<td>UC Room 333</td>
<td>Marcella Connolly</td>
<td>&quot;Climate Crisis 1: Conservation and Conscience&quot;</td>
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<td>UC Room 332</td>
<td>No Presenter</td>
<td>&quot;Does this Spark Joy: Examining Conceptions of History, Heritage, and Hoarding&quot;</td>
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<td></td>
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<td>UC Room 333</td>
<td>Jessica Ray</td>
<td>&quot;Lung Fun&quot;</td>
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**Abstract/Artist Statement Section**
GradCon Oral Presentations - Continued

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<th>UC Room 330</th>
<th>UC Room 331</th>
<th>UC Room 332</th>
<th>UC Room 333</th>
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</thead>
<tbody>
<tr>
<td>Ridge Scholars</td>
<td>None</td>
<td>&quot;Climate Crisis 1: Conservation and Conscience&quot;</td>
<td>UM BRIDGES</td>
<td>&quot;Does This Spark Joy: Examining Conceptions of History, Heritage, and Hoarding&quot;</td>
<td>&quot;Lung Fun&quot;</td>
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<tr>
<td>10:40-10:55am</td>
<td>Reece Brandon</td>
<td>Tina Cummins</td>
<td>Cassandra Sevigny</td>
<td>Emily Cahoon</td>
<td>Camilla de Mattos</td>
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<th>Block 3</th>
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</thead>
<tbody>
<tr>
<td>Ridge Scholars</td>
<td>None</td>
<td>&quot;Climate Crisis 2: Past Failures, Future Hope&quot;</td>
<td>&quot;Science 2: Truth Boogaloo&quot;</td>
<td>&quot;Learning How to Teach: Youth Studies&quot;</td>
<td>&quot;Politics of the South&quot;</td>
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<tr>
<td>11:00-11:15am</td>
<td>Erica Johnson</td>
<td>Emma Gjullin</td>
<td>Patrick Kreitzberg</td>
<td>Rebekah Skoog &amp; Sisilia Kusumaningsih</td>
<td>Logan Olson</td>
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<td></td>
<td>A Needs Assessment of Patrons Experiencing Homelessness at the Missoula Public Library</td>
<td>Climate Decisions &amp; Geoengineering</td>
<td>Efficiently finding the smallest k values in a large Cartesian product of lists</td>
<td>Student Immediacy: The key to collaborative learning dynamics?</td>
<td>Lion Hearted Originalism and the Second Amendment</td>
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<td>No Presenter</td>
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<td>11:20-11:35am</td>
<td>No Presenter</td>
<td>No Presenter</td>
<td>Shalom Kristanugraha</td>
<td>Kyle Lucke</td>
<td>No Presenter</td>
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<td>Complicity in Climate Change</td>
<td>Towards a General Protein Inference Model</td>
<td>No Presenter</td>
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<tr>
<td>11:40-11:55am</td>
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Ridge Scholars Panel Discussion: “Body, Mind & Spirit - A Conversation on Health & Humanities”
12:00-1:20pm - UC North Ballroom

Join us for this “not-to-be-missed” lunchtime event during GradCon! Ridge Scholars from across UM’s campus will discuss prevalent issues bridging individual health/healthcare & the humanities. Informed by their research interest and academic work, the panelists will contribute a personal perspective on their research and what unbelievable discoveries they made along the way. Lunch is generously sponsored by the Institute of Health and Humanities. All are invited!

COME FOR THE FREE LUNCH & STAY FOR THE PANEL DISCUSSION!
<table>
<thead>
<tr>
<th>Time</th>
<th>UC Room 326</th>
<th>UC Room 327</th>
<th>UC Room 330</th>
<th>UC Room 331</th>
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<tr>
<td>Block 4</td>
<td>&quot;Montana History&quot;</td>
<td>&quot;Pop Culture and Comedy&quot;</td>
<td>&quot;Innovative Undertakings: Rural &amp; Tribal Healthcare in Montana&quot;</td>
<td>&quot;Sustainable Foodways, Social Responsibility&quot;</td>
<td>&quot;Surviving: Coping Mechanisms and Social Support&quot;</td>
<td>&quot;The Remains of Care: Bioanthropological Studies of Human Remains&quot;</td>
</tr>
<tr>
<td>1:30-1:45pm</td>
<td>Kate Kolwicz</td>
<td>J.C. Bromley</td>
<td>Shayna Killam &amp; Tianna Leitch</td>
<td>Erika Berglund</td>
<td>Kinsie Dunham</td>
<td>Felicia Sparozic</td>
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<td></td>
<td>Forgotten No More: Public Archaeology in Missoula</td>
<td>Rae Bourbon: Queen of America</td>
<td>Precision Medicine under the Big Sky: Pharmacogenetic Implementation in Rural Settings</td>
<td>Food policy for a sustainable, equitable local food system: recommendations for Missoula</td>
<td>Alcohol Use Disorder among Nonexclusively-Oriented Women: Exploring Unique Risk Factors and Targets for Psychological Intervention</td>
<td>A Snapshot of Care: Creating models of care for Individuals included in the Terry Collection</td>
</tr>
<tr>
<td>1:50-2:05pm</td>
<td>Jennifer Simpson</td>
<td>Gabrielle Patterson</td>
<td>Sarah Ballou</td>
<td>Rebecca Elderkin</td>
<td>Nora Uhrich</td>
<td>Amanda Williams</td>
</tr>
<tr>
<td>2:10-2:25pm</td>
<td>Kristin Gates</td>
<td>Dac Cederberg</td>
<td>Jennifer Harrington</td>
<td>No Presenter</td>
<td>Cali Caughie &amp; Phoebe Bean</td>
<td>Katherine Baca</td>
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<td></td>
<td>Montana and the Backwater of Birchism</td>
<td>The Essential Queerness in Elizabethan Society</td>
<td>An analysis of tribal consultation: A case study of policy v. practice in Superfund</td>
<td>Wilderness Therapy as an Intervention for At-Risk Youth: A Pilot Study of Treatment Mechanisms and Program Effectiveness</td>
<td>Wilderness Made My Community Stronger: How wildfire can galvanize community members and catalyze community resilience to wildfire</td>
<td>Three-Dimensional Geometric Morphometric Sex Determination of the Human Pubic Bone</td>
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<tr>
<td>Block 5</td>
<td>&quot;Athletes, Trauma, and Risk Assessment&quot;</td>
<td>&quot;Communication is Key: The Complexity and Importance of Speech&quot;</td>
<td>&quot;A Bear of a Problem: Understanding the Social Aspects of Human/Environment Interactions&quot;</td>
<td>&quot;What We Owe Ourselves: Self-Care, Self-Reflection, Self-Compassion&quot;</td>
<td>&quot;Mystery Science Theater&quot;</td>
<td>&quot;Barking Up The Right Tree: Understanding Ecological Webs&quot;</td>
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<tr>
<td>2:30-2:45pm</td>
<td>Lucas Bonnevie</td>
<td>Jarrett Hopewell</td>
<td>Lily Clarke</td>
<td>Bethany Gorter</td>
<td>Tahereh Ziglari</td>
<td>Hallee Kansman</td>
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GradCon Afternoon Oral Presentations - Continued

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<tr>
<td></td>
<td>&quot;Athletes, Trauma, and Risk Assessment&quot;</td>
<td>&quot;Communication is Key: The Complexity and Importance of Speech&quot;</td>
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<td>&quot;Barking Up The Right Tree: Understanding Ecological Webs&quot;</td>
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<tr>
<th>2:50-3:05pm</th>
<th>Katherine Berglund</th>
<th>Kaylee Walter</th>
<th>Megan Moore</th>
<th>Morgan Bowlen</th>
<th>Mariah Rayl</th>
<th>Chelsea Wisotzkey</th>
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<tr>
<td></td>
<td>Acute Depressive Symptoms Post-Concussion: A Systematic Review</td>
<td>Preliminary Investigation of an Aphasia-Friendly Version of the PHQ-8 Compared to other Patient and Proxy Reported Outcome Measures of Depression</td>
<td>Social Trust and River Restoration in the Clark Fork Watershed in Montana</td>
<td>Self-Compassion as a Protective Factor Against Minority Stress for LGBT Individuals</td>
<td>Screening assays fail to predict the full extent of variation caused by PPARγ drugs</td>
<td>The Link Between Diet and Metal Accumulation in Aquatic Insects</td>
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<tr>
<th>3:10-3:25pm</th>
<th>No Presenter</th>
<th>No Presenter</th>
<th>Holly Nesbitt</th>
<th>Phoebe Bean &amp; Cali Caughie</th>
<th>Caleb Schwartzkopf</th>
<th>Enzo Paolo Martelli Moya</th>
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<td>Collective Aspects of Mitigating Interactions Between Large Carnivores and Humans</td>
<td>Making a Case for Nature</td>
<td>Filamentous Pf bacteriophage suppress type IV pili in Pseudomonas aeruginosa to prevent superinfection and secondary bacteriophage infections</td>
<td>Whitebark Pine ecology and management: synthesizing current understanding</td>
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Visual & Performing Arts Presentations - 3:30-4:30pm

<table>
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<tr>
<th>Time</th>
<th>UC North Ballroom</th>
<th>UC South Ballroom</th>
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<tbody>
<tr>
<td>3:30-3:45pm</td>
<td>Elijah Fisher</td>
<td>Jane Best</td>
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<td>Finding Strength in Being TIRED</td>
<td>More Than Notes and Rhythms: Using the Semiotics of Music to Unlock Characterization in Musical Theatre</td>
</tr>
<tr>
<td>3:50-4:05pm</td>
<td>Shane Lutz</td>
<td>Jadd Davis</td>
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<td>As Much for Your Sake: Gay History in Performance</td>
<td>Laryngeal Positioning and its Impact on Storytelling</td>
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<td>4:10-4:25pm</td>
<td>David Mills-Low</td>
<td>Peter Phillips</td>
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<td>The Proximity Principle as used in Blocking 360 Video</td>
<td>An Interpretive Endeavor to Apply Musical Interlude to the Two Character Play By Tennessee Williams</td>
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<tr>
<td>Poster #</td>
<td>Social Sciences/Humanities</td>
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<tr>
<td>1</td>
<td>Emily Hattouni - Using Ecological Momentary Assessment as a Mindfulness Intervention for Student-Teachers</td>
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<tr>
<td>2</td>
<td>Victoria Bigelow - A Reconsideration: Hiring Approaches at the University of Montana</td>
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<tr>
<td>3</td>
<td>Rebekah Engelland - Inter-site Evidence of Social Inequality in the Middle Fraser Canyon, British Columbia</td>
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<td>4</td>
<td>Anna Hampton - Sex, Ancestry, and Death: Not all are Created Equal</td>
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<tr>
<td>5</td>
<td>Daniel Salois - Changing Student's Attitudes About Rape Myths</td>
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<tr>
<td>6</td>
<td>Julia Goar - Investigating Childhood Stunting and Malnutrition Outcomes in Sukadana and Simpang Hilir, Indonesia</td>
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<td>7</td>
<td>Megan Denis - The Evolution of Foliate Bifaces in Northwest North America</td>
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<tr>
<td>8</td>
<td>Rachel Steffen - Investigating Maya Terminal Classic Period Architecture at Plaza H, Cahal Pech, Belize</td>
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<td>9</td>
<td>Paige Plattner - Diet-Breadth Analysis in the Southwest: Comparison of Metabarcoding and Shotgun Sequencing Methods with Coprolites</td>
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<tr>
<td>10</td>
<td>Haley O'Brien - Is it Human? Engaging in the academic and forensic applications of Zooarchaeology</td>
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<td>11</td>
<td>Samantha Ramey - DNA integrity in forensic samples</td>
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<td>12</td>
<td>Anna-Marie David - Skeletal Analysis of Limited Skeletal Elements What Can Be Done?</td>
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<td>13</td>
<td>Claire Hanson - Alas Poor Yorick: A DNA Analysis of Ancestry Using Crania</td>
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<td>14</td>
<td>Samantha Hofland - Sacralization of the Fifth Lumbar Vertebra: A Case Study</td>
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<td>15</td>
<td>Hope Vance - Congenitally Missing Maxillary First Molars and FSD 19-161</td>
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<td>16</td>
<td>Susan Greene - Fish on Fluoxetine: Before, During, and After</td>
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<tr>
<td>Poster #</td>
<td>STEM (Science, Technology, Engineering, Mathematics)</td>
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<td>17</td>
<td>Alec Johnson - Development of an Autonomous Dissolved Organic Carbon (DOC) Sampler</td>
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<td>18</td>
<td>Thomas Colligan - Mapping Irrigation with Fully-Convolutional Neural Networks</td>
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<tr>
<td>19</td>
<td>Anna Crockett - Challenges of Modeling Water Rights in Montana</td>
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<td>20</td>
<td>Sarah Khalid - Determining the Extent of Summer Precipitation Required to Mitigate Extreme Urban Heat Events Using a Fully Distributed Eco-Hydrological Model</td>
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<td>21</td>
<td>Jordan Jimmie - Modeling Hydrologic Impacts of Water Rights Quantification and Settlement on the Flathead Indian Irrigation Project</td>
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<tr>
<td>Poster #</td>
<td>STEM (Science, Technology, Engineering, Mathematics)</td>
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<tr>
<td>22</td>
<td><strong>Fischer Young</strong> - Discrete and continuous spatiotemporal trends of organic and inorganic carbon along the upper Clark Fork River, Montana, USA</td>
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<td>23</td>
<td><strong>Franklyn Dunbar</strong> - Inference of Velocity Variations at the Wolverine Glacier</td>
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<td>24</td>
<td><strong>Yubin Kwon</strong> - Generation, Characterization &amp; Reactivity of a Novel High-Valent Cobalt-Oxo Species</td>
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<td>25</td>
<td><strong>Jane Reynolds &amp; Sarah Popp</strong> - Investigating the underlying mechanisms responsible for the effectiveness of behavioral cough suppression therapy: Preliminary findings</td>
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<td>26</td>
<td><strong>Elise Brady</strong> - Examining the Effects of a Weighted Pack on Functional Movements in Smokejumpers</td>
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<td>27</td>
<td><strong>Tyler Hansen, Madie Siebenaler &amp; Nick Costa</strong> - Use of Electrotherapy to Facilitate Post- Exercise Muscle Recovery and Perceived Soreness</td>
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<td>28</td>
<td><strong>Yuzo Fujiki</strong> - Examining the Effectiveness of Anterior Cruciate Ligament Injury Prevention Programs in Male Collegiate and Elite Soccer Players: A Systematic Review</td>
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<td>29</td>
<td><strong>Kayla Schmidt, Luke McCarthy, Zachary Wisniewski &amp; Marlon Pamiwulf</strong> - Comparing the Effectiveness of Cryotherapy and Compression Modalities on Skin Temperature Cooling</td>
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<td>30</td>
<td><strong>Evelyn Schwartz</strong> - Chiral Effects on Nonactate-scaffold based Antibiotic Activity</td>
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<td>31</td>
<td><strong>Matthew Sydor</strong> - Titanium Dioxide and Zinc Oxide Nanomaterials Change Lipid Order and Increase Permeability in Model Systems</td>
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<td>32</td>
<td><strong>Lewis Sherer</strong> - Octopamine-dependent aggression requires dVGLUT from dual-transmitting neurons</td>
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<td>33</td>
<td><strong>Shelby Cole</strong> - Influenza vaccines using liposomal formulations of toll-like receptor (TLR) 7/8 and 4 agonists as adjuvants</td>
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<tr>
<td>34</td>
<td><strong>Briana Young</strong> - Behavioral Stability in Old vs Young Rats</td>
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<td>35</td>
<td><strong>Kim Bolhuis</strong> - Control on Bedrock Recharge and Discharge in Mountainous, Headwater Catchments</td>
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"Best of GradCon" Award Session
6:00-6:30pm - UC North Ballroom

Please join us for this exciting culmination event! “Best of GradCon” award winners will ONLY be notified at this time. Hors d'oeuvres and a no-host cash bar will be available. Make sure to bring cash & ID.
Three-Dimensional Geometric Morphometric Sex Determination of the Human Pubic Bone
Author(s): Katherine Baca
UM Faculty Mentor: Meradeth Snow, Anthropology
Category: STEM (Science, Technology, Engineering, Mathematics)

Abstract / Artist Statement:
Geometric morphometrics is the analysis of shape, and this method has become more popular in anthropology as three-dimensional data and research become more available. This research provides a new method utilizing 3-D geometric morphometric analysis to determine sex from the human pubic bone. Previous methods of sex determination rely heavily on the visual analysis of bone by the expert forensic anthropologist; these methods generally result in accuracy rates of about 90-95%. Creating a metric method adds credibility and statistical accuracy to the practice of sex determination. This study used a sample of N=378 individual pubic bones from the University of New Mexico Maxwell Documented Collection. Eight landmarks were digitized on each individual bone using a Microscribe Digitizer. Results from the Principle Components Analysis provide promising clustering between male and female groups, as well as indications that the method may be ancestry-specific, and that parity may have an effect on the shape of female pubic bones. The Discriminant Function analysis of the training data set resulted in 96.2% accuracy in predicting the correct sex, and the testing data set resulted in 94.6% accuracy (p This research is groundbreaking within the field of forensic anthropology because refining the use of the method to a small portion of bone which can accurately predict the sex of an individual greatly increases the applicability toward real forensic casework. Very rarely is a forensic anthropologist presented with an entire human skeleton to analyze; much more often we are presented with fragments which must be analyzed to provide as much information as possible. Improving this method so that it is accurate on small portions of bone is a huge advantage to the forensic anthropologist, especially if they must testify as an expert in court. It is important to back up all estimations and information with metrically determined results; this method provides a new and very accurate metric method. As this method continues to be validated on more samples in the future, it could change the way unknown human remains are analyzed and identified.

Interdisciplinary Health Screenings: Health Impact of Wildfire Smoke Exposure in Rural Montana
Author(s): Sarah Ballou
UM Faculty Mentor: Chris Migliaccio, Biomedical and Pharmaceutical Sciences
Category: STEM (Science, Technology, Engineering, Mathematics)

Abstract / Artist Statement:
As wildfires continue to increasingly affect the Western United States and the world, the need for expanding research on the effects of wildfire smoke exposure is warranted. Some research on the health effects of wildfire exposure has begun, however it has been focused on very narrow aspects of the larger problem. This study utilizes a pharmacist-led interprofessional team to assess the health effects of a severe wildfire smoke exposure in the rural community of Seeley Lake, Montana from a multidisciplinary perspective. The present study is designed to assess long-term effects of wildfire smoke through a series of screenings considering physiological, psychological and social health dynamics. This project includes the utilization of student practitioners in clinical assessment of participants and the organization of a control cohort in Malta, MT. These students have a unique opportunity to work in a collaborative practice setting. This research has broad-reaching applications both by the scientific quantification of the health impacts, as well as in the formation of such a collaborative and educational team.
Purpose: The objective of this research was to organize a pharmacist-led interprofessional team to assess the health effects of patients living in rural Montana after being exposed to high levels of smoke during the summer of 2017. Additionally, to train and implement student practitioners in the clinical assessment of patient participants.

Methods: several interprofessional health screening events were conducted in Seeley Lake, Montana following the 2017 Rice Ridge Fire. Participant's lung function was measured using spirometry and several other clinical markers were measured. Participants also completed several surveys that addressed demographic data, mental health status, and health history. Additionally, a control cohort was established in Malta, MT.

Originality: This research uniquely combines scientific analysis of smoke inhalation with a novel clinical practice setting for health professional students. This type of research has not been conducted before. Participants are longitudinally studied over several years following a particular exposure. Most research in this area of smoke inhalation is done retrospectively based on hospital admissions or insurance claims related to respiratory damage.

Significance: As mentioned above, this research will not only help to quantify the impact of wildfire smoke exposure but will advance interdisciplinary collaboration in clinical practice.

Making a Case for Nature
Author(s): Phoebe Bean, Cali Caughie, Robin Kodner
UM Faculty Mentor: Rachel Severson, Psychology
Category: Social Sciences/Humanities

Abstract / Artist Statement:
Previous research suggests that connectedness to nature increases as a result of engagement in various nature-related activities (e.g., observing animals, hiking, creative arts, and special events). In turn, connectedness to nature promotes greater environmental concern and more pro-environmental behaviors. Importantly, positive experiences related to conservation have a ‘spillover effect’ to increase the likelihood of future pro-environmental behaviors. However, to date researchers have not evaluated the effectiveness of citizen-science programs on environmental attitudes, connectedness to nature, and/or perceptions of science and conservation. To make a case for nature, our project aims to promote conservation of wild lands and wildlife through The Living Snow Project. This program engages the outdoor recreation community through citizen science, utilizing volunteers to collect snow algae samples across mountain ranges in order to help people understand more about the planet’s invisible biodiversity. The outdoor recreation community is under-engaged in conservation efforts, despite their reliance on healthy ecosystems for recreational opportunities; we will target this group to assess how place-based education about complex ecological principles, in combination with community building, can create a desire for conservation and motivate people to take action, which has been shown to be effective in related contexts. To this end, we will conduct an evaluation of participants’ attitudes and perceptions of science and conservation, and any links between attitudes and conservation actions using validated scales designed to assess environmental attitudes, beliefs, and concerns (e.g., Environmental Motives Scale and New Environmental Paradigm), as well as connectedness to nature (e.g., Connectedness to Nature Scale and Nature Relatedness Scale) and pro-environmental behavior. This presentation will summarize the findings from the multiphasic surveys conducted with participants from the LSP and disseminate the environmental implications of the results.

Food policy for a sustainable, equitable local food system: recommendations for Missoula
Author(s): Erika Berglund
UM Faculty Mentor: Neva Hassanein, Environmental Studies
Category: Social Sciences/Humanities

Abstract / Artist Statement:
Food is not only essential to life but it is also inextricably tied to public and environmental health, economic development, social justice, and community resilience. As such, the nature of local food systems and the policies that affect them have profound implications for community well-being, yet food has historically been absent from local government policy agendas in North America. Over the last 40 years, municipalities and counties have endeavored to address this oversight through food policy councils, groups that, broadly speaking, serve as forums to engage the public, identify prominent food-related issues, develop solutions, and provide food policy recommendations. While
FPCs have made tremendous progress in supporting sustainable and equitable local food systems, they continue to face institutional and organizational challenges; issues that some local governments have sought to remedy with the establishment of governmental food policy coordinator positions. According to the Johns Hopkins Center for a Livable Future, there are 341 verified FPCs in North America and over 18 municipal and county food policy coordinator positions in the U.S. While there is considerable literature on FPCs, little research has been published regarding governmental food policy coordinator positions.

The City and County of Missoula, MT have expressed goals in support of a vibrant local food system yet lack a comprehensive and holistic policy framework for achieving them. Despite clear goals to bolster local food and agriculture, Missoula continues to face challenges regarding healthy food access and security, farmland preservation, and economic opportunities for local food and agriculture. As an ad hoc multi-stakeholder food policy group, assembled by County Commissioner Slotnick, prepares to present a joint city-county resolution that would prompt the creation of the Missoula Food Policy Advisory Council, research on FPCs and governmental food policy coordinators may provide necessary insight to realize an effective and viable council.

For this professional paper, I will present a literature review of FPC scholarship as well as original semi-structured, in-depth interviews with city and county food policy coordinators across the U.S. Findings will be synthesized in a report that will include recommendations to the future Missoula Food Policy Advisory Council and relevant city and county staff and elected officials. This research seeks to provide a useful resource to the Missoula local government to aid in their efforts to develop effective strategies in pursuit of food policy initiatives that support a sustainable and equitable local food system.

**Acute Depressive Symptoms Post-Concussion: A Systematic Review**

**Author(s):** Katherine Berglund, Shane Murphy  
**UM Faculty Mentor:** Shane Murphy, Integrative Physiology and Athletic Training  
**Category:** STEM (Science, Technology, Engineering, Mathematics)

**Abstract / Artist Statement:**

**Context:** Athletes who sustain an injury may experience depression, anxiety, tension, fear, and low self-esteem due to being taken out of their sport and changing their daily activities. These acute and chronic emotional or mood disturbances are common and highly studied in concussion patients; however, acute consequences of concussions are not as well understood. This review will seek to clarify the understanding of acute mood disturbances and depressive symptoms post-concussion in a physically active population based on the current available literature. This will provide information for healthcare providers to use in athletes’ return to play decisions and follow-up care post-concussion. This information also allows better understanding and education available to athletes, parents, coaches, teachers, school administrators, and many other people who play integral roles in athletes’ healing after a concussion. **Methods:** A systematic literature search was completed in October 2019 via the PubMed database to include articles published between 2004 and 2019. The search utilized the PRISMA framework used the following keyword combinations: (depression OR suicide OR apathy) AND (MTBI OR "Mild traumatic brain injury" OR concussion) AND ("acute phase" OR "short-term" OR "short term" OR "early"). Articles were included in the final analysis if: completed on an athletic or physically active population, evaluated depressive symptoms after a concussion was sustained, and were not completed on elderly patients. Year published, level of evidence, participant demographics, patient outcomes, and various depression and mood scale scores were extracted from the final selection of articles. The present study was limited by utilizing a single research database. **Results:** Of the 203 articles identified through the database search, 13 studies were included in this review. Main themes across the collection of studies included depression, anxiety, and irritability and mood liability. Four studies identified depressive symptoms with comorbid anxiety symptoms and eight studies identified comorbidities or measured total mood disturbances in addition to depression. Further, two studies identified mood lability and irritability as specific depressive symptoms post-concussion. Four studies compared concussed patients to non-concussed patients and musculoskeletal patients and had conflicting results on whether concussion patients experienced depression symptoms longer or worse than non-concussion patients. Conclusions: Rates of depression, anxiety, irritability, and mood lability are significantly greater in the acute phase of concussion recovery; however, these rates do not necessarily have an impact on return to play decisions except when severely impacting a patient’s ability to perform in the classroom or social settings. In many cases, these symptoms reduced approximately two weeks post-concussion. This systematic review demonstrated the relationship between concussions, psychological symptoms, and post-concussion outcomes. These data provide rationale for better psychological screening tests in baseline and post-concussion testing. Future research is
necessary to determine the utility of waiting to return athletes to play until after psychological symptoms have returned to baseline levels.

**More Than Notes and Rhythms: Using the Semiotics of Music to Unlock Characterization in Musical Theatre**

*Author(s):* Jane Best  
*UM Faculty Mentor: *David Cody, Music  
*Category:* Visual & Performing Arts

**Abstract / Artist Statement:**
As a music director for the stage, I take great pride in shaping the musical expression of my performers and musicians throughout the production process. Musical theatre reaches its peak when the music and the story work in harmony (pardon the pun) to find the perfect balance between truthful storytelling and emotional expression. It engages audiences in a way that creates community, connection and empathy.

Oftentimes, we use the written aspects of a show, both book and lyrics, to explore this sense of community and engagement, but by combining the explicit implications of written text with the implicit, emotional aspects of musical style, an actor can further heighten and inform a believable performance. The harmonies, orchestrations, rhythms, and melodies of a score are each their own layer of depth and emotion, and by informing the performers of these interwoven textures, they are able to further deepen their own understanding of character, plot, and objective.

While musical literacy and formalized training is incredibly helpful in the process of musical theatre, it should not be used as a gatekeeping tool. One of my aspirations as a theatre artist is to try to break down some of those barriers and help performers overcome their insecurities as they embrace their natural musical inclinations.

This semester, I am music directing Spring Awakening, the 2006 Tony Award-winning musical by Steven Sater and Duncan Sheik. I am using this rehearsal process to practice my research on the use of musical concepts to enhance storytelling. In Spring Awakening, the music exists separate from the dramatic action and is used to comment on the characters’ internal emotional experiences. Each song exists as an independent, complete unit, which provides a built-in structure from which to analyze the song. The discoveries found through a formal or informal exploration of a song’s components can be essential tools in unlocking aspects of characterization or emotion.

This presentation will showcase some of the approaches I take in my music direction before and during the rehearsal process. I will introduce some of my pre-production discoveries of the Spring Awakening score and explain how the music informed my initial understanding of the show. I will then talk about the rehearsal process and the discoveries we made as a cast by applying these musical concepts to their work, and I will demonstrate different applications of musical concepts to an actor’s performance. This will be part lecture and part demonstration as I coach one of my actors through a portion of a song. Through this research, I hope to demonstrate the power of music to create effective storytelling.

**A Reconsideration: Hiring Approaches at the University of Montana**

*Author(s):* Victoria Bigelow  
*UM Faculty Mentor: *Sara Rinfret, Public Administration & Policy  
*Category:* Social Sciences/Humanities

**Abstract / Artist Statement:**
Purpose: The University of Montana (UM) values “...building and sustaining diverse communities,” yet the underrepresentation of women and minorities in leadership roles within the organization has come into question. It has been observed that high-level leadership positions (e.g., dean, president, provost) have been filled by a disproportionate number of non-minority men. As research suggests, one rationale for why this occurs is the lack of standardized human resource management search and hiring procedures (National Academies Press, 2007). For these reasons, the purpose of this project is to propose a new hiring policy for the University of Montana. This policy, the Equitable Hiring Policy (EHP), considers the recruitment and hiring processes, making specific policy recommendations to create more equitable opportunities for women and minorities to professionally advance into leadership positions at the University of Montana.
Methods: This project uses a qualitative research approach. Through semi-structured interviews, policy assessments and analysis, and observational techniques, themes are detected to propose new policies for consideration.

Originality: Currently, there is no set policy dedicated to equitable hiring and recruitment practices, only common practice, at the University of Montana. With an established policy on equitable hiring mandate, UM will become a model for equity and continue its work towards overcoming the observed underrepresentation of women and minorities to promote equal and active representation throughout positions at UM. The research of this project is equally original and critical in that there are very little interorganizational policy practices related to hiring equity at the University of Montana, or across higher educational institutions more broadly.

Significance: The hiring process at the University of Montana has room for growth and change that can positively impact diversity in leadership positions. According to Inside Higher Ed, “Only 30 percent of college presidents in the U.S. are women, the number a dismal five percent for women of color...Women represent less than half of all chief academic officers. As for professors, only 32 percent of full faculty tenure positions are held by women.” (Lincoln 2019). These are just a few of the reasons why an Equitable Hiring Policy would address these issues, and significantly challenge the inequalities that are present at the University of Montana. The Equitable Hiring Policy is a plausible solution for a complicated issue that the University of Montana and other institutions are struggling to manage. Policy will create the infrastructure to uphold equitable opportunities and outcomes for the University of Montana, and can serve as a model to inspire other organizations to follow more inclusive practices.

Time to Return-to-Play Post Anterior Cruciate Ligament Reconstruction in Female Soccer Players: A Systematic Review
Author(s): Lucas Bonnevie, Shane Murphy
UM Faculty Mentor: Shane Murphy, Athletic Training
Category: STEM (Science, Technology, Engineering, Mathematics)

Abstract / Artist Statement:
Context: Compared to men, female athletes are up to ten times more likely to rupture their anterior cruciate ligament while playing soccer, a major stabilizer in the knee. These athletes undergo anterior cruciate ligament reconstruction (ACLR) and return-to-play (RTP) rehabilitation protocols; however, previous research on RTP has been limited to addressing individual underlying factors. This systematic review aims to use a more holistic approach and provide insights on which factors affect the overall RTP timeframe of female soccer athletes post ACLR, and in turn provide healthcare professionals with more certainty in return-to-play timeframes in female soccer players. Methods: A systematic literature search was completed in October 2019 via the PubMed database. The search utilized the PRISMA guidelines and used the following keyword combinations: “ACL” or “Anterior Cruciate Ligament”, “ACLR” or “Anterior Cruciate Ligament Reconstruction”, “Soccer” or “European Football” or “Football”, “Women” or “Female”, “Return To Sport” or “RTS”, “Return To Play” or “RTP”, “Return To Activity” or “RTA”. Articles excluded from the final analysis focused on ACL revision surgery, only included male participants, or if RTP timeframe post ACLR was not reported. Average and range of time to return to sport, average and range of time to return to competition, age at time of injury, and underlying factors such as motivation to RTP, hormonal levels, injury mechanism, graft choice, and rehabilitation protocols were extracted from the final selection of articles when available. This review was limited by performing the original search in a single research database. Results: Of the 29 records identified through database searching, five studies were included in this qualitative synthesis. A total of 649 knees were examined across all five studies. All records included in the final analysis reported RTP timeframe in some form or manner, along with factors influencing RTP. Multiple studies differentiated returning to play (practice) and returning to competition. Average time to return-to-play and return-to-competition were 7.3 and 9.3 months, respectively. The reported time to return to play and competition varied between studies, ranging between 5.5-9.0 and 6.1-12 months, respectively. Factors appearing to influence the timeframe of RTP the most included rehabilitation program, graft selection used to repair the torn ligament, and motivation to return to sport. Conclusions: The timeframe of RTP in female soccer players who have undergone ACLR varies with a number of factors contributing to intraindividual differences. The RTP timeframe appeared to be accelerated with specific factors such as utilizing autografts during ACLR and if the rehabilitation plans included exercises to oppose knee valgus motion. Future research should focus on improving the understanding of how motivation, rehabilitation plans, and graft selections influence RTP timeframe in female soccer players.
Self-Compassion as a Protective Factor Against Minority Stress for LGBT Individuals

Author(s): Morgan Bowlen
UM Faculty Mentor: Jennifer Waltz, Clinical Psychology
Category: Social Sciences/Humanities

Abstract / Artist Statement:
Individuals who identify as lesbian, gay, bisexual, and/or transgender, along with other sexual and gender identities (LGBT), experience psychological difficulties and negative health outcomes that are influenced by stigma, discrimination, and negative emotions and thoughts about the self. Mindfulness is a quality of approaching the present moment and the self with full awareness and non-judgment. This stance may be beneficial for bringing more conscious awareness to thoughts and emotions that may lead to negative health outcomes such as depression and anxiety. Results from multiple studies support the relationship between mindfulness and coping skills, life satisfaction, and positive health outcomes for LGBT individuals. The current study extends this work to focus on a specific aspect of mindfulness, self-compassion. Self-compassion involves extending kindness toward the self, especially during times of difficulty. It also includes maintaining awareness that suffering is universal, and thus that the individual is not uniquely flawed or pathological when they experience distress or failure. This study looked at mindfulness and self-compassion as factors that may be related to well-being in a sample of LGBT individuals. Five hundred fifty-eight participants were recruited online for the study and completed measures of day-to-day minority stress, well-being, mindfulness and self-compassion. Six facets of self-compassion were explored “(a) self-kindness—extending kindness and understanding to oneself, (b) common humanity—seeing one’s experiences as part of the larger human experience, and (c) mindfulness—holding one’s painful thoughts and feelings in balanced awareness,” as well as the opposites of these, (self-judgment versus self-kindness, isolation versus common humanity, and over-identification versus mindfulness; Neff, 2003b). Results indicated that facets of self-compassion (self-kindness and isolation) were significantly related to well-being. These results lend support to the importance of further exploring specific facets of self-compassion that may relate to well-being in LGBT individuals.

Examining the Effects of a Weighted Pack on Functional Movements in Smokejumpers

Author(s): Elise Brady
UM Faculty Mentor(s): Shane P. Murphy, Valerie J. Moody
Category: STEM (Science, Technology, Engineering, Mathematics)

Abstract / Artist Statement:
Context: Wildland firefighters (WLFF) most common non-lethal injuries are slips, trips and falls following accidents involving equipment, tools or machinery. Preventing injuries in WLFF not only protect the personnel but could decrease cost for WLFF agencies. Objective: The purpose of this study was to examine movement and mobility patterns with and without the addition of external load in smokejumpers. Design: Repeated single cohort and repeated measure design. Setting: Missoula Smokejumper Base in Missoula, MT. Patients: Eight smokejumper active in the 2018 fire season (7 male and 1 female) with the age of 41.25 ± 8.21. Of the 8 individuals, 7 had the right limb dominant and 1 left. Interventions: We had the subjects perform three movements both unweighted and weighted with 50kg pack. The three movements were overhead squat, hurdle step and anterior reach. The purpose of this study was to examine movement and mobility patterns with and without the addition of external load in smokejumpers. Main Outcome Measures: Overhead squat and hurdle step were given scores 0-3 based on quality of movement guidelines. Anterior reach is scored for furthest distance in cm. Results: Paired t-tests revealed weighted scores in the deep squat, ND hurdle step, D hurdle step and overall composite scores were found to be significantly reduced (p 0.05) for D or ND anterior reach and the anterior reach interlimb symmetry index. The addition of weight had a large effect on all measures except ND anterior reach distance. Conclusion: The purposes of our study were to compare weighted, and un-weighted movement and if limb dominance had an effect on coordination within the movement score. The addition of the weighted pack negatively affected the scoring of functional movements; however, no statistical differences were found in the anterior reach distance or symmetry with the addition of the weighted pack. Medium to large effect sizes were measured with the addition of the added pack for all measures. Our recommendation is to train single leg balance, stability and strength to increase quality of movement. Key Words: wildland firefighter, functional movement, weighted movement
Incomplete: The Prevalence and Impacts of Spinal Cord Injuries for Individuals

Author(s): Reece Brandon
UM Faculty Mentor: Molly Blair, School of Physical Therapy
Category: Visual & Performing Arts

Abstract / Artist Statement:
Throughout the fall of 2019, I have created a video documentary in partnership with the New Directions gym on the campus of University of Montana. This is a specific location for patients currently undergoing treatment at the University’s physical therapy clinic to perform their prescribed exercise in an assisted and supervised manner. Because the clinic is one of the only clinics in the area that focuses on nervous system ailments - strokes, spinal cord injuries, brain injuries, amputations, etc. - the patients there typically have something in that list. The patients’ difficulties, although surely difficult, are not overshadowed by their motivation and will to continue and improve with every visit. Specifically speaking, my project focuses on the impact that spinal cord injuries may have on an individual, and I have worked closely with a cast of both patients and physical therapists to help create it. I have interviewed the patients on camera, asking them to share their stories to a broad audience, and have followed up with the physical therapists to demonstrate how effective rehabilitation can be when people are diagnosed with the complicated condition of a spinal cord injury. This project will serve a dual purpose: allow me to creatively produce a research-oriented and thoughtful visual piece while simultaneously learning more about my future career, physical therapy. The primary external purpose, adding on to that, is that people in the general public will then become more aware of the vulnerability, strength, and persistence of people living with such a condition.

Rae Bourbon: Queen of America

Author(s): J.C. Bromley
UM Faculty Mentor: Michael Musick, Media Arts
Category: Social Sciences/Humanities

Abstract / Artist Statement:
Decades before Lenny Bruce made headlines for his arrests and obscenity trial, another comic stood as the queen of controversy. Rae Bourbon, drag queen and stand-up comedian, was arrested for obscenity, impersonating a female, impersonating a male, and accomplice to murder during their long career on stage. An icon of pre-Stonewall Queer culture, Bourbon has almost entirely been forgotten by modern audiences. But Rae’s story, one that took them from the stages of vaudeville in the 1930s to the release of a comedy album about their own purported gender affirmation surgery in the 1950s, also charts America’s views towards gender and sexuality. By examining the joke style, delivery, and subject matter of Rae’s comedic routines and songs—sampled from Rae’s decades of audio recordings—our society’s attitudes towards the ongoing struggle of gay and transgender people is laid bare.

Dissecting Sequoyah: An Anthropological Study of Sequoyah’s Methodology for Creating a Cherokee Syllabary

Author(s): Emily Cahoon
UM Faculty Mentor: Cheyenne Laue, Anthropology
Category: Social Sciences/Humanities

Abstract / Artist Statement:
Humans have a unique ability to produce, understand, and design a method of communication called language. Though not all humans are literate, and all cultures do not have formal writing systems, only half of the living languages spoken globally have and utilize a complex alternative form of communication other than speech-literacy (Anon 2019). Dating back to some of the original written occurrences for a language, found in Mesopotamian eras (Diamond 2017:213) around 3500 BCE, language has proven to be a complex substance that conveys culture and embodiment. Furthermore, creating a system of writing for any given language is not a simple endeavor and has been carried out from early Cyrillic alphabets, to modernly spoken indigenous languages via linguistic field methods. Many methods exist to create an alphabet or syllabary that may be efficiently understood by its speakers, and most of them are created from observing other cultures and their modes of communication.

In this project, I examine the methodologies employed by a Cherokee tribal member, Sequoyah, to create a syllabary for the Cherokee language as emphasized by Ellen Cushman, Jarred Diamond, the Cherokee Nation, and others.
Likewise, I display the background and upbringing of Sequoyah, the challenges he endured while creating the syllabary, and how the creation of his syllabary benefited the Cherokee nation and their language both historically and presently. Likewise, I describe the syllabographic - or a symbol that represents a syllable - representation Sequoyah accentuated to create, develop, and maintain the characters used in the syllabary, as well as, the pragmatics of the syllabary's underpinnings.

To complete this project, I attempted to answer the questions: what were Sequoyah's methods for creating a syllabary for the Cherokee language, how did he develop the syllabary, and what socio-political and socio-linguistic obstacles did he overcome to complete the syllabary? To present this data and my findings, I implement the use of GIS technologies to provide a reference map of the regions where the Cherokee language was spoken during the time of the syllabary's creation and show the present-day locations of the Cherokee Nation. Likewise, I will reference literature on the Cherokee history, language, and of those who have previously studied the Cherokee community to develop and gather information for my analysis.

Anon


Diamond, Jared


Conceptions & Receptions: Examining Four Local Museums and Their Communities

Author(s): Mary Casey
UM Faculty Mentor: Gregory Campbell, Anthropology
Category: Social Sciences/Humanities

Abstract / Artist Statement:
Between 2017-2018, the American Alliance of Museums (AAM), in partnership with Wilkening Consulting, found that 97% of the American public believe that museums are educational assets for their communities, and regardless of political persuasion, 96% approve of elected officials who support museums, and take legislative action to fund their operations. Additionally, 66% of all leisure travel in the United States involves cultural heritage sites or activities, such as visiting museums (AAM). The statistics presented here represent the AAM’s efforts to understand how museums, of all institutional type, are received by their communities and the general public on a national scale. The theme of community engagement has been a prevalent topic of debate and discussion among museum professionals across the country, and so this thesis seeks to examine how four local museums connect with their local audiences in meaningful and successful ways.

With knowledge of the statistics presented by the AAM, this thesis research identified and analyzed community-museum relationships in three locations across the United States for the purpose of understanding how these inferences of museum successes are playing out on the microlevel. Utilizing relevant literature to diachronically examine museums, more generally, as institutions in the United States, this thesis first develops the historical underpinnings of cultural heritage preservation, management, and interpretation. With the incorporation of four local museums, as the foci of this research, this thesis also seeks to understand how local museums are situated within the present museological models motivated by education, community need, and cultural heritage tourism within the experience economy. Small and localized museums have the potential to intimately engage their community’s perceptions of identity, heritage, and assessed needs, and because the literary footprint surrounding cultural heritage and museums predominantly focuses on larger institutions like the Smithsonian, the MET, the Field Museum, etc., a lens must now attempt to illuminate the transformative potential of smaller, local museums.

The Historical Museum at Fort Missoula (Missoula, M.T.), Strawberry Banke Museum (Portsmouth, N.H.), The Tuck Museum of Hampton History (Hampton, N.H.), and the James House Museum (Hampton, N.H.), were selected as case studies for this research. Having completed seven months of qualitative research that included participant-observation, semi-formal interviews, surveys, photographic documentation and document analysis, this presentation will summarize the results of this research and illuminate the complex socio-cultural, political, and economic contexts that influence community engagement tactics utilized by the leadership at each of the four museums.
I'm Still Here: A Multimodal Approach to Understanding the Biopsychosocial Experiences of Aging

Author(s): Cali Caughie
UM Faculty Mentor: Stuart Hall, Clinical Psychology
Category: Social Sciences/Humanities

Abstract / Artist Statement:
The growing aging population is ripe with wisdom and generational insight. Already in my early research career I have been awed and inspired by the many older people who have sat down with me and shared their experiences, their reflections, and their beliefs about living, growing, aging, and dying. The process of aging is inevitable for all of us who should be so lucky as to wake up each morning to discover the world anew. It is thus invaluable to take advantage of the collective knowledge of humanity in the many years of our older citizens, both for our own sake in living our lives well, as well as for the sake of understanding the aging process and the biopsychosocial influences thereof.

As a Ridge Scholar, my aim is to express my research on older adults’ experiences of aging in an accessible and creative format. My project is an integration of qualitative research data and audio art. Through this project, I hope to communicate older adults’ perspectives on aging through audio which presents qualitative data, personal quotes, music, and sound. Data specifically looks at common themes in the experience of growing older, including common trials, tribulations, surprises, and life philosophies among adults 65 and older. Generational music is included to both represent these themes and to represent the lyrical associations older adults commonly made within the research study.

This project is motivated by the many elders I have been privileged to work with in my graduate studies who have graciously shared their lives, time, and wisdom. As a firm believer in the incredible worth of listening to the expressions of others and communicating the knowledge that comes from the experiences of humans across cultures and generations, I am excited to have the opportunity to share my work at the intersection of health and the humanities. It is with utmost conviction that I believe the integration of health and humanities is integral to deepening not only the communication of scientific data, but the felt sense of its meaning and significance.

Wilderness Therapy as an Intervention for At-Risk Youth: A Pilot Study of Treatment Mechanisms and Program Effectiveness

Author(s): Cali Caughie, Phoebe Bean, Samantha Russell, Morgan Heimbigner, Madison Goldstein
UM Faculty Mentor: Stuart Hall, Clinical Psychology
Category: Social Sciences/Humanities

Abstract / Artist Statement:
Wilderness therapy is a model of treatment intervention which utilizes components of traditional therapy in combination with outdoor expeditionary principles. Most often, wilderness therapy is applied to adolescent populations struggling with social, emotional, and behavioral issues. While previous research has shown that wilderness therapy for youth leads to treatment outcomes above and beyond those of residential treatment programs, the specific mechanisms involved in therapeutic growth are not well defined. In order to continue to develop the accessibility of wilderness therapy treatment options across the country, it is important that evidence based research is conducted in order to further establish intervention effectiveness and to better understand interventional mechanisms of therapeutic growth.

Our project seeks to support the aims of better understanding wilderness therapy outcomes and mechanisms through administering a series of pre- and post- tests and questionnaires to participants in a 5-week wilderness therapy program in the Pacific Northwest. Measures specifically assess executive function, hope, attachment, resiliency, emotion regulation, and adaptive behavior. The project also intends to analyze qualitative interviews collected from program participants, parents, and staff before and after the intervention.

While this project is ongoing, current pilot data has shown promising results. Of particular note, wilderness therapy participants showed a significant decrease in somatic symptoms from pre- to post-intervention (t=3.198, p=.019). While more data is necessary to draw any firm conclusions, participants also tended to increase in hope, resiliency, interpersonal effectiveness and attachment to caregivers. They further showed increased executive function performance and decreased interpersonal distress, social problems, and behavioral dysfunction.
With a varied history and a developing future, wilderness therapy interventions are in a position to be better understood by both those seeking care and those providing services. Not only will research in this field provide more specificity as to intervention outcomes, it will also serve to support intentional program development. Inasmuch, research in this area holds the potential to aid in increasing accessibility and expansion of treatment options for vulnerable youth populations.

**The Essential Queerness in Elizabethan Society**

**Author(s):** Dac Cederberg  
**UM Faculty Mentor:** Bernadette Sweeney, Theatre  
**Category:** Social Sciences/Humanities

**Abstract / Artist Statement:**  
Shakespeare's Twelfth Night demonstrates a central inconsistency in the relationship between gender roles, societal expectations and sexual attraction in Elizabethan society. Annamarie Jagose describes “queer” as follows: “Broadly speaking, queer describes those gestures or analytical models which dramatize incoherencies in the allegedly stable relations between chromosomal sex, gender, and sexual desire.” The play illustrates how Elizabethans saw same sex affiliation as more natural than heterosexual unions, and yet abhorred homosexual activity. This “homonormative principal of effect” as described by Laurie Shannon, means that renaissance Englishmen thought like should attract like. This explains the central conceit of Twelfth Night, how the Lady Olivia was able to fall for a woman dressed as a boy, as one character explains to her in the final act of the play: “So comes it, lady, you have been mistook. But nature to her bias drew in that. You would have been contracted to a maid. Nor are you therein, by my life, deceived: You are betrothed both to a maid and man.”1 (5.1.271-275) Yet, any homosexual activity was strictly prohibited by Elizabethan society; thus, the essential queerness. The research for this project was conducted through textual analysis supported by various theorists including Casey Charles, Stephen Greenblat, Annamarie Jagose, Louis Adrian Montrose, Laurie Shannon and Mihoko Suzuki. This paper represents a bold new synthesis of ideas and concepts on this topic. No previous scholar has applied the label of queer to Elizabethan society in so broad a sense. The research is significant in that it could cause a paradigm shift in the analysis of renaissance English literature, allowing for queer re-imaginings of countless texts.

**The Forgotten Friendship: The United States and Ottoman Empire, 1840-1855**

**Author(s):** Sari Chabot  
**UM Faculty Mentor:** Kyle Volk, History  
**Category:** Social Sciences/Humanities

**Abstract / Artist Statement:**  
Throughout the nineteenth century the United States was forming economic and political alliances. On such ally was the Ottoman Empire in the mid-nineteenth century. This original research utilizes primary sources which illuminates when the United States sought out peaceful, diplomatic relations with the Ottoman Empire. In order to deeply study this connection, the research will center around one specific Turkish envoy to the United States in 1851. This six month long diplomatic mission by the Ottoman Empire sought to learn about the United States and form deeper connections with American politicians and culture. This historical study examines the forces and individuals responsible for promoting the budding relationships between the United States and Ottoman Empire in the 1840s-1850s with historical analysis and narrative.

Historians have documented the relations with the Ottoman Empire in the beginning of the nineteenth century with the Barbary Pirates and have well researched the decline in relations during World War I, but scholars have not looked into the middle of the nineteenth century where a friendship appeared to emerge. The Turkish envoy has not been highlighted by other historians. This research examines the envoy from the American perspective and looks at the conditions that allowed for a diplomatic relationship to emerge.

Many scholars have examined the transatlantic diplomatic and economic connections in the mid-eighteenth century with other regions such as Latin America, Europe and China. However, scholars have not closely examined the emerging relationship the United States had with the Islamic world during this same time period. This work will showcase the important interconnections between Americans and Ottomans formed in the 1840s and 1850s. This is significant politically, diplomatically and economically. This case study of examining the envoy of 1851 shows how the
United States made connections with the Middle East. This research shows how Americans viewed themselves in the world and what subparts of American society advocated for a relationship with the non-European foreign power.

Primary documents will guide and lead the research. Utilizing government documents such as letters between government officials and diplomats in the United States discussing the Ottoman envoy will show intentions and concerns American politicians had with developing relations with the Ottoman Empire. Other primary documents include speeches from Secretary of State John M. Clayton, President Milliard Fillmore, and U.S. Senators. To show the complex concerns the American public had with developing close connections to the Ottoman Empire, this research will include sources from multiple newspapers and journals that were circulated throughout the mid-nineteenth century.

Understanding Conservation of Agrobiodiversity in Mexican Foodways

Author(s): Marisela Chavez
UM Faculty Mentor: Laurie Yung, Society and Conservation
Category: Social Sciences/Humanities

Abstract / Artist Statement:
Native landraces, the crops that have been adapted to a range of conditions through generations of seed selection, constitute the agrobiodiversity that farmers around the world depend upon. However, large scale political-economic forces including trade policies that promote monocrop farming, changes to property rights that enable consolidation, and the use of genetically modified crops to serve commodity agriculture have radically reduced agrobiodiversity globally. Despite these forces that push farmers to abandon native landraces and the absence of policy supporting agrobiodiversity conservation, small farmers in many parts of Mexico continue to save, exchange, plant, eat, and select for a diversity of native crops. This is critical in a country that is the center of origin for multiple food crops, including maize, beans, and tomatoes.

Climate change is projected to deepen global food insecurity, making the conservation of native landraces particularly important, since these crop varieties enable farmers to adapt to a range of conditions. If conserved, native landraces and plant genetic material from Mexico can facilitate adaptation in other locales, ultimately contributing to global food security. Since small farmers not only safeguard but help create native landraces, it is critical that we understand more about why and how some farmers conserve agrobiodiversity, and how policy can support these efforts.

This presentation will summarize findings from exploratory research that was conducted in 2019, which sought to better understand how different individuals and institutions in Mexico see the role of agrobiodiversity in Mexican foodways. Data collected from 12 semi-structured interviews with different stakeholders, from small family farmers to government officials, revealed that despite unfavorable public policies, maintaining agrobiodiversity in Mexican foodways is important because it embodies knowledge that connects people to their landscape and native crops, it reflects culture, and it is a component of building resilience from the local to the national scale.

In addition, this presentation will describe future directions for the research, including collaboration with Mexico’s National Commission for Biodiversity Knowledge and Use (CONABIO) so that research results can be integrated into CONABIO’s policy recommendations to support agrobiodiversity conservation and small farmer resiliences. Plans for fieldwork that will be conducted from 2020-2021 in two communities in Oaxaca, where remarkable agrobiodiversity continues to be safeguarded by small family farmers, will also be discussed.

Wildfire Made My Community Stronger; How wildfire can galvanize community members and catalyze community resilience to wildfire

Author(s): Lily Clarke
UM Faculty Mentor: Alexander Metcalf, Society and Conservation
Category: Social Sciences/Humanities

Abstract / Artist Statement:
Human communities and ecosystems within fire-prone landscapes are increasingly threatened by severe wildfires. This study investigated how human communities may harness the energy and emotions experienced during and after threatening wildfire events to support community resilience to wildfire. Research has established that community resilience is supported by sharing resources such as time, labor, and food (Granovetter 1973), especially after disaster. Experiencing a wildfire can inspire community members to share resources (Carroll et al. 2000; Blatner et al.
indicating that wildfire can galvanize a community. A community feeling galvanized may support collective action that supports community resilience. Community members feeling galvanized post-wildfire may more actively pursue new policies and practices that support community resilience to wildfire. Thus, further description and identification of factors leading to community members feeling galvanized post-wildfire is warranted. To explore the galvanizing nature of wildfire, we conducted a mixed methods study which involved interviews with community members, a mail-back survey of community residents, and a community-wide facilitated group discussion. Preliminary findings suggest that community engagement and strong leadership (Kulig et al. 2013), information and communication (Norris et al. 2008), and a sense of community (Absher and Vaske 2007), all of which are components of previously established community resilience scales, are related to communities feeling galvanized post-fire. Understanding the underlying factors that lead community members to either feeling motivated or deterred to making change after a wildfire is essential if communities wish to stay resilient to changing wildfire regimes.

Literature Cited


Granovetter, M (1973) The strength of weak ties. American Journal of Sociology 78: 1360–1380.


Influenza vaccines using liposomal formulations of toll-like receptor (TLR) 7/8 and 4 agonists as adjuvants

Author(s): Shelby Cole, Van Cybulski, Margaret Whitacre, Stephanie Lathrop, Helene Bazin-Lee, David Burkhart

UM Faculty Mentor: Jay Evans, Division of Biological Sciences

Category: STEM (Science, Technology, Engineering, Mathematics)

Abstract / Artist Statement:

Influenza virus infection is a global health concern and causes severe illness and thousands of deaths each year. While there are currently licensed vaccines available for both seasonal and pandemic influenza viruses there are several issues to consider: 1) current vaccines do not provide supra-seasonal or universal protection against influenza subtypes, 2) antigenic mismatch between the vaccine and circulating influenza strains impact vaccine efficacy, 3) and the efficacy of influenza seasonal vaccines could be improved in the elderly and immune compromised populations. Therefore, vaccine adjuvants capable of inducing more robust and broadly cross-protective immune responses to various subtypes of influenza virus is a critical unmet need. To address this challenge, we developed a synthetic dual TLR adjuvant combination system (TRAC-478) to improve influenza vaccine immunity. Preliminary data in human peripheral blood mononuclear cells demonstrate that combining our synthetic TLR7/8 and TLR4 agonists results in a synergistic innate immune responses. Influenza vaccine immunogenicity studies in both murine and pig models demonstrate the safety and efficacy of this new dual TLR adjuvant system. Using a co-encapsulated TRAC-478 liposome delivery system with a split-flu vaccine resulted in strong anti-influenza humoral, Th1 cell mediated immunity, and protection from a heterologous influenza challenge in mice. We hypothesize that using the TRAC-478 adjuvant system in combination with current influenza vaccines will induce a more robust and broadly cross-protective immune responses to circulating or pandemic influenza virus.
Mapping Irrigation with Fully-Convolutional Neural Networks
Author(s): Thomas Colligan, David Ketchum, Douglas Brinkerhoff, Marco Maneta
UM Faculty Mentor: Douglas Brinkerhoff, Computer Science
Category: STEM (Science, Technology, Engineering, Mathematics)

Abstract / Artist Statement:
Irrigation is responsible for approximately 70 percent of global freshwater withdrawal and accounts for 80-90 percent of consumptive water use in the United States. As global population grows, the need for irrigated cropland will only become more prevalent. Quantifying irrigated acreage in a timely manner will help inform responsible decisions about irrigation and provide insight into matters such as groundwater depletion and water stress. The availability of high-resolution satellite imagery and open-source machine learning software means mapping irrigated extent is now possible. Past techniques have used multilayer perceptrons and other machine learning algorithms such as random forest classifiers to classify satellite imagery on a large scale. Here we describe a novel method of mapping irrigation in using convolutional neural networks. Convolutional neural networks are currently the state of the art in computer vision, capable of outperforming humans in certain tasks. Using a general U-Net architecture we segment Landsat-8 images over Montana: irrigated, non-irrigated, uncultivated, fallow, and wetland, with test accuracy of 98 percent.

Museums and the Curation Crisis: The Dire Need for Innovation
Author(s): Micaela Connolly
UM Faculty Mentor: Kelly Dixon, Anthropology
Category: Social Sciences/Humanities

Abstract / Artist Statement:
Museums are dynamic institutions, changing with the fads and trends of the modern world amid curations crises. Gone are the days of collecting in glass cases and the museum acting as an organization for the wealthy. With the advent of Web 2.0 and other advancements in the museum field, museums exist for the enjoyment of the visitor. ICOM's development of a new definition for museums may force a conceptual renovation in museums, or the definition may develop to fit the museums of today. Museums have even started to develop different formats, such as electronic, virtual reality, even “pop-up” museums, to better reach the very public they are trying to serve. The question remains whether the word “museum” is truly fitting for each of these formats. This question is explored and innovative solutions are needed to sustain museums in amid the intense stimuli of today’s fast-paced world.

Parental Decision-Making: Navigating the Medical Ethics of Neonatal Intervention in the 21st Century
Author(s): Danielle Cooney
UM Faculty Mentor: Ashby Kinch, English
Category: Visual & Performing Arts

Abstract / Artist Statement:
Hypoplastic Left Heart Syndrome is a congenital heart defect in which the left chambers of the heart are underdeveloped and, if left untreated within the first week of birth, is a fatal condition. Via personal interviews, extensive research on the progression of neonatal intensive care through the Ridge Collection in the advent of modern medicine, and analysis of shared stories of loss, this creative project will recount the medical journey of my younger sister, Kathleen, one of the oldest individuals living with this rare heart defect. Narrative medicine weaves the emotional with the scientific, vividly illustrated in my sister’s condition and the unwavering community that has navigated the unknowns alongside her. This work of creative nonfiction will address the following aspects of medical ethics with regard to neonatal intervention: first, unpacking the parameters of a life “worth” living; second, elucidating the relationship between quality of life and letting go specifically when the pressure of such high-stakes decisions is placed upon emotionally distraught parents; and third, when applicable, examining legal and ethical implications of technological advancements in Western medicine as they pertain to prolonging life. Though a niche story within the scientific realm, this is an uncertain and complex experience that warrants further exploration.
Challenges of Modeling Water Rights in Montana

Author(s): Anna Crockett
UM Faculty Mentor: Brian Chaffin, W.A. Franke College of Forestry & Conservation, Department of Society & Conservation
Category: STEM (Science, Technology, Engineering, Mathematics)

Abstract / Artist Statement:
Water is an essential element of social and ecological systems. The uncertainty of climate change, through shifts in the quantity and timing of water flows, compounds the stress on these systems, particularly in the arid American West. These shifts can result in loss of aquatic habitat and decreases in aquatic species populations. Additionally, they can impact water-dependent economies and livelihoods through the loss or reduction in availability of water for human consumption and irrigated agriculture. Along with climate, governance also plays a role in the fate of future water supplies. Prior appropriation, the primary legal water doctrine in the West, adheres to a water distribution policy of ‘first in time, first in right’ where the oldest water users get first use of available water. There is a need to link climate change with the legal system for allocating water in western states to better understand future water use needs and to improve current planning. My research seeks to address the uncertainty of climate change’s impacts on water supply as it relates to the administration of prior appropriation water rights. I plan to approach this problem through a streamflow and policy analysis using a geospatial dataset of Montana water rights integrated into a hydro-economic model. This presentation considers the challenges associated with working with the Montana water rights database and its integration into a hydro-economic model. Specifically, I will highlight (1) the difficulties of working with the database itself – a large, complex database with data that is constantly in flux due to statewide water right adjudications; (2) the process of determining how the data needs to be culled and refined to include only information pertinent to the model; and (3) the challenges associated with translating the data to the model itself. Additionally, this presentation will highlight current progress on this integration and next steps. Through this integration, I hope to explore whether instream flow policies, either in their current or modified form, could serve to balance water use between agriculture and aquatic species/habitat protection given the uncertainty of future availability and timing of water. Integrating water rights data into a hydro-economic model will allow the model to represent not only physical but also legal thresholds of water availability and produce more accurate, meaningful results of water availability.

Understanding Farmer's Conservation Behaviors and Attitudes in the Chesapeake Bay Watershed

Author(s): Tina Cummins
UM Faculty Mentor: Alex Metcalf, Society and Conservation, Forestry
Category: Social Sciences/Humanities

Abstract / Artist Statement:
There are over 83,000 farm operations in the Chesapeake Bay Watershed that account for approximately thirty percent of the land area and contribute over half of the phosphorous and sediment that enter the bay through rivers and streams. In 2014 The Chesapeake Bay Watershed Agreement became the first agreement signed by representatives from the entire watershed setting ten goals and thirty-one outcomes to be achieved by 2025. Limited research is available on the social science of farmer's conservation adoption in the Chesapeake Bay Watershed. As a first step, our research team conducted semi-structured interviews with twenty farmers in the watershed. A qualitative analysis of these interviews is conducted to answer four research questions. First, based on their current level of soil conservation behaviors what are farmer's attitudes towards cover crops, no-till, riparian buffers, and manure management? Second, how do different groups of farmers view conservation organizations and media messages? Third, what does the Chesapeake Bay mean to them? Or, how does the water quality of the Chesapeake Bay impact them? And, fourth, how do operational structure and decision-making processes differ among farmers, particularly about conservation practices? The results of the analysis will be used to inform future surveys and behavioral interventions in the watershed.

Skeletal Analysis of Limited Skeletal Elements What Can Be Done?

Author(s): Anna-Marie David
UM Faculty Mentor: Kirsten Mink, Biological Anthropology
Category: Social Sciences/Humanities
Abstract / Artist Statement:
Forensic Anthropologists around the world use a variety of techniques to understand people using analysis of human remains. However, in instances when a researcher is given an incomplete set of remains it narrows the variety of methods that can be used as well as the accuracy of those methods. Therefore, information about the individual is restrained and can limit positive identification. At the University of Montana graduate students in the Forensic Anthropology program work together under the supervision of their professors to analyze skeletal remains cases. A Forensic Anthropology skeletal report consists of; minimum number of individuals (MNI), sex, age, stature, ancestry, pathology, taphonomy, and trauma. This report can be used by law enforcement to positively identify human remains in a forensic context. The accuracy and comprehensiveness of a skeletal report relies on the researcher having as much information, i.e. a complete skeleton, as possible. As a graduate student of Forensic Anthropology that has been assigned a case with limited skeletal material available for analysis, I have seen the limitations of only having fragmentary remains. This poster will compare and contrast the methodology of a forensic case that consisted of three skulls of varying completeness. This research will look at the differential findings based on the variety of methods of analysis between the skull that was 90% complete, to the two skull fragments that had less than 50% completeness. This evaluation is significant in understanding the limitations of current analyses on human remains in the field of Forensic Anthropology and pose questions on how that limitation can affect the positive identification of individuals. This research also highlights the need for new methods that work on fragmentary remains and the importance of interpretation of these types of analysis in law enforcement.

Laryngeal Positioning and its Impact on Storytelling
Author(s): Jadd Davis
UM Faculty Mentor: Pamyla Stiehl, School of Theatre & Dance
Category: Visual & Performing Arts

Abstract / Artist Statement:
Classical voice training is designed to maximize the beauty, efficiency and individual quality of the human voice. A perfectly-trained classical singer can create a tone quality consistent with traditional aesthetics of opera, art song and oratorio.
A challenge occurs when a singer is training for a non-classical career in musical theatre with its diverse technical approaches to vocal production. Whereas opera singers develop their voice to sing roles that are perfectly suited for their instrument, musical theatre singers are often tasked with performances whose vocal sound is widely variable from one role to the next. Compare the skills required to perform a near-classical piece like Les Miserables against a far more contemporary-sounding musical like Hamilton – yet singers are expected to have a detailed understanding of how to navigate such vocal diversity. Classical training can thus fall short for contemporary practitioner.
In my research as a practitioner of musical theatre, I have been fortunate enough to study roles that require marked flexibility of the vocal apparatus, in particular the larynx (where the initial vibrations occur in the throat). From my experiences, I have worked to develop a system of study that applies the larynx’s fundamental virtue – its ability to be motile in the throat to create a variety of sounds – to the stylistic needs demanded by a given piece of vocal music. Within this pursuit, I have constantly considered vocal health and sustainability as necessary companions to vocal flexibility.
In this presentation, I will demonstrate – through sung performance excerpts – three distinct laryngeal positionings and their impact on storytelling and vocal quality, with the express purpose of informing musical theatre practitioners some of range of creativity they may safely explore as vocalists.

An Acute-to-chronic Virulence Switch in Pseudomonas aeruginosa Suppresses Pf Bacteriophage Replication by Sensing Kin Cell Death
Author(s): Camilla de Mattos, Lia Michaels, Caleb Schwartzkopf
UM Faculty Mentor: Patrick Secor, Department of Biological Sciences
Category: STEM (Science, Technology, Engineering, Mathematics)

Abstract / Artist Statement:
Pseudomonas aeruginosa is a major human pathogen responsible for millions of human infections annually. Many strains of P. aeruginosa are themselves infected by filamentous Pf bacteriophages (phages). Recent work
demonstrates that Pf phages enhance the virulence potential of P. aeruginosa by triggering maladaptive antiviral immune responses. Thus, disrupting the Pf lifecycle may reveal novel therapeutic strategies to prevent P. aeruginosa infections. A previous genetic screen revealed links between Pf phage lifecycle modulation and the Gac/Rsm pathway, a highly conserved acute-to-chronic virulence switch in many species of bacteria. Because the Gac/Rsm pathway can be activated by a ligand released by lysed P. aeruginosa cells, we hypothesized that Pf-induced bacterial lysis would stimulate the Gac/Rsm pathway, inhibiting the spread of Pf infection. To test this hypothesis, we engineered bacteria where Gac/Rsm signaling was either disabled or constitutively activated. We measured Pf replication in Gac/Rsm mutants and found that when Gac/Rsm signaling was constitutive, the Pf lifecycle was disrupted while bacteria with disabled Gac/Rsm signaling had enhanced susceptibility to infection by Pf. One possible explanation for these observations are that Pf phages were not able to attach or penetrate P. aeruginosa. However, Gac/Rsm-active cells still expressed type IV pili, the cell surface receptor used by Pf to infect P. aeruginosa. Furthermore, Pf genes were highly expressed in Gac/Rsm-active bacteria after infection with Pf virions. These results raise the possibility that Gac/Rsm signaling inhibits Pf replication at a posttranscriptional level. Finally, we find that P. aeruginosa lysates collected from sonicated cultures were able to suppress Pf replication in wild-type P. aeruginosa in a Gac/Rsm-dependent manner. Collectively, these results suggest that the Gac/Rsm pathway plays a role in suppressing Pf replication in response to kin cell lysis. Understanding how the Gac/Rsm pathway and the Pf lifecycle intersect could be leveraged therapeutically to temper the virulence of P. aeruginosa. Furthermore, given how well-conserved the Gac/Rsm pathway is amongst bacterial pathogens, it is possible that the Gac/Rsm phage suppression mechanism could translate to a range of bacterial and phage species, which may have implications for the use of bacteriophages to treat bacterial infection.

The Evolution of Foliate Bifaces in Northwest North America
Author(s): Megan Denis
UM Faculty Mentor: Anna Prentiss, Anthropology
Category: Social Sciences/Humanities

Abstract / Artist Statement:
Foliate or leaf-shaped bifacial tools are widely distributed through time and space in the Pacific Northwest region. Despite a number of previous studies, we still know little concerning the development and persistence of variation in these tools. This study applies phylogenetic analysis to collections of leaf-shaped bifacial tools from six archaeological sites from the Pacific Northwest. Phylogenetic analysis is a useful tool for studying cultural macroevolution, in this case, the pattern and process of descent with modification in tool manufacturing systems. The sites chosen for this study span the last ten thousand years and extend from southeast Alaska to northern Washington. Specific sites include On Your Knees Cave, Richardson Island, Cattle Point, Glenrose Cannery, Milliken, and Namu.

I analyze published images and descriptions of foliate bifaces from published reports. The traits that I examine include the length, width, base type, stem type, flake scar retouch, and flake scar orientation. I then input these data into PAST 2.17c to calculate the most parsimonious phylogeny and checked the retention and consistency indices for evidence of homoplasy. The strength of these branches is tested with 1000 bootstrap replicas.

There have not been any published works specifically examining the evolution of foliate bifaces from the Pacific Northwest. There have been studies that compare the different traits of various sites in the Pacific Northwest or that examine the other tool traditions of this area. In order to help learn more about the past spread of culture over time and space in the Pacific Northwest, more case studies examining various aspects or traits of a culture are important. By examining the distribution of different traits across various sites over time, it is possible to map out the spread of this technology, which can also help to define potential trade routes, migration patterns, or social traditions used by people of the past. This is important in order to answer larger questions about cultural evolution across the region.

Prevention of Chronic Diseases in Missoula, Montana
Author(s): Marcia Dias
UM Faculty Mentor: Kari Harris, School of Public and Community Health
Category: Social Sciences/Humanities

Abstract / Artist Statement:
Foliate or leaf-shaped bifacial tools are widely distributed through time and space in the Pacific Northwest region. Despite a number of previous studies, we still know little concerning the development and persistence of variation in
these tools. This study applies phylogenetic analysis to collections of leaf-shaped bifacial tools from six archaeological sites from the Pacific Northwest. Phylogenetic analysis is a useful tool for studying cultural macroevolution, in this case, the pattern and process of descent with modification in tool manufacturing systems. The sites chosen for this study span the last ten thousand years and extend from southeast Alaska to northern Washington. Specific sites include On Your Knees Cave, Richardson Island, Cattle Point, Glenrose Cannery, Milliken, and Namu.

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Inference of Velocity Variations at the Wolverine Glacier

Author(s): Franklyn Dunbar, Douglas Brinkerhoff
UM Faculty Mentor: Douglas Brinkerhoff, Computer Science
Category: STEM (Science, Technology, Engineering, Mathematics)

Abstract / Artist Statement:
Glaciers are dynamic, therefore it is critical to quantify and monitor their behavior over varying timescales to allow for a more concise study on an individual basis. Currently, the glacial mass balance in Alaska is an estimated loss of -75 +/- 11 giga-tonnes/year, contributing to approximately 0.2 mm of sea level rise per year (Larsen et al 2015). It has been suggested by Berthier et al (2010) that previous studies of regional mass balance failed to accurately account for the contributions of large mountain glaciers due to an oversampling of relatively smaller glaciers. This is likely due to the difficulties associated with acquiring accurate estimates on larger glaciers relative to smaller ones as it is easier to project mass loss from smaller glaciers onto larger ones than vice-versa. The physics of glacial movement do not perfectly scale in relation to mass, and thus the estimates become biased. Implementing a robust method to determine annual scale glacial velocities can help constrain this issue within the glacial mass-balance estimates and in turn reduce uncertainties in calculating global sea-level rise. Accurate year long measurements on glacial velocities constrains the rate at which ice flows from high elevation areas of glacial mass accumulation zones, to warmer, low elevation environments of increased ablation. To improve measurements we will improve upon an implementation of optical flow tracking methods (Brinkerhoff et al 2016) to derive velocity vectors and surface elevations from time-lapse data sets of the Wolverine glacier in South central Alaska. By generalizing current techniques to N cameras, we will reduce uncertainties in measurements and be able to inversely infer relevant physical parameters of the glacier.

Alcohol Use Disorder among Nonexclusively-Oriented Women: Exploring Unique Risk Factors and Targets for Psychological Intervention

Author(s): Kinsie Dunham
UM Faculty Mentor: Bryan Cochran, Psychology
Category: Social Sciences/Humanities

Abstract / Artist Statement:
Alcohol use is positively associated with cancer, cirrhosis, attempted suicide, and premature mortality (1, 2). Nonexclusively oriented women (NOW) experience unique stressors (3, 4, 5) and barriers to treatment (6, 7) that may explain elevated rates of alcohol use (8). NOW, or women who are attracted to multiple genders (e.g., attracted to both men and women, or attracted to transgender men and women) report higher alcohol consumption and meet criteria for alcohol use disorder (AUD) at higher rates than both lesbians and heterosexual women (9, 10, 11, 12). Therefore, research aimed at specializing treatment and prevention is required to identify factors than precipitate and maintain elevated alcohol use and misuse among this at-risk group. Health disparities in sexual minority (i.e., non-
heterosexual) populations are often attributed to the effects of minority stress (12, 13); that is, unique, identity-salient social stressors such as discrimination and prejudice that contribute to an increased cumulative stress load and elevated rates of substance use concerns. However, a unique minority stressor related to non-exclusive orientations, bi-negativity (14), remains understudied. This area of research augments the minority stress model by examining psychological processes that may be useful targets for intervening in the relationship between minority stress and health outcomes (15). Therefore, the current study assesses bi-negativity and psychological processes related to alcohol misuse in order to highlight processes relevant to specialized treatment. This project examines three primary hypotheses: 1) NOW will experience more bi-negativity than exclusively oriented women (EOW), 2) Cumulative effects of bi-negativity and general minority stressors will predict higher alcohol use disorder symptoms, and 3) Psychological processes (social support, alcohol use motivations, and positive alcohol expectancies) will augment the relationship between minority stress and alcohol use. Participants (N= 55 currently; recruitment ongoing) were recruited through social media (i.e., Facebook, Reddit) to complete the survey. Potential participants completed the full survey if they met inclusion criteria (i.e., non-heterosexual and female-identified) and were entered into a raffle to win one of five $30 gift cards to an online retailer upon survey completion. NOW and EOW will be compared to identify differences in bi-negativity and general minority stressors using multivariate analysis of variance (MANOVA). The unique contribution of bi-negativity over and above general minority stressors in explaining alcohol use will be examined using hierarchical regression analyses. The impact of psychological processes (social support, alcohol use motivations, and positive alcohol use expectancies) on the relationship between bi-negativity, general minority stress, and alcohol use will be examined using parallel mediation analyses. This project uniquely addresses a gap in the current understanding of factors that may explain higher rates of problematic alcohol use among NOW. Further, NOW are an understudied population, even within research LGBTQ+ research. Therefore, this project seeks to highlight psychological processes important in the treatment and prevention of AUD and problematic alcohol use for an at-risk and underserved population. Results and their implications for

Advancing the Double SNAP Dollar Collaborative: Building a sustainable platform for healthy food access in Montana

Author(s): Rebecca Elderkin
UM Faculty Mentor: Blakely Brown, College of Health Professions
Category: Social Sciences/Humanities

Abstract / Artist Statement:
Across the United States, the gap to accessing healthy foods is growing and increasingly related to socioeconomic status. This gap in access especially impacts Montanans. Increasing affordability and consumption of healthy, locally produced foods is a key strategy of the USDA Advancing Double SNAP Dollars program (DSD). DSD customers receive a dollar-for-dollar match when they exchange Supplemental Nutrition Assistance Program (SNAP) benefits at markets, which ‘doubles’ their purchasing power when shopping for local produce. In this way, the program also supports local producers by injecting of federal money into the local economy.

Purpose: The main purpose of the study was to assess the impact of the DSD program on fruit and vegetable consumption and variety of fruits and vegetable consumed in DSD customers.

Methods: DSD program customers were asked to complete a self-administered survey that assessed the customer’s number of servings of fruits and vegetables consumed daily and the impact of the DSD program on amount and variety of fruits and vegetables consumed. These questions were adapted from the national Behavioral Risk Factor Surveillance Survey validated survey and pilot tested to further refine the questions before the study began. The study used a convenience sampling approach to recruit participants from eight Montana farmers market that participated in the DSD program in 2019.

Results: Demographics: 113 DSD customers completed the survey. The average age of the respondents was 39 years old; ages ranged between 17 and 77 years old. 74% (n=83) of the respondents were female; 83% (n=94) were not Hispanic or Latino; 85% (n=96) were White, 6% were Native American or Alaska Native, 3% (n=3) were Black or African American, and 1% (n=1) was Asian. Forty-six percent of the respondents reported having a yearly income between $0 to $10,000, 31% had a yearly income of $10,000 - $20,000, and 16% had a yearly income of $20,000 to $30,000.
Fruit and Vegetable intake: When DSD customers USE the program, consumption of fruits and vegetables, on average, was higher (i.e., three to five servings of fruits and vegetables per day) compared to when they DON'T USE the program (i.e., one to three servings of fruits and vegetables per day). The majority of respondents (95% or 98/103) indicated that the variety of fresh fruits and vegetables consumed increased some/greatly as a result of the DSD program. There were no respondents who reported that the variety of fresh fruits and vegetables consumed decreased some/greatly as a result of the DSD program.

Conclusions: These data show that the DSD program is effective on increasing participant consumption of fruits and vegetables and the variety of fruits and vegetables consumed. The DSD program can help improve access and consumption of fruits and vegetables in low-income families.

Inter-site Evidence of Social Inequality in the Middle Fraser Canyon, British Columbia

Author(s): Rebekah Engelland
UM Faculty Mentor: Anna Prentiss, Anthropology
Category: Social Sciences/Humanities

Abstract / Artist Statement:
The archaeological record of the Middle Fraser Canyon provides abundant evidence of social inequality. While inequality in this region is typically identified on an intra-site basis, it has rarely been examined using inter-site data. By pulling together evidence from three different sites, it is possible to see a pattern of households with differential access to resources including food and prestige items.

Located in south-central British Columbia, the Middle Fraser Canyon is home to a wide variety of environments. The sites being considered here were pithouse villages. A pithouse is a semi-subsurface structure where a pit is dug and then a roof constructed over it and used during the winter. These large pithouse villages were occupied between 1900 and 800 years ago by complex hunter-gatherers who relied heavily on salmon for subsistence. Around 1200 years ago, the population peaked at over 8000 people in the area before a drop in salmon caused the population to decline and the people to abandon the villages.

This poster considers archaeological evidence such as artifacts, burials, faunal and floral remains, and features from the Bell, Bridge River, and Keatley Creek sites. By studying the faunal and floral remains, as well as stone tools, we can determine the subsistence patterns of the people who lived in these villages. The occupants’ use of space can be seen in their storage facilities and activity areas within the pithouse. The presence of prestige items can be an indicator of social inequality, as people of higher status would have better access to those types of goods.

For social inequality to get a foothold, there are different theories. Brian Hayden proposes the aggrandizer/accumulator idea, where certain ambitious individuals take advantage of surplus resources to further their own designs. However, the fact that inequality appears suddenly and simultaneously at both Keatley Creek and Bridge River makes this an unlikely explanation. A more plausible catalyst for social inequality in the Mid-Fraser is the strain on resources which caused people to adopt different strategies for survival. Around 1200 BP, people in the area faced reduced access to critical resources. Subsequently, cooperation in labor declined, and social inequality appeared.

By drawing data from multiple sites, most specifically large pithouse villages, this study will provide insights into social behavior not always recognized in single site studies. Because social inequality is unusual among hunter-gatherers, researching how it gets a foothold can tell us much about the nature of social inequality. The study also provides insight into the cultural history of the indigenous people of the Middle Fraser Canyon.

Finding Strength in Being TIRED | T1RED

Author(s): Elijah Fisher
UM Faculty Mentor: Bernadette Sweeney, School of Theatre and Dance
Category: Visual & Performing Arts

Abstract / Artist Statement:
TIRED | T1RED is a very personal and original dance piece that is largely inspired by the state of exhaustion that I exist in as a Black and Filipino person in predominately white spaces. From the beginning, I had one goal for myself:
‘to make the audience as tired as I am when I am performing it.’ Through my creative process, I discovered a little more nuance. Along that nuance, I came across strength within vulnerability as well as a vulnerability within strength.

I created and presented this piece as the final assignment for my Creative Practice I class in the Fall of 2019. In it, I use a neutral mask that was re-introduced to me in my Graduate Physical Performance class in the same semester. Alongside this, my research in my Performance Theory & Criticism class was based in whiteface as a performative device. Discovering the correlation between all of these allowed me to approach this work from many different angles.

In Creative Practice I, I was able to explore choreographic devices by constantly creating work. In a choreographic process, decisions must be made. I would say the same applies to most creative processes. Whether it is thinking about images, spacing, music, lighting, and more, it is important to consider it all. I was able to pull inspiration from dance artists like Tsiambwom Akuchu, Les Twins and Botis Seva while letting the music of JID, Denzel Curry, Kanye West, and Tyler, the Creator inspire me throughout the process.

In my Graduate Physical Performance class, I was able to explore my relationship with the neutral mask. The neutral mask is white, but the neutrality allows it to take on the other forms that we take on to exist and survive in the world. For me, it takes on my Black identity and/or my Filipino identity and/or my internal whiteness and/or so much more. At one point in the piece, I place the mask on the back of my head, and instantly think of how exhausting it is to code-switch.

In my Performance Theory & Criticism class, I was able to reflect more on the history behind the identities that we take on. Researching books like White Like Me by Marvin McAllister and Black Like You by John Strausbaugh as well as articles, plays, and other texts was crucial in growing my understanding of what the work of whiteface means.

In this presentation, you will see a PowerPoint along with excerpts from my piece, TIRED | T1RED, that will show more than I can always say. Looking forward, I will continue to develop this work as I am looking to present it further at other conferences and performance venues.

Title: Examining the Effectiveness of Anterior Cruciate Ligament Injury Prevention Programs in Male Collegiate and Elite Soccer Players: A Systematic Review

Author(s): Yuzo Fujiki
UM Faculty Mentor: Shane Murphy, Integrative Physiology and Athletic Training
Category: STEM (Science, Technology, Engineering, Mathematics)

Abstract / Artist Statement:
Purpose: The purpose of this systematic review is to determine the most effective injury prevention programs in reducing risk of anterior cruciate ligament (ACL) injury in male collegiate and elite level soccer players. One of the most dramatic events that might occur and could end a soccer player’s career is the rupture of the ACL, of which 200,000 occur annually in the US. While much of the focus of injury prevention programming (IPP) has been on female soccer players, similar effects in reduction of injury have been documented in male soccer players as well. Perhaps the most widely known injury prevention program for soccer is the FIFA 11+; however, other injury prevention programs exist such as the Prevent Injury and Enhance Performance (PEP) program, and the Sportsmetrics program. All of these programs have documented effectiveness in reduction of ACL injury by integrating strength, agility, plyometric and proprioceptive activities. The purpose of this systematic review is to determine the most effective injury prevention program in reducing risk of anterior cruciate ligament injury in male collegiate and elite level soccer players. Methods: A database search was performed using PubMed in October of 2019. The search utilized the PRISMA guidelines and used the following keyword combinations: soccer, “Injury Prevention”, “Prevention Injury”, “Anterior Cruciate Ligament”, ACL, male, collegiate, and elite. Studies were included if they used an injury prevention program for one entire season, discussed number of total injuries, injury rate, number of knee injuries, number of ACL injuries, and ACL injury rate. This review was limited by only utilizing a single research database to complete the search. Originality: Most injury prevention programs reviewed in this study demonstrated a decrease in injury rate, total injury, knee injury, and ACL injury. Evidence suggests that the most effective approach to IPP includes a multi-modal approach that contains exercises that can be included in a soccer warm up. Notable decreases in injury trends are apparent in as little as 12 minutes, two times a week with the integration of an evidence based IPP. Significance: This systematic review may provide a greater depth of knowledge for athletic trainers as they choose which injury prevention protocol they may implement in their own practice.
Developing Argumentation Skills in Elementary Students

Author(s): Alyssa Fusco, Greg Friedman
UM Faculty Mentor: Jingjing Sun, Teaching and Learning
Category: Social Sciences/Humanities

Abstract / Artist Statement:
The process of learning argumentation skills empowers students to think critically and communicate their ideas in a democratic society. When students can understand how to construct and interpret effective arguments, they can better engage meaningfully with others and with content. Effective argumentation entails both cognitive and social domains, as individuals need to consider both the quality of their reasoning and the nature of their interaction with their audience. Prior researchers developed argument schema theory (AST), which posits that engaging in dialogic interactions (group oral argumentation) strengthens individual argumentation. Specifically, Collaborative Reasoning (CR), a model for structuring dialogic interactions, has been studied as an effective instructional implementation of AST. Prior studies have repeatedly found that engaging in a series of CR discussions promotes: (a) cognitive and social learning in groups of students and (b) improved class competency in argumentative writing. However, prior studies have not examined the variation in individual students’ shifts in competency as a result of CR discussions. This was the first study to look at written student argumentation both before and after Collaborative Reasoning (CR). Specifically, we examined how individual student argumentative writing changes as a result of experiencing and participating in a series of CR discussions. Students in three local fourth-grade classrooms (n=76) responded to the same writing prompt both before and after participating in six to eight CR discussion groups. The researchers coded and analyzed both (pre and post) writing tasks for each student to assess changes in the quality of student responses. Prior researchers have identified recognizing alternative perspectives and breadth of reasoning as likely transferable argumentation skills when moving from oral CR discussions to individual student writing. We modified and redesigned existing coding schema to more deeply examine perspective (both internal and external) and breadth of reasoning. Our analysis utilized NVivo software, spreadsheets, and handwritten notes to discover patterns in student writing.

This study has expanded on prior research by examining the differential effects of CR discussions on individuals - in particular, those that did not possess the targeted argumentation skills prior to the intervention. In examining the overall posttest results, class performance was relatively stable, with modest gains in some skills and modest drops in others. However, when examining the smaller number of students that demonstrated relatively lower skill in the pretest, posttest improvement in argumentation was notably more pronounced. We intend to continue to examine the data to determine whether the quality of each CR group’s interactions impacted individual student writing differently. This study is significant in that it deepened the understanding of the effectiveness of an academic intervention (CR, in this case) for individual students.

Montana and the Backwater of Birchism

Author(s): Kristin Gates
UM Faculty Mentor: Jody Pavilack, History
Category: Social Sciences/Humanities

Abstract / Artist Statement:
Clandestinely established in 1958 by candy tycoon Robert Welch after the death of Joseph McCarthy, the John Birch Society had a significant presence in Montana, particularly eastern Montana and the Bitterroot Valley, throughout the 1960s. Correspondence from this time between U.S. Senator Mike Mansfield and his Montana constituents is rife with examples of attempts by society members to root out the subversive communist plots that they saw existing in even the most routine elements of community life. Broadly, this paper will serve as an exploratory essay of the origins of the group in Montana. Anyone acquainted with the John Birch Society, mocked and satirized as it often was in mainstream discourse throughout its heyday in the 1960s, might very well marvel at the fact that ideas propagated by a “lunatic fringe” group managed to wend their way into institutions like the National Security Council and the Oval Office circa 2017. Yet the Society is survived by more than its ideas – it is still an actively-recruiting organization dedicated to the credo of “less government, more responsibility.” Granted, its founding obsession with rooting out subversive communist plots in all levels of government and elements of community life is long gone, but some of its twenty-first century goals will seem familiar to anyone parsing various ideologies espoused by both the present-day Republican Party and the Trump White House. It may come as little surprise to followers of Montana politics that the group once had a significant presence in the Treasure State. By examining the collections and constituent
correspondence of Montana politicians Mike Mansfield and Arnold Olsen as well as records from KGVO Radio, the Montana Attorney General’s Office, and the Educational Cooperative Publishing Company of Montana, this paper explores the Society’s origins and influence in areas such as eastern Montana and the Bitterroot Valley throughout the 1960s and early 1970s. How did right-wing extremism affect education and academic freedom in Montana? How did the national spread of Birchism, Cold War conspiracy culture and the politics of division play out on the local level in Montana communities? What impact did the Society have on state government? What connections, if any, were drawn between (waning) behemoths such as the Anaconda Company and the Montana Power Company and sponsored Birchist activity? These are some of the questions that an examination of these archival collections brought to light. Although the hotbed of Birch activity in Montana was located in eastern Montana and the Bitterroot Valley, letters about the Society – both favorable and unfavorable – reached Mansfield and Olsen from all over Big Sky Country: Libby, Kalispell, Hot Springs, Missoula, Helena, Great Falls, Bozeman, Billings, and elsewhere. By the 1970s, stories about the John Birch Society had largely disappeared from Montana headlines, but reverberations of its effects can arguably still be felt in communities around the state today.

The Role of Aquatic Plant Assemblages in Predicting River Primary Production: Implications for Dam Removal

Author(s): Laurel Genzoli
UM Faculty Mentor: Bob Hall, Flathead Lake Biological Station
Category: STEM (Science, Technology, Engineering, Mathematics)

Abstract / Artist Statement:
The planned removal of 4 large dams from the Klamath River in 2022 will result in the largest dam removal in history. Although the primary purpose of this dam removal is to restore fish passage, it is also expected to restore ecosystem function and improve water quality below the dams. The growth and proliferation of aquatic plants are expected to respond to physical, chemical, and biological changes in rivers, including those associated with dam removal. Our objectives were to understand how the aquatic plant assemblages in the river change along a gradient of conditions associated with the presence of dams, and how these assemblages relate to overall rates of primary production. These relationships will guide predictions of how dam removal will influence aquatic plant assemblages and rates of ecosystem primary production.

In June and July of 2019, we snorkeled 11 reaches on the Klamath River in Northern California. Study reaches spanned ~170 river miles from below Iron Gate Dam to above the Klamath River Estuary. At each reach, we snorkeled 6 transects, collecting data from 11 quadrants at each transect, to document the coverage of rooted aquatic plants and filamentous algae along a gradient of river conditions. At each reach, we deployed dissolved sensors for 3 months, which log dissolved oxygen and water temperature every 10 minutes. Using this dissolved oxygen data, we model daily rates of ecosystem primary production at each reach. We related the percent cover of aquatic plants to rates and patterns of daily primary production to understand how the primary producer community influenced ecosystem rates of primary production.

Ecosystem response to large dam removal has received little attention, making predicting changes in primary production and associated water quality and basal food resources challenging. Further, examining how primary producer assemblages control ecosystem rates of primary production has not been attempted in rivers. By working across the sub-disciplines of community- and ecosystem- ecology, we will bring new understanding into how aquatic plant assemblages control the magnitude and timing of ecosystem primary production, adding a mechanistic understanding of primary production that will improve predictions of ecosystem change associated with dams and their removal.

Aquatic plants are central to rivers ecosystems, providing food resources to higher trophic levels and storing and processing nutrients from the surrounding watershed. However, land use and river alterations can change the amount and types of aquatic plants present, with increases in aquatic plant growth leading to degraded water quality and changes to these aquatic plant communities altering aquatic food resources. Making informed predictions about how land use and river alterations, such as dam removal, will influence river ecosystems will benefit from increased understanding of the community mediated drivers of riverine primary production.
Climate Decisions & Geoengineering
Author(s): Emma Gjullin
UM Faculty Mentor: Soazig Le Bihan, Philosophy
Category: Social Sciences/Humanities

Abstract / Artist Statement:
In this paper, I suggest that the precautionary principle is relevant to making decisions regarding the climate crisis. I explain Steel’s interpretation of the precautionary principle and how it attempts to solve the issue of incoherence. Incoherence occurs when the precautionary principle can both recommend and prohibit a precaution. Steel attempts to resolve incoherence with the consistency stipulation. This stipulation forbids any version of the precautionary principle in which incoherence occurs. I argue that while Steel’s interpretation of the precautionary principle can consistently endorse mitigation options, mitigation alone is not sufficient for responding to climate change; it is necessary to consider adaptation options, especially those involving technology. I will then argue that though Steel’s precautionary principle maintains coherence when applied to mitigation, it does not maintain coherence for technological adaptation options. I’ll show this by assessing a carbon dioxide removal technique using Steel’s framework.

Organizational influence on engagement in knowledge co-production
Author(s): Evora Glenn
UM Faculty Mentor: Laurie Yung, Society and Conservation
Category: Social Sciences/Humanities

Abstract / Artist Statement:
We currently face challenges in our social-ecological systems that are stimulating efforts into interdisciplinary and transdisciplinary science with the aim of generating potential solutions. One of the challenges with scientifically generating ‘solutions’ for decision-makers is a long standing disconnect between research and governance. Often characterized as a ‘gap,’ the interface of science and governance is wrought with misunderstandings, conflicting priorities, and professional incentives that do not make it easy to spend time and resources cooperating. While many methodologies have been proposed to foster more effective connectivity between the two enterprises, knowledge co-production is an approach seen to confer unique benefits. Through iterative and inclusive processes, scientists, decision-makers, and community stakeholders can engage in knowledge creation. While co-production has been described as taking numerous forms, it often entails the co-development of research questions and methodologies, the integration of different knowledges into research outputs, and collective meaning-making of the resultant knowledge. This ongoing collaboration throughout co-production processes has been seen to help navigate differences between participants, cultivate shared understanding of complex social-ecological challenges, and foster the interpersonal capacity to continue learning and adapting to subsequent challenges going forward. It also has produced knowledge products that are perceived as more salient, credible, and legitimate by participants, meaning that they are more often perceived as relevant, accurate, and as having emerged from trustworthy processes. When knowledge is perceived as salient, credible and legitimate, it’s often more likely to be used. Despite these potential benefits, legacies of disconnection between research, practice, and community stakeholders can manifest as organizational structures and cultures that are not conducive to collaborative processes or the more adaptive management they enable. Case studies of how organizations, such as research organizations, are currently employing collaborative processes can help illuminate what changes may improve support for co-production. We’ve examined seven projects involving scientists from the Rocky Mountain Research Station through in-depth interviews with project participants. Though participants describe being encouraged to engage in this work, and that they’re often personally motivated to do so, these cases illustrate how the design of professional positions, including how their performance is evaluated, as well as current funding structures and limited staff capacity can each constrain the extent that station scientists choose to engage in knowledge co-production. From these findings, we proffer organizational adjustments that may ease these constraints and provide support for further engagement. The Station, and similar research organizations, could adjust their scientific positions to incorporate collaborative work as part of their professional job duties, and then similarly adjust professional evaluations to value this collaborative work. Additionally, research organizations that are also funders, such as the Station, could provide more funding over longer time periods to more adequately cover the costs of the additional time and resources that co-production processes tend to require. And lastly, research organizations that aim to focus on creating actionable science for decision-makers could invest in
additional scientific staff that work specifically at the interface between research products and decision-making challenges, to facilitate the connection between science and governance.

**Investigating Childhood Stunting and Malnutrition Outcomes in Sukadana and Simpang Hilir, Indonesia**

**Author(s):** Julia Goar  
**UM Faculty Mentor:** Kimber McKay, Public Health  
**Category:** Social Sciences/Humanities

**Abstract / Artist Statement:**  
**Purpose:** Infant and child growth is understood as an important indicator of nutritional status and health in populations. Stunting, wasting, and being underweight are the indicators used to measure child growth and reflect nutritional imbalance resulting in undernutrition. The World Health Organization has cited Indonesia as one of five countries that have child stunting higher than both the regional and global averages, making this a priority issue for the government as well as clinics across the country including Alam Sehat Lestari (ASRI) Clinic located in Sukadana, Borneo. The aim of this study is to gain information on the target population to inform a tailored intervention within the capacity and existing programming of the clinic.

**Methods and Materials:** A health assessment survey was implemented in the clinic and in the surrounding community to measure differences in malnutrition outcomes based on household factors, access to quality health care, issues during pregnancy, maternal and child health, breastfeeding and complementary feeding practices, and quality of child diet.

**Results:** Out of a rich variety of results, some factors were associated with higher rates of malnutrition outcomes or were otherwise noteworthy. Rates of stunting and underweight were 32% and 48% respectively in households with smoking exposure in the home compared to 14% and 27% respectively in households with no smoking. There was a difference in rates of stunting and underweight children from mothers who reported having a cough during their pregnancies (31% and 44% respectively) compared to mothers who reported not having a cough (20% and 34% respectively). Additionally, there was a 13% difference in stunting and an 11% difference in wasted and an 11% difference in underweight in children who had a cough in the last month. Although almost all mothers breastfed their child at some point, initiating and maintaining breastfeeding did not always follow best practices. Stunting and underweight were 23% and 15% higher, respectively, in children that received liquids or food other than breastmilk under 6 months compared to those 6 months or older. Additionally, stunting and underweight were 50% and 31% higher, respectively, in children who first received solid foods under 6 months. The majority of mothers did not believe that stunting was an issue in the community or identified specific causes. Mothers also held the belief that a multitude of foods should be avoided during and after pregnancy to prevent convulsions and luge (weak disease).

**Significance:** ASRI Clinic can address childhood stunting and malnutrition outcomes in Sukadana and Simpang Hilir by investing in community education focusing on tobacco cessation, breastfeeding and nutrition. Within the clinic, ASRI can implement policies and procedures to support patients in smoking cessation and best breastfeeding practices. In addition, the clinic can partner with Puskesmas to continue education and monitoring outside of the clinic.

**Originality:** This is the first time that ASRI clinic has investigated malnutrition outcomes in their community and has partnered with the University of Montana to assess a health disparity.

**Enhancing Positive Outcomes of Future Mental Imagery Via Personal Values**

**Author(s):** Bethany Gorter  
**UM Faculty Mentor:** Craig McFarland, Psychology  
**Category:** Social Sciences/Humanities

**Abstract / Artist Statement:**  
**Prospection** involves mental imagery of future events and is a part of everyday human life. Lately, research has revealed faulty prospection in various clinical populations, such as anxiety, PTSD, and depression. One robust finding has been that individuals with depression reliably demonstrate difficulties generating positive future scenarios as compared to healthy controls; and also tend to imagine these events in less detail. Researchers suggests that this cognitive style underlies and maintains depression by depriving individuals of positive affective experiences
associated with positive prospection, and contributes to hopelessness and suicide as people struggle to imagine a meaningful, and important future that is worth living. One way to enhance the experience of prospection for both clinical and nonclinical populations could be to enhance the meaningfulness and importance of existing plans by linking them with personal values. Personal values are global life desires (i.e., striving for knowledge, intimacy, adventure) and behavior tends to reflect these values. Our study sought to develop a novel intervention to increase the meaningfulness and importance of prospections by having individuals link personal values (i.e., “growth”) with existing plans (i.e., “study in the library for chemistry test”). We hypothesized that encouraging people to make explicit links between values and future plans would enhance the affective experience of prospection by increasing access to details. Additionally, we hypothesized that values driven prospection would increase perceived meaningfulness and importance of the events, and increase hope.

Students from the University of Montana imagined 3 time-limited, future events in as much detail as possible. The values group linked them to personal values, while the control group completed an unrelated filler task. After each event, participants responded to questions on a 7-point Likert scale regarding content (i.e., meaningfulness, importance, value relatedness) and quality (i.e., clarity, ease of construction, “pre-experiencing”), and then completed measures of depression, and level of hope. Measures of positive affect were given prior to the intervention and after the intervention.

Consistent with our hypothesis, our study found that values driven prospection enhanced the perceived meaningfulness and importance of prospection; but only for events highly consistent with values (i.e., 6 or 7/7 rating on item “this is related to my value”). Additionally, the values group had significantly higher ratings on the hope scale. These are promising findings, as research has shown that the perception that one is living a valued, meaningful life buffers against psychopathology and contributes to overall well-being. Contrary to expectations, there were no differences in affective experience, or perceived quality of prospections between the groups. However, we did find significant, positive correlations suggesting that relatedness of personal values to the event was strongly related to enhanced mood and additional access to detailed prospections. Future work will investigate whether adopting a value-based perspective on future actions may reduce depressive symptoms. In practice, linking personal values to existing plans is a quick, simple, and a potentially profound way to enhance one’s subjective interpretation of the future.

Fish on Fluoxetine: Before, During, and After
Author(s): Susan Greene, Allen Szalda-Petree
UM Faculty Mentor: Allen Szalda-Petree, Psychology
Category: Social Sciences/Humanities

Abstract / Artist Statement:
Wastewater pollution contaminating surface waters has become a concern all over the world, even in places humans don’t permanently live. These contaminants come from a variety of chemicals, such as anti-depressants, and the effects vary between species. Unfortunately, methods for extraction of these chemicals from wastewater are not economical and cheaper alternatives are still being developed. This has led to an increase in chemicals in surface water, with antidepressants increasing 400 percent in recent decades. This increase in chemicals in surface water could have impacts on the creatures inhabiting the polluted water. Few studies have been conducted on what impact the chemicals could have on these creatures, but so far physical deformities and changes in sexual characteristics have been reported. Behavioral changes have also been documented, with changes in feeding habits, motor activity levels, and aggressive responding in various species of fish. These changes could have a major impact on smaller aquatic life, which led to the selection of Betta splendens for this project. These fish are small and have obvious aggressive responses that make them ideal to study these impacts. For this project the focus has been on looking at the impact Fluoxetine has on male Betta splendens. There are multiple hypotheses for this project surrounding latency to aggression against mirror, mirror preference, and fighting behavior. It is proposed that the drug will increase latency to aggression against the mirror while simultaneously decreasing the fish mirror preference and the amount of aggressive responding exhibited by the fish toward the mirror. While most previous work has focused on the impact of the anti-depressant Fluoxetine on aggression and movement in male Betta splendens the methods excluded an important contextual cue- a female fish. The female fish presentation would create a more species typical context to study the male’s aggression and courting behavior, while still considering the motor impacts of the drug. Furthermore, this work will utilize an ABA design with A representing Baseline and B representing the drug condition. The use of this design will allow for casual conclusions for the Fluoxetine behavioral effects and determine if returning to Baseline is possible within 25 days. For the B condition the drug dose will exceed that found in environmental concentrations to simulate
bioconcentration, buildup of the drug overtime in an animal's system. This higher dose will be more representative of the concentrations found in the smaller animals living in the natural waterways. Trials will include 5 excitatory mirror presentations and 5 inhibitory non-mirror presentations daily using a Go No Go task. The fish will be split into 2 groups: Female Primed (FP) and Non-Female Primed (NFP). Priming will occur before trials and will involve either a female fish (FP) or empty chamber (NFP). After the prime, trials will begin by lifting the door to the start box and releasing the fish into the alleyway. The time it takes the fish to swim through the alleyway into the goal box will be recorded. The male will have 30 seconds in the goal box.

Sex, Ancestry, and Death: Not all are Created Equal
Author(s): Anna Hampton
UM Faculty Mentor: Randall Skelton, Anthropology
Category: Social Sciences/Humanities

Abstract / Artist Statement:
Homicide is the killing of one person by another person. Previous studies on homicide have been conducted for individual cities within the United States, and on a global scale and sub-national levels, incorporating individuals of all ages, ancestries, and sexes from all nations. This study compares the homicide rates between male and female individuals of European and African ancestry utilizing the University of Tennessee Forensic Data Bank (FDB) and compares the results to the United Nations Office on Drugs and Crime Global Study on Homicide (UNODC) and other small-scale studies. The original data set was narrowed down to include individuals with known ancestry as being either African or European, discovered in the United States, with homicide as the manner of death. Frequency distributions and crosstabulations for those individuals were run using the statistical software SPSS. Statistical analysis includes differences in age, geographic location found, cause of death, age at death, and date of death year. The results produced from an initial pilot study incorporating only males indicate that there is a statistically significant difference in the homicide rates between individuals of European and African ancestry, with a higher rate of individuals of African ancestry as being victims of homicide. Temporal differences surfaced as well, showing that most individuals were victims of homicide in the 1970s and 1980s. The findings in totality show that certain populations of individuals are more susceptible to homicide than others. Many previous studies have focused on the validity of using FORDISC, an interactive computer program that classifies adult skeletal remains by ancestry and sex using a combination of standard measurements. No studies exist, to the researcher's knowledge, of a study that looks at the validity of the FDB. The purpose of this research is to expand on the results of the initial pilot study by incorporating females to result in a more comprehensive examination of homicide trends in the United States, as well as to examine the validity of the FDB by comparing it to previously published studies.

Use of Electrotherapy to Facilitate Post- Exercise Muscle Recovery and Perceived Soreness
Author(s): Tyler Hansen, Madie Siebenaler, Nick Costa
UM Faculty Mentor: Valerie Moody, Integrative Physiology and Athletic Training
Category: STEM (Science, Technology, Engineering, Mathematics)

Abstract / Artist Statement:
Context: Electrical stimulation is often used to modulate pain and facilitate recovery following injury. However, research is inconclusive regarding the use of electrical stimulation as a means of performance recovery. The purpose of this study was to determine if electrical muscle stimulation following exercise was effective in reducing perceived soreness and improving muscle recovery. Our hypothesis was that the higher intensity protocol would decrease muscle soreness, relative to a low intensity protocol.

Methods: A repeated measures design was used for this study, whereby a non-random sample of 7 subjects (4 males, 3 females) participated in two trials (average age 22.3 ± 3.0 years; height 64 ± 6.8 inches; weight 190.8 ± 54.72lbs). The two trials included a high intensity stimulation protocol and low intensity stimulation protocol using the Compex Sport Elite 2.0 portable electrical stimulation unit. On the first day, subjects reported a baseline level of soreness (numeric rating scale provided) before performing double leg bodyweight squats to self-reported failure. Total number of squats was recorded. Upon completion of squats, the subject rated perceived soreness before randomly drawing the treatment protocol (high intensity or low intensity stimulation). The first treatment was delivered to the dominant quadriceps for 20 minutes. Subjects returned at 24, 48 and 72 hours to rate perceived soreness and receive the same
Compex treatment. Upon completion of the final treatment, subjects performed double leg bodyweight squats to failure and the number of squats were recorded. Two weeks passed before subjects returned to complete the other trial following the same procedures. Descriptive statistics were calculated for perceived soreness and squats including mean and standard deviation. A 2 x 4 repeated measures ANOVA was conducted for perceived soreness to determine if significant differences exist in recovery between time points. A 2 x 2 repeated measures ANOVA was conducted for squats to determine if a significant difference exists in squat performance between trials. Microsoft Excel and SPSS 25.0 were used for data analysis.

Results: A 2x2 (time x trial) repeated measures ANOVA was conducted for squat performance which revealed no statistical significance (p = 0.11) Similarly, a 2x4 (trial x time) repeated measures ANOVA was completed for perceived soreness and was not statistically significant (p = 0.36). However, trends suggest that performance and perceived soreness improved with the use of muscle stimulation to facilitate recovery regardless of setting.

Conclusion: While the results of the study suggest that both performance and perceived soreness might improve with the use of electrotherapy, further research is warranted examining this influence on a larger sample size. A higher intensity setting demonstrated a greater trend in reducing soreness when compared to a lower intensity setting; however, both settings resulted in comparable squat performance.

Alas Poor Yorick: A DNA Analysis of Ancestry Using Crania
Author(s): Claire Hanson
UM Faculty Mentor: Meradeth Snow, Anthropology
Category: Social Sciences/Humanities

Abstract / Artist Statement:
here is a database created by the University of Tennessee that holds the cranial measurements for approximately 3,400 individuals which is often used by forensic anthropologists to create a biological profile. By taking measurements of crania and inputting them into this database, known as FORDISC, anthropologists should in theory, be able to identify the ancestry of the individual you are studying. However, the sample bias for FORDISC is troubling, as many minority groups are less accounted for. This means that FORDISC has great difficulty assigning an ancestry to those who do not fit a specific group of measurements. This lack of accuracy has the potential to make curation of individuals difficult as some individuals may be of an ancestry or culture that require different practices for returning remains. In order to increase accuracy, including DNA evidence in the biological profile would allow forensic anthropologists to find the ancestry of an individual and either curate the remains or work with tribes to repatriate the remains.

This research project used two newly accessioned crania in the University of Montana Forensic Lab as well as six existing crania housed in the University of Montana Forensic Collection. To obtain the DNA needed for this project, we drilled into a small portion of the crania near the inner ear called the petrous portion From this bone sample, we were able to extract DNA and run an analysis that sequenced the entire mitogenome in order to determine maternal lineage. This lineage is traced through mitochondrial DNA (mtDNA), which shows what haplogroup the remains belong to. Because haplogroups show which area of the world a particular sequence of mtDNA is most commonly found, we were able to assign a probable ancestry to each of these individuals. These results were then compared to FORDISC assessments to test the accuracy of the online database. We then were able to correct any ancestral estimate errors in the current University of Montana forensic collection.

As more admixture occurs between populations, it becomes increasingly difficult to assess ancestry via non-metric and metric measurements. Databases such as FORDISC do not account for admixture and can therefore not be the only source of ancestral assessment that we employ. By incorporating DNA analysis, we can vastly improve the accuracy of forensics as well as guarantee that ethical and proper curation will take place.

An analysis of tribal consultation: A case study of policy v. practice in Superfund
Author(s): Jennifer Harrington
UM Faculty Mentor: Brian Chaffin, W.A.Franke College of Forestry and Conservation
Category: STEM (Science, Technology, Engineering, Mathematics)
Abstract / Artist Statement:
Federal agencies like the Environmental Protection Agency (EPA) are charged with protecting human health and the environment; when Tribal land and resources are involved, the EPA is legally bound to formally consult with affected Tribal Nations. Many Tribes endure the legacies of environmental contamination from industry, and thus are subject to the processes of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA; Superfund) administered by the EPA. This research seeks to answer the following questions: What is the role of tribal consultation in the Superfund process? Why is consultation often inadequate or absent? What can be done to make EPA-Tribal consultation engaging, meaningful, and effective? I have conducted this research using a combination of indigenous research methodologies and contemporary methods for qualitative social science data collection and analysis. Indigenous Research methodologies substantially influenced my understanding of the problems, created a platform through which Tribal people and places were given priority, and it provided a voice for the Tribal members involved in the case study. I followed a single case study protocol—the investigation of a real-world phenomenon in context using multiple sources of data—to investigate consultation (or lack thereof) between the EPA and the Confederated Salish and Kootenai Tribes (CSKT) regarding the investigation of the contaminated Frenchtown Mill site, located 13 miles west of Missoula, MT in the aboriginal territory of the Salish and Pend d'Oreille peoples. In analyzing semi-structured interviews conducted with Tribal members and employees, I found that EPA project managers, state agency representatives, and other government officials do not know how to appropriately and meaningfully consult with Tribes. When Elders spoke about their experiences with consultation, it was clear that from their perspective, consultation has never been inclusive nor transparent. Consultation between the EPA and Tribes with regard to Superfund sites is intended to provide site characterization and final remedies that will restore the environment to pre-contamination conditions. Currently, EPA processes of consultation are at odds with tribal world views and approaches, making EPA-driven outcomes incompatible with tribal values. Consultation, from the EPA perspective, means informing a Tribal nation of actions or environmental hazards that may affect the Tribe. Consultation as currently conceived does not include: mechanisms for ongoing feedback from a Tribe; Tribal participation in EPA actions such as contaminated site investigation and clean-up processes; nor an equal seat at the table, generally. Meaningful consultation from the EPA point-of-view is not meaningful or effective from a Tribal perspective. Results from this research lead to specific conclusions and recommendations for improving EPA-Tribal consultation around Superfund, such as: (1) efforts to include tribal history, rights, and contemporary uses of potential and listed Superfund sites in EPA documents; (2) involve Tribal representatives in all phases of the Superfund process including negotiations with parties responsible to fund cleanup; and (3) increase transparency in final settlements.

Using Ecological Momentary Assessment as a Mindfulness Intervention for Student-Teachers
Author(s): Emily Hattouni
UM Faculty Mentor: Jacqueline Brown, Psychology
Category: Social Sciences/Humanities

Abstract / Artist Statement:
Overview and Purpose: There is a high-rate of burnout among teachers around the US, often linked with the increasing stressors and demands. Furthermore, various interventions have been proposed to address teacher burnout in the schools. Stress factors influence teacher burnout, and there may be effective ways of promoting self-care among teachers (i.e., mindfulness-based practices). Additionally, researchers have demonstrated the importance of teachers’ social and emotional competence for promoting well-being and academic success in classrooms. Within the school setting, teachers have limited time and resources to devote to self-care and building skills that are not directly related to academic teaching, such as social-emotional intelligence. Brief interventions and informal practices may effectively improve coping skills and the ability to regulate emotions and respond to stress adaptively.

Ecological momentary assessment is a relatively new measurement technique that allows researchers to collect vast data over brief periods of time. Participants are prompted throughout the day to complete self-reports or engage in experimental interventions; however, participants are not required to leave their current location (e.g., home, work) to complete study tasks. This measurement technique has been used to study various psychological phenomena as they occur in a natural setting. Using ecological momentary assessment allows for real-time data to be collected about stress, coping techniques, and engagement with mindfulness.

The project being presented was aimed at understanding the utility of mindfulness practice for pre-service teachers. A goal of this study was to use EMA as an intervention tool to influence the frequency of engagement with mindfulness.
A daily reminder may encourage individuals to practice mindfulness and serve to increase the likelihood of future mindfulness practice. Cultivating a mindfulness practice evolves over time and a daily prompt to engage in mindfulness may encourage the growth of a mindfulness habit that can translate to the classroom setting.

Method: After a brief (100-minute) psychoeducation session on mindfulness for teachers, undergraduate student studying to become teachers were invited to participate in the current study. Participants provided their phone number to receive a text message three times per day for fourteen days; each text message contained a link to a Qualtrics survey. Treatment group received a reminder to practice mindfulness before completing the survey. All participants completed a survey on their current stress levels, recent coping strategies used, and state mindfulness.

Results: The effect of psychoeducation was investigated to determine in 100-minutes of psychoeducation increased understanding and awareness of mindfulness. Results suggested that on average, participants had a greater accuracy for defining mindfulness after psychoeducation. Additionally, results suggest that ecological momentary assessment may provide more detailed information about the various levels of stress that individuals encounter. Implications for practice include the feasibility of utilizing smartphone devices and ecological momentary assessment for the implantation of mindfulness-based interventions among teachers.

Sacralization of the Fifth Lumbar Vertebra: A Case Study

Author(s): Samantha Hofland
UM Faculty Mentor: Kirsten Mink Green, Anthropology
Category: Social Sciences/Humanities

Abstract / Artist Statement:
Sacralization of the fifth lumbar vertebra, also known as Lumbosacral transitional vertebra (LSTV) (Jancuska et.al 2015), is a common congenital pathology that may affect up to 30% of the population (Alonzo et al, 2018). This condition is characterized by the enlargement, pseudo-articulation or fusion of one or both transverse processes of the fifth lumbar vertebrae to the sacrum. The expression of LSTV varies in severity between individuals and even from one side to another within a single individual (Alonzo et al, 2018). This pathology has also shown to be influenced by genetic inheritance. Sacralization has also been shown to vary amongst populations (Shett&Jetti, 2017). FSD 19-232 arrived at the University of Montana Forensic Anthropology laboratory on September 16th, 2019 and was assigned by Dr. Kirsten Green Mink to Samantha Ramey and Samantha Hofland for forensic anthropological analysis. Based on metric and nonmetric analysis of the remains, the individual was likely male with mixed European ancestry likely with including some African and Native American/Asian gene contribution. Due to lack of long bones stature could not be properly estimated. The individual presented with numerous pathologies and trauma including surgical wire in the manubrium, fluorosis on the teeth, a bony callus on the rib and sacralization of the fifth lumbar. This case present unilateral stage 2 sacralization of the fifth lumbar vertebra to the sacral alae on the individual’s right side. Lumbosacral transitional vertebra is a common and minor anatomical variation, but it can lead to other pathological conditions including spinal disc herniation, cervical ribs, and Bertolotti’s syndrome (Shiksha, 2015). These issues frequently happen in individuals that have sacralization on only one transverse process (Shiksha 2015). Based on the level of sacralization found on FSD 19-232, it is possible that this individual suffered from Bertolotti’s syndrome. The spinal column, ribs, and sacrum showed numerous anomalies consist with this syndrome. These anomalies also suggest the individual may have struggled with disc degeneration. Further studies of LSTV’s would allow researchers to better understand painful and dangerous side effects that may be associated with anatomical anomaly. More research needs to be done in order to discover the true relationship between sacralization and lower back pain within the population, as surgery is often need to correct pain caused by sacralization. Also, the relationship between different populations and sacralization needs to be further analyzed in order to identify at-risk populations. In the forensic field this condition could along with other methods could help identify or confirm the likely ancestry of an individual (Shetty&Jetti, 2017). When examining this individual there were numerous spinal and rib anomalies on the right side suggesting that there may be a correlation between these pathologies and the sacralization seen on the individual, more case studies need to be done to determine the effects sacralization may have on the rest of the skeleton.

On the Complexity of Conceptual Animal Metaphors in Queer Speech

Author(s): Jarrett Hopewell
UM Faculty Mentor: Susan Penfield, Linguistics (Anthropology)
Category: Social Sciences/Humanities
Abstract / Artist Statement:
For English speaking members of the queer community in the United States, there is a group of animal terms used to categorize different “tribes” of community members. For example, the term bear generally refers to an individual who is large, hairy, and older. Samardžić (2015) proposes these animal terms as the conceptual metaphor: GAYS ARE ANIMALS. In cognitive linguistics, conceptual metaphor refers to the understanding of an abstract concept in terms of a concrete source. In other words, the different “tribes” of queer community members are conceptually understood in terms of animals.

Departing from Samardžić (2015), the present author proposes that the conceptual metaphor, GAYS ARE ANIMALS, is a complex metaphor, meaning it consists of more than one type of metaphor. For example, while terms such as bear and otter primarily refer to one’s physical appearance, other terms such as pig and pup refer to one’s kinks and sexual desires. This would be a simple metaphor if all the animal terms described the same features (e.g. physical appearance). The author analyzes these animal metaphors within the framework of Conceptual Metaphor Theory (Lakoff and Johnson, 1980; Kövecses, 2010) using data collected from online media sources.

Very little academic literature exists on the topic of animal metaphors in queer speech, and this project aims to shed light on the complexity of these metaphors. Animal metaphors encode a conceptual understanding of the human experience through the lens of the queer community. By analyzing these metaphors, this project not only contributes to the study of conceptual metaphors, but also contributes to the documentation and study of queer culture and language.

"I want you to act as if our house is on fire!” Framing Climate Change: Women Climate Activists’ Collective Action Frames
Author(s): Sara Humphers-Ginther
UM Faculty Mentor: Kathy Kuipers, Sociology
Category: Social Sciences/Humanities

Abstract / Artist Statement:
Climate activists urgently emphasize collective action and global institutional change to prevent irreversible damage to human and natural systems from climate change. However, global institutional responses to climate change have been deemed ineffective and slow, and this has been linked to gender imbalance within dominant international climate change negotiations and research. Research shows improved climate change responses and policy agendas when there is greater gender balance within climate negotiations and research. More effective climate responses and policy agendas are dependent on a shared understanding of the problem. This is communicated through the way we frame, or interpret, the phenomenon. Framing is a method of organizing the ways in which people interpret a phenomenon by establishing a shared sense of meaning. A collective action frame involves four steps: identify the (1) problem; (2) causes of the problem; (3) solutions to the problem; and (4) ways to engage others to take solution-oriented actions. Collective action frames against climate change can inform policy agendas by raising alternative questions and solutions, acknowledging more neglected issues, and including marginalized perspectives. I will qualitatively analyze the characteristics of women climate activists’ collective action frames against climate change through 20 in-depth, in-person interviews. Because climate change has only recently become a dominant political narrative, my approach is unique in that interview data will be compared between women who are 18 – 36 years versus women who are 55 years and older to explore the extent to which collective action frames vary by age. Variations of collective action frames of climate change across women of two generations might reveal different climate change policy agendas.

Modeling Hydrologic Impacts of Water Rights Quantification and Settlement on the Flathead Indian Irrigation Project
Author(s): Jordan Jimmie
UM Faculty Mentor: Brian Chaffin, Department of Society and Conservation
Category: STEM (Science, Technology, Engineering, Mathematics)

Abstract / Artist Statement:
The Confederated Salish and Kootenai Tribes (CSKT) of the Flathead Reservation are a federally-recognized group of tribes (Kootenai, Salish, and Pend d’Oreille) located in western Montana. On the reservation lies the expansive Flathead Indian Irrigation Project (FIIP), which supplies irrigation water to approximately 127,000 acres of tribal and non-tribal agricultural land. The 1904 Flathead Allotment Act opened “surplus” land to non-native homesteaders.
A Needs Assessment of Patrons Experiencing Homelessness at the Missoula Public Library

Author(s): Erica Johnson  
UM Faculty Mentor: Keith Anderson, Social Work  
Category: Social Sciences/Humanities

Abstract / Artist Statement:
Collaborations between social workers and public libraries have been proliferating over the last decade. These partnerships provide an opportunity for social workers to connect with library patrons who are experiencing homelessness and address their social determinants of health. By meeting these patrons where they are, library social workers serve as a vital connection to social services that may otherwise be difficult to access. Library social workers also help librarians work with patrons with difficult behavior by deescalating conflicts, encouraging behavior change, and educating librarians on social issues and best practices.

In order to understand if a library social work program is needed in Missoula, a needs assessment will be conducted. This mixed method research will help us understand whether this model is appropriate for our community and any adaptations that may be needed to make it successful. Phase I of this research is almost complete. This phase was focused on quantitative data that was collected as part of the annual Point in Time Count. Phase II will include interviewing patrons experiencing homelessness and library staff. This research will help ensure that program development is influenced by the needs of those most impacted by homelessness at the public library. This research is a collaborative effort between the University of Montana’s School of Social Work, the City of Missoula’s Reaching Home: The 10-Year Plan to End Homelessness, and the Missoula Public Library. In addition to benefitting our community, this research will contribute to the nascent body of literature on library social work.

Development of an Autonomous Dissolved Organic Carbon (DOC) Sampler

Author(s): Alec Johnson  
UM Faculty Mentor: Mike DeGrandpre, Chemistry  
Category: STEM (Science, Technology, Engineering, Mathematics)

Abstract / Artist Statement:
Dissolved Organic Carbon (DOC) is the portion of carbon containing material in waters that have organic carbon incorporated in their structure. It is important to study DOC in aquatic systems for a variety of reasons, including both environmental monitoring as well as waste management. DOC often regulates major physical and biogeochemical...
processes in aquatic systems. These processes include the transformation and transportation of essential nutrients, complexation of environmentally important heavy metals such as Cu, Pb, Hg, and Cd, as well as being used as the energy substrate in the microbial processing of larger organics. The reactivity of the DOC pool can in turn also lead to important emissions of carbon dioxide to the atmosphere. Due to all of these factors, the flux of DOC within and out of the ecosystem can be a significant component for calculating carbon budgets in both small- and large-scale ecosystems.

DOC can vary dramatically over time in natural waters and characterizing the patterns and drivers of DOC variability and requires information spanning a wide range of temporal resolution. Often, the temporal resolution of DOC data is very limited due to infrequency of sampling. This is the problem that my current research is addressing. Although long-term investigations of DOC dynamics are common with infrequent sampling, studies done at a high temporal resolution are lacking due to the complex logistics and laboratory costs surrounding DOC analysis in remote environments. Currently there are no in-situ instruments that are dedicated to DOC analysis.

Common laboratory methods for quantification of DOC include High Temperature Oxidation/Combustion methods (HTOC), which involves complete oxidation of DOC to CO2 in extreme heat, persulfate oxidation which is a type of chemically-assisted degradation, as well as UV absorption or fluorescence methods. In the HTOC and persulfate methods, the generated CO2 is quantified using infrared absorption. There is a high energy demand that would required for full degradation of organic matter for an in-situ instrument utilizing similar techniques. In-field preservation and storage is thus ideal for an in-situ sampler that can utilize HTOC techniques for determination of DOC levels in stored samples. My current research has been working with a method for preservation and storage of DOC that could utilize a lab-based approach for DOC determination at the end of the sampling period, as described above.

This presentation will describe current research that I have been working on regarding development of this system and background experimentation. It will also be exploring and understanding the data that has come from these experiments. In addition, the presentation will describe possible future directions the project may head in for the full development of a dedicated in-situ DOC-sampling instrument in the coming months.

**Cutting the Mussel’s Threads: How Invasive Species Influence Public Policy and Regulatory Schemes in Montana**

**Author(s):** Hallee Kansman  
**UM Faculty Mentor:** Sara Rinfret, Public Administration & Policy  
**Category:** Social Sciences/Humanities

**Abstract / Artist Statement:**
Invasive species are a nationwide threat to natural ecosystems and can affect all sectors of government - local, state, tribal, and federal. The Montana Invasive Species Council (MISC) was created in 2015 by Governor Bullock and is comprised of stakeholders from state and federal agencies, tribal governments, and private entities. A year after its formation, MISC launched an Invasive Species Strategic Framework, highlighting five areas for improvement within Montana: coordination, prevention, detection, rapid response and control. In 2018, MISC conducted listening sessions and interviews, compiled a compendium of Montana statutes and regulations pertaining to invasive species, and organized a statewide summit. Currently, MISC is pursuing potential legislative changes regarding the Aquatic Invasive Species Act and management statutes within the Montana Code Annotated.

The purpose of the 2018 Summit was to uncover public perceptions regarding the proposed gaps and challenges with the current statutory and regulatory authority pertaining to invasive species. The results of the Summit would then be used to initiate legislative action and regulatory reform, essentially designating outcomes for future statutory re-design. During the Summit, MISC explored the option of implementing an all-taxon invasive species list, which would emphasize improvements in the listing process and definitions. MISC also discussed the benefits and consequences of increasing enforcement and penalties within the existing statutory and regulatory schemes. They found that most state officials and agency members would support the creation of an all-taxon listing process, as long as the process was clear regarding management responsibilities and uniform in its use of terminology. Further, MISC found the need for improvement in statute, specifically with the Aquatic Invasive Species Act [Montana Code Annotated § 80-7-1001].

From the Summit results, MISC launched a committee process to unravel the issues surrounding the current listing process and how the current statutes and agency regulations define certain terms, such as “invasive species.” Another committee, tasked with statutory reform, dissolved and instead created an Aquatic Invasive Species Summit during
the fall of 2019, in Helena, Montana. MISC plans to utilize the results from the listing committee and from the AIS Summit to drive the legislative and regulatory reform going into the 2021 Legislative Session. Although some of its action items can be resolved outside the legislative process, MISC hopes to inspire productive discussions with current state legislators and policy makers throughout all levels of government.

As mentioned, MISC swiftly decided to tackle the issues involving the listing process and management authority through committee process, with hopes of inducing legislative action or regulatory reform. This presentation will summarize the results from the Summit and detail stakeholder opinions within MISC. Additionally, the presentation will showcase how traditional models of organization theory and policy analysis can drive the improvements MISC strives to achieve. Through continued discussions with agency members and stakeholders, MISC intends to find the best possible solution for the current deficiencies within Montana's invasive species statutes and regulations.

Determining the Extent of Summer Precipitation Required to Mitigate Extreme Urban Heat Events Using a Fully Distributed Eco-Hydrological Model

Author(s): Sarah Khalid, Marco Maneta, Zack Holden, Chris Soulsby
UM Faculty Mentor: Marco Maneta, Geosciences
Category: STEM (Science, Technology, Engineering, Mathematics)

Abstract / Artist Statement:
The western U.S and other regions of the World are experiencing drier summers and longer periods of consecutive days without wetting rain. Less frequent summer storms reduce the moisture available to dissipate heat, increasing the amount of energy available to heat the ground and the air. This reapportion of the energy balance is especially acute in urban environments because of low surface albedo and relatively low thermal capacity of asphalt and concrete. To investigate the impact of summer storms and urban irrigation on the energy balance and thermal comfort in urban environments we use a fully distributed ecohydrological model to simulate the urban microclimate of Missoula, MT, a typical temperate, mid-latitude town in the inter-mountain western US. We conduct simulations during a wet and a dry summer and evaluate the fluctuations of surface temperatures attributed to summers storms. The driving hypothesis is that less frequent summer storms and less urban irrigation reduce the dissipation of available energy as latent heat, effectively increasing surface temperatures and decreasing thermal comfort in urban environments more significantly than the expected regional increase in air temperature associated with climate change. The goals of this study are 1) to determine to what extent does frequency and duration of summer precipitation and urban irrigation helps dissipate heat and help mitigate extreme heat events; 2) to evaluate urban thermal impacts induced by longer and more frequent dry periods during summers; and 3) to quantify the role that different land covers and water plays on the reapportion of the energy balance and on ameliorating localized heat islands. A comparison of turbulent heat flux partitioning between wet and dry years during preliminary model runs show considerable differences between the two, modulated strongly by the presence of water.

Precision Medicine under the Big Sky: Pharmacogenetic Implementation in Rural Settings

Author(s): Shayna Killam, Tianna Leitch
UM Faculty Mentor: Erica Woodahl, Department of Biomedical and Pharmaceutical Sciences
Category: STEM (Science, Technology, Engineering, Mathematics)

Abstract / Artist Statement:
Recent scholarship has generated much optimism about the potential of precision medicine to transform healthcare. Yet, implementation strategies have been limited to major academic medical centers serving metropolitan communities and large health systems. By contrast, rural, community-based health systems have been slow to implement precision medicine advances, threatening to exacerbate existing health care disparities for rural populations. In Montana—where two-thirds of the population live in rural areas—we have established partnerships with early adopter sites who are eager to implement pharmacogenetics. Our partners serve high-risk rural populations including American Indian, pediatric, and low-income patients across the state. Our goal is to gather perspectives from key stakeholders to ensure that our implementation approach is feasible and accepted by clinical partners. We conducted 31 semi-structured interviews with healthcare personnel, including physicians, pharmacists, informatics specialists, electronic health record coordinators, and administrators. Interviews were transcribed and imported into Atlas.ti to identify and organize themes generated from interview questions. Two team members independently
reviewed transcripts and created a codebook based on major themes. The codebook was then extensively revised through consensus by the analytic team. We identified major themes involving provider-perceived benefits to patients such as individualized treatments, reduced adverse events, and improved medication adherence across all partner sites. Significant concerns regarding patient and provider education for genetic testing and test interpretation, as well as lack of access to these resources in rural settings were common. Additionally, ethical strategies for collecting and returning genetic results for patients belonging to the aforementioned vulnerable populations was emphasized. While there is an overall interest in utilizing pharmacogenetics, significant concerns must be addressed, including, but not limited to, barriers in reimbursement, testing turn-around time, and effective integration into electronic health systems. The themes generated from these interviews will provide a framework for implementing a pharmacogenetics delivery model with our early adopter sites. Our project provides the opportunity to identify a broad range of implementation issues for further expansion across Montana and will serve as a model for pharmacogenetic implementation in rural settings.

Forgotten No More: Public Archaeology in Missoula, Montana

Author(s): Kate Kolwicz
UM Faculty Mentor: Kelly Dixon, Anthropology
Category: Social Sciences/Humanities

Abstract / Artist Statement:
Historical Archaeology seeks to democratize history, highlighting the experiences of "those of little note" that have been forgotten or overlooked by history. History books tend to memorialize the lives of wealthy, white men - while other groups, such as the Overseas Chinese, immigrants, the working class, women, and sex workers, have slipped through the cracks. While they may not appear in the annals of written history, these groups left behind material culture, and these artifacts represent fragments of the lived experiences. Archaeology seeks to use these "small things forgotten" to decipher the story of these groups.

This paper will discuss the archaeological work that is currently in progress at The Cranky Sam Public house, set to open in downtown Missoula in March of 2020. This project highlights the importance of place-based history in creating personal - and corporate in this case - identities. The project began during the summer of 2019 when the business owners reached out to UM archaeologists in an attempt to understand their historic space. Unexpectedly, the construction work undertaken that summer unearthed a treasure trove of artifacts relating to the Redlight District of Missoula during the late 19th century to the early 20th century. In particular, the site provided thousands of artifacts related to sex workers, African Americans, and the Chinese. We know almost nothing about these groups, aside from the stories that were written about them in the local newspapers. We have nothing written by these people, and in this case, we must rely on archaeology to fill in the blanks. Furthermore, rapid development has destroyed almost all of the sites in Missoula that are related to these populations - making Cranky Sam Public House that much more important.

This paper explores the work that archaeologists working at the University of Montana have undertaken to bring archaeology to the people, and uses this local example to illustrate the good, the bad, and the ugly of public archaeology. Within the discipline, archaeologists currently debate the most effective way to share these stories with the public, while avoiding further sensationalizing and further exploiting minority classes and their descendent populations. How can we discuss the potentially traumatic experiences of marginalized groups in a respectful fashion? How can we engage the public without resorting to stereotyping or sensationalizing? Despite these nuanced ethical questions, archaeologists have much to offer the modern world, as we continue to struggle with issues of marginalization and mistreatment based upon race, class, gender, and nationality.

What is Wonder?: A Phenomenological Investigation

Author(s): Henry Kramer
UM Faculty Mentor: Deborah Slicer, Philosophy
Category: Social Sciences/Humanities

Abstract / Artist Statement:
As this is a phenomenological investigation, I will stick closely to the question of what it is like to feel wonder. This is a descriptive project about the kind of perception that accompanies a state of wonder, and a description of the basic internal world of that wonder, its felt dimensions. I also hope to trace the experiential causes and consequences of wonder. This involves questions such as: What sort of events lead to feelings of wonder? What sort of dispositions
predispose us to experience wonder? How do feelings of wonder affect the way we navigate our world? These questions are secondary – yet intimately connected – to the primary question of the thesis (what is wonder like?). In my investigation, I hope to draw connections between wonder and attention, intersubjectivity, engagement, intimacy, animism, play, judgment, imagination, spiritual experience, and metaphor.

In the section of my thesis I plan to present, I will focus on the relationship between wonder, attention, and judgment. Judgment is defined here as "a final ruling on what something is and could possibly be." As a perceptual phenomenon, judgment prohibits attention, and attention is necessary to experience wonder. I will explore the relationship between these three modes of experience, including on the benefits and drawbacks of each, and also talk a bit about play and imagination.

**Efficiently finding the smallest k values in a large Cartesian product of lists**  
*Author(s):* Patrick Kreitzberg, Kyle Lucke  
*UM Faculty Mentor:* Oliver Serang, Department of Computer Science  
*Category:* STEM (Science, Technology, Engineering, Mathematics)

**Abstract / Artist Statement:**  
If you are on a budget, how may you go about finding the best drink and entrée combination at a restaurant? You may simple choose the least expensive items, but a water and side salad is not a great dinner. Instead, you may want to judge the ten least expensive drink and entrée combinations to pick your favorite. If you create a list of drink prices and a list of entrée prices, then all possible combinations of a drink and an entrée would be the Cartesian product of the two lists. Then, you would want to choose from the ten least expensive meals produced by the Cartesian product.

Finding the smallest k values from the Cartesian product \( X+Y \), where \( X \) and \( Y \) are lists of values \( X = \{x_1, x_2, \ldots\} \), \( Y = \{y_1, y_2, \ldots\} \), is a well-studied fundamental problem of computer science. There have been several methods which solve this problem with a runtime proportional to \( n + k \), where \( n \) is the length of the lists. This is the best runtime possible since all input and output values much be touched at least once. The generalization of the problem, where the Cartesian product is on many lists \( X_1+X_2+\cdots+X_m \), has never seen a fast algorithm. We present an algorithm for the generalization which is faster than \( m\cdot n + k\cdot m \). This is remarkable because to load \( m \) lists, each with \( n \) values, has runtime \( m\cdot n \) and looking up k values in \( m \) lists has runtime \( k\cdot m \).

In computer science, there are many different structures used to store data. In order to get a fast runtime, we use a new data structure called a "layer-ordered heap" which gives information about the ordering of the values in a list while still not completely sorting the data. It may seem intuitive to use sorting since we want to find the smallest values; however, sorting a list of k values has a runtime of at least \( k\cdot \log(k) \). In the runtime of our method, we want the term which grows with \( k \) to be faster than \( k\cdot \log(k) \) so we can not use sorting. Keeping the data organized in such a way that it has some ordering to it but is not completely sorted is the key to our algorithm.

One important application of our algorithm is to calculate the most abundant isotopes of a molecule. The isotopes of an element (e.g. oxygen) are all the ways in which an element may have a different number of neutrons. For example, carbon dioxide CO\(_2\) is made up of one carbon and two oxygens. Carbon has two isotopes which appear in nature, 12C and 13C, while oxygen has three, 16O, 17O, and 18O. This means that carbon and oxygen may naturally form six different combinations of isotopes, which is the Cartesian product of three lists: \{12C, 13C\}, \{16O, 17O, 18O\}, and \{16O, 17O, 18O\}. Six possible isotopes may seem trivial, but for very large molecules there may be millions of possible isotopes, being able to efficiently compute only the top k is very helpful.

**Complicity in Climate Change**  
*Author(s):* Shalom Kristanugraha  
*UM Faculty Mentor:* Christopher Preston, Philosophy  
*Category:* Social Sciences/Humanities

**Abstract / Artist Statement:**  
Complicity has come to the fore as the defining mode of moral relationship in our time of climate crisis. That climate change arises out of global structures of exchange and exploitation make bare the fact that any and all who participate in modern life are in some shape or form complicit in the suffering and dying of many forms of life. While complicity, or
"the state of being an accomplice, partnership in wrongdoing or an objectionable act,” is by no means a new kind of moral relationship, never have we had to reckon with it at so large a scale and across so many domains.

As many climate ethicists (such as Stephen Gardiner, Dale Jamieson, and Elizabeth Cripps) have pointed out, the dominant varieties of moral and ethical thinking available to us today fail to help us engage well with complicity. In fact, the opposite seems to be true (at least in many a liberal democratic developed nation). Arguably, it is the case that cultural, political, and ethical traditions arising from a Western philosophical tradition—given their individualistic focus—hamper our ability to comprehend and address complicity in large scale and undirected collective harms. In light of the climate crisis and on an individual level, the lack of clear ways to engage with one’s complicity in global harms have resulted in real psychological distress (i.e., ‘eco-anxiety’), paralysis, and overwhelm for many persons who live in affluent and high-emitting nations (such as the USA). This in turn inhibits the development of a robust political will in these countries necessary to bring about the drastic changes needed for all of us to avoid the worst consequences of climate change.

In this project, I seek to help develop an account of complicity that better enable us to honestly, justly, and effectively act out and from the fact of our complicity, specifically in light of the climate crisis. First, I shall make an argument as to why we must at least try to revise the ethical paradigms we have inherited from Western tradition, instead of replacing it completely. Towards this end, I shall draw on contemporary philosophical work on complicity, focusing specifically on Christopher Kutz and Iris Marion Young. I shall analyze how their respective approaches stand when applied to the peculiar spatiotemporal features of our climate crisis. Noting where their accounts fall short, I shall work to synthesize their approaches to come to a theory of complicity that will help the average individual—particularly those who live in high-polluting nations states—to understand their positionality and act ethically in the face of climate crisis. I argue in conclusion that, far from being an intractable and lamentable moral problem, the fact of our global, inescapable, and ubiquitous complicity provides fertile ground for the growth of a new global ethics. Understanding complicity beyond the rigid framework of blame and guilt paves the way for the emergence of new and revolutionary social imaginaries that will enable us to better address the climate crisis.

**Generation, Characterization & Reactivity of a Novel High-Valent Cobalt-Oxo Species**

**Author(s):** Yubin Kwon  
**UM Faculty Mentor:** Dong Wang, Chemistry  
**Category:** STEM (Science, Technology, Engineering, Mathematics)

**Abstract / Artist Statement:**
Terminal metal-oxo species are key intermediates in many biological systems such as the mononuclear non-heme iron (Fe) oxygenases that utilize Fe(IV)-oxo intermediates to initiate oxidative transformations and many other reactions that are done in nature. A terminally bound oxo ligand is a double or triple bound oxygen atom and acts as a multielectron donor to the metal. To this day, the chemical and physical properties of these species remain elusive. One way to observe and understand these properties are to design synthetic models of these intermediates.

The generation of stable high-valent metal-oxo complexes for late-transition metals is challenging synthetically. There have been many models that have been studied and are stable up to group 8 on the late transition metal block (d-block) of the Periodic Table of Elements. Complexes of the early transition elements (groups 3-6) are extremely stable and abundant. The mid-transition elements (groups 7-8) are more reactive and are the most investigated. It has been reported of Mn and Fe models showing the structural and electronic properties and substrate oxidation reactivities. As we go beyond group 9 and beyond, the isolation of these complexes are difficult due to the electronic repulsion and high d-electrons. There have been a few but not many reports of high valent metal-oxo late transition metal complexes.

In this work, we synthesized and characterized a series of mononuclear cobalt complexes at different oxidation states of +2, +3 and +4 supported by a dianionic, tridentate ligand. We have conducted a one-electron oxidation of a Co(III)-OH species producing a novel high valent Co(IV)-O containing complex. This complex was characterized using combined spectroscopic methods such as X-ray crystallography, UV-Vis, and EPR. This novel complex is the first Co(IV)-O containing species that is structurally characterized by X-ray crystallography. Furthermore, this complex is able to carry out C-H bond cleavage up to 87 kcal/mol which has not been observed by previously reported species by other groups. This complex that we report will contribute to understand the properties and functions of terminal metal-oxo intermediates utilizing a late transition metal.
Climate Change Impacts on Montana’s Agricultural Water Use
Author(s): Zachary Lauffenburger
UM Faculty Mentor: Marco Maneta, Geosciences
Category: STEM (Science, Technology, Engineering, Mathematics)

Abstract / Artist Statement:
Water resource managers in Montana face difficult choices on adapting water policies that account for the impacts of climate change. In an effort to aid policy makers and natural resource managers an integrated hydro-economic model was developed which simulates hydrologic conditions across Montana, coupled with an economic model of farmers’ decision making. A major gap in the use of hydro-economic models has been the lack of how different climate change scenarios will have on the response to water diversions for irrigation and subsequent response to river discharge downstream. This presentation presents how the integrated hydro-economic of agriculture model can address this gap with application to an important agricultural region of Montana for the assessment of a range of climate change scenarios and policy choices. A suite of Global Climate Models (GCMs) for mid-century and end-of-century were inputs into the model and time series of river discharge and water diversions were analyzed throughout the watershed to quantify changes in water use and demand and how policy choices can impact farmer decision making. The tradeoffs among water policy choices are important to understand how the design of policies aimed at climate change adaptation can affect farmers’ decision and how those policy decisions can ripple downstream.

What is marketing? How has it been applied to conservation?
Author(s): Hannah Leonard
UM Faculty Mentor: Alex Metcalf, Society and Conservation
Category: Social Sciences/Humanities

Abstract / Artist Statement:
This study explores how marketing, holistically defined, has been applied in conservation and what opportunities remain. In completing a systematic review process, we can see the landscape of marketing theories and techniques currently in practice in conservation. The purpose of this systematic review is to outline the gaps and opportunities conservationists have to use marketing tools and techniques to more effectively and efficiently accomplish their goals.

Highly Reactive ColII,IV2(μ-O)2 Diamond Core Complex That Cleaves C−H Bonds
Author(s): Yan Li
UM Faculty Mentor: Dong Wang, Chemistry and Biochemistry
Category: STEM (Science, Technology, Engineering, Mathematics)

Abstract / Artist Statement:
The activation of carbon–hydrogen (C−H) bonds is the first step of functionalizing inert hydrocarbons. This transformation is a key step in many biological and synthetic processes. Nature offers highly efficient and selective solutions for carrying out aliphatic C−H bond functionalization using metalloenzymes that employ earth-abundant transition metals such as iron and copper in the active sites. One representative example is soluble methane monoxygenase (sMMO), a nonheme dinuclear iron-dependent enzyme that catalyzes the hydroxylation of the strong C−H bond of methane (bond dissociation energy BDE = 105 kcal/mol) using O2 as the oxidant. The catalytic cycle of sMMO has been extensively studied over decades and features a high-valent bis-μ-oxo FeIV2(μ-O)2 “diamond core” intermediate called Q as the active oxidant for C−H bond activation. On the other hand, synthetic high-valent model complexes of sMMO-Q have been reported. A number of dinuclear μ-oxo and bis-μ-oxo manganese, iron, and copper complexes exhibited C−H bond cleavage and O−O bond formation activities. However, only one of them, a (μ-oxo)diiron(IV) complex supported by an anionic pentadentate N4O ligand, is capable of activating strong sp3 C−H bonds such as those in cyclohexane (BDE = 99.3 kcal/mol). In contrast, the high-valent diamond core chemistry of cobalt has been much less investigated, likely due to the difficulty of generating high-valent oxocobalt(IV) species for characterization. There is evidence showing that high-valent oxocobalt(IV) species are involved in a number of water oxidation and C−H bond cleavage reactions. To date, six ColII2(μ-O)2 complexes supported by tridentate or bidentate ligands have been structurally characterized. However, no higher-valent derivative is available.

In the present study, we report an unprecedented high-valent ColII,IV2(μ-O)2 complex supported by a tetradeutate tris(2-pyridylmethyl)amine (TPA) ligand. This species can be generated by one-electron oxidation of its ColII2(μ-O)2
precursor. Characterization using combined spectroscopic and computational approaches confirmed that it has a diamond core structure with a short Co····Co distance of 2.78 Å. More importantly, CoIII,IV2(μ-O)2 is highly reactive and activates C−H bonds at a rate constant that is 3–5 orders of magnitude higher than its diiron and dimanganese analogs measured at higher temperatures. Furthermore, the CoIII,IV2(μ-O)2 species can be activated by Lewis bases to enhance its reactivity towards C-H bonds. We also discovered that CoIII,IV2(μ-O)(μ-OH), the protonated form of CoIII2(μ-O)2, is the intermediate in the reaction of CoIII,IV2(μ-O)2 with C-H bonds, allowing us to understand such reactivity from a thermodynamic aspect. These interesting findings shed light on better understanding of the high-valent diamond core chemistry for cobalt and inspire future development of more effective approaches for C−H bond activation by bioinspired dicobalt complexes.

**College Students' Social Media Uses and Emotional Correlates**

**Author(s):** Jennifer Lippold  
**UM Faculty Mentor:** Duncan Campbell, Clinical Psychology  
**Category:** Social Sciences/Humanities

**Abstract / Artist Statement:**

Given the high prevalence of mental health conditions such as depression and anxiety among college students, research on social media use, a salient feature of the modern college experience, is increasingly warranted. While research documents a link between negative psychological symptomology and social media use, few studies have examined what specific patterns of use may be more or less harmful than others. Therefore, the present study investigated whether specific types of social media use are more or less strongly associated with psychological distress among college students. Specifically, we examined socially oriented uses, information seeking (e.g., news consumption) uses, and entertainment uses and investigated whether differential relationships exist between use types and emotional variables. Based on prior literature, we expected social use to be related to depression, information seeking use to be related to anxiety, and entertainment use to be related to positive emotion. Our sample of 206 undergraduate students completed a cross sectional survey of social media use, depression and anxiety symptoms, and positive and negative emotion. Utilizing four hierarchical linear regression models, we examined the degree to which the different types of social media use account for the variance in our four mood criterion variables. Contrary to our hypotheses, none of the three types of use were significant predictors of depression, anxiety, or positive emotion (ps>.05). However, both social and information seeking use were found to be significant predictors of negative emotion, such that higher social use predicted lower negative emotion ($B = -.218, t(197) = -2.198, p < .01$). These results suggest that while these three types of social media use may not have differential relationships with specific symptoms of psychopathology, social and information seeking use do seem related to more global experiences of negative emotion. Further, while the link between information seeking and negative mood reflects findings in other research on news exposure, our findings on social use and lower negative emotion were unexpected given prior documentation of a link between socially oriented uses and increased psychological distress and depression symptoms. Our findings suggest that the relationship between socially oriented use of social media and negative emotion is likely more complex than previously suggested, with the possibility for both harmful and beneficial impacts of interacting with others online. Thus, our research adds to the growing number of studies that suggest that the relationship between social media and psychological symptoms may be less pessimistic than previously thought. While some social media uses, such as consuming news, may relate to negative emotions, using social media to connect with others may actually be related to positive psychological outcomes.

**Towards a General Protein Inference Model**

**Author(s):** Kyle Lucke  
**UM Faculty Mentor:** Oliver Serang, Department of Computer Science  
**Category:** STEM (Science, Technology, Engineering, Mathematics)

**Abstract / Artist Statement:**

While the genome gives us a large amount of information about an organism, it does not tell us everything. Each cell in the human body is genetically identical to one another, so what causes cells to differentiate from one another? The genes expressed by a particular cell determine which proteins the cell produces, which in turn determine a cell's form and function. Samples are typically intact proteins, which are hard to work with. The proteins are broken down into their constituent parts and then ran through a mass spectrometry machine to determine which peptides are present in the sample. The resulting peptides are then used to infer, or determine, which proteins were present in the sample.
Deciding what our set of candidate proteins should be is a difficult problem that is still an active area of research. From these candidate proteins, protein inference methods seek to determine a final subset of proteins which are actually present in the sample.

Protein inference has many important applications in medicine: aiding in the creation of new drugs to target certain diseases and improving medical diagnostics. Protein inference also plays a pivotal role in developing our understanding of the biology of living systems.

Now that we have a set of proteins and a set of peptides, we would like to visualize the relationship between proteins and peptides. One column is formed with the proteins and another is formed with the peptides. A line is drawn between a protein and a peptide if it is known that the peptide is part of the protein. Every peptide the protein is connected to is supporting evidence for the presence of the protein in the sample.

Though protein inference is a new field, many different methods to solve this problem have been discovered. Early methods were simple: if a protein is connected to a given number of peptides, the protein is considered to be present in the sample. Although these types of methods are simple to understand, they are not very informative. Further, because multiple proteins can be adjacent to the same peptide, some of these methods are also easily confused.

Current state of the art methods create these structures which connect proteins to peptides and then score each protein according to a set of rules based on the number of peptides a protein is connected to. These types of models are much more informative and they are able to much more easily incorporate additional information into them.

We present a new method, which is based on a set of fundamental rules that should be obeyed by any good model. For instance, one basic rule would be the more peptides a protein is connected to the more we think the protein is actually present in the sample. Since our model is based on these fundamental rules, it encompasses many other models which already implicitly follow these rules.

As Much for Your Sake: Gay History in Performance
Author(s): Shane Lutz
UM Faculty Mentor: Bernadette Sweeney, School of Theatre & Dance
Category: Visual & Performing Arts

Abstract / Artist Statement:
As Much for Your Sake is a play devised from letters sent between gay and queer men in the 20th Century as they document their experiences in life, loss, and love. The work highlights the narratives and outlooks of LGBTQ folks in order to give visibility to our vibrant past. An intimate look at these letters in performance allows us to consider how oppression and resistance within the queer community has changed. And yet, in many ways the issues faced by these individuals remain as pertinent today as they did in a time when being gay was illegal, dangerous, and often deadly.

My research began with Rictor Norton’s anthology My Dear Boy, a collection of letters between gay men beginning with Marcus Aurelius in 180 AD. I went through hundreds of correspondences across millennia, searching for throughlines, patterns, and shared experiences. I quickly discovered the mammoth of a project I had before me and simply began putting the letters in order, working meticulously to slowly build a narrative. I honed in on the correspondences from the 20th Century as the language remained more accessible to an audience, allowing me to leave much of the material completely unedited. This type of work in which a performance is built out of found material—in this case written letters—is known as Verbatim Theatre. The product of this effort became As Much For Your Sake.

The play offers visibility to a community whose rich and colorful past remains eclipsed by the larger hegemonic perspective of history. LGBTQ people have always been here and we continue to exist today. However, in 2020, we have the opportunity to claim space in a way that the authors of the letters in My Dear Boy cannot due to a myriad of pressures and obstacles. As Much for Your Sake asks us to consider our place in the construction of the future and what we will leave behind in ten, a hundred, a thousand years. What are we fighting for today that generations yet to come will reap? This Verbatim performance celebrates the past, emphasizing its value and importance in knowing who we are today. However, at its core the three characters in the play—stand-ins for real people in real places having real experiences—remind us that life is a fleeting thing, love is worth fighting for, and we have no guarantee that there will be a tomorrow. All you can do is be grateful for today and proudly embrace your role in the great construction of history.
Native tree species enhance ecological integrity of unproductive teak plantations

Author(s): Abigail Marshall
UM Faculty Mentor: Cara Nelson, W.A. Franke College of Forestry and Conservation
Category: STEM (Science, Technology, Engineering, Mathematics)

Abstract / Artist Statement:
As interest in managing forests for ecosystem services grows, forest restoration increasingly seeks to maximize synergies rather than balance trade-offs in the driving forces of ecological, social and economic benefits. The Panama Canal Watershed (PCW) is a uniquely appropriate case study in reforestation, for its outstanding value in these multiple regards and the direct linkages between desired services. The area is home to nearly half of Panama’s population and the Canal directly generates >15% of the Panamanian government’s annual revenue. The PCW also provides a critical global trade route and an international tourism destination. But in addition to these economic and social values, the Canal is fundamentally a waterway; perhaps the greatest potential threat to Canal function is insufficient dry-season water availability. Restoration and maintenance of forest cover can help mitigate this threat by providing a “sponge effect” of buffering seasonal high- and low-flows. Additionally, PCW forests store carbon, provide wildlife habitat, and support rural employment and eco-tourism.

In Panama, many native timber species are highly-valued and managed using Traditional Ecological Knowledge (TEK) in both indigenous and Latino rural communities. However, larger-scale reforestation efforts common in the PCW do not incorporate TEK; the vast majority of PCW plantations consist of a single exotic timber species, teak (Tectonia grandis). While teak is renowned as a high-value tropical wood, the acidic clay soils in much of the PCW result in low harvests, which in many cases are less profitable than even traditional cattle ranching. Considering that financial incentive is crucial to participation in reforestation programs, it is clear that a more-profitable alternative is needed for successful reforestation of the PCW.

In collaboration with the Smithsonian Tropical Research Institute (STRI), my research seeks to address the disconnect between TEK and ongoing reforestation efforts by integrating native timber species into PCW teak plantations. Specifically, I am testing the viability of enrichment planting (the addition of target species to the understory of established forests) as a technique for incorporating shade-tolerant native species into existing plantations. Although enrichment planting has been successfully implemented worldwide, results vary across sites and are contingent on correct pairing of species and site conditions. This study is the first to my knowledge to experimentally test enrichment planting in the context of teak plantations, which are widely thought to suppress understory growth.

In an ongoing field trial at a STRI research site and private plantations in the PCW, I am assisting with monitoring growth and survival of over 3,000 enrichment planting seedling of six native species. I am interested in whether the growth of seedlings is related to light availability and crowding from neighboring teak, and whether chemical fertilizer application can improve seedling performance. Promising early results suggest that enrichment planting is a viable technique for increasing reforestation and native timber production in the PCW. This strategy could provide an option for land managers seeking to add both ecological and economic value to underperforming teak plantations. Findings also offer an opportunity to address broader ecological questions related to competition and biotic interactions within tree plantations.

Whitebark Pine ecology and management: synthesizing current understanding

Author(s): Enzo Paolo Martelli Moya
UM Faculty Mentor: Cara R. Nelson, Department of Ecosystem and Conservation Sciences
Category: STEM (Science, Technology, Engineering, Mathematics)

Abstract / Artist Statement:
Whitebark pine (Pinus albicaulis), an ecologically important tree species of high-elevation ecosystems of western North America, is declining across most of its range due to the combined effects of an invasive pathogen (blister rust; Cronartium ribicola) and a native insect (mountain pine beetle; Dendroctonus ponderosae), as well as climate-change-induced increases in wildfire frequency and severity. Concern over these threats to whitebark pine as well as successional replacement by shade-tolerant firs has led to its listing under both the US and Canadian Endangered Species Acts and an increase in research activities. In addition, management agencies have adopted coordinated,
trans-boundary restoration strategies (e.g., Range-Wide Restoration Strategy for Whitebark Pine and the National Whitebark Pine Restoration Plan) that call for silvicultural treatments and prescribed burning, among other interventions. Despite a growing literature and widespread agreement on the need for conservation and restoration, there is little synthetic information on the species ecology, successional dynamics, and response to management interventions. In order to identify gaps in knowledge and improve restoration strategies for white bark pine, we conducted a literature review on the status of knowledge on the species in general. Specifically, we identified all publications listed on Web of Science and grey literature available on AGRICOLA (National Agricultural Library, USDA) from 1950 to 2018 using the search terms whitebark pine and “Pinus albicaulis”. We only reviewed articles that mentioned the species in the abstract or title, or studies in which whitebark pine ecosystems were a main focus.

Although the number of published articles has been increasing over the last 30 years, most studies focused on biotic interactions (27%), pathogens and MPB outbreaks (39%), mortality (35%), and regeneration dynamics (25%). On the other hand, there was very little available information on the efficacy and effects of restoration and other management activities (less than 10% of all articles). There were also few articles published on the species life history, fire ecology and successional dynamics. Our findings indicate a significant gap in information required for effective conservation and restoration of whitebark pine. To improve capacity for successful management of whitebark pine, there is a need to invest in research that aligns with conservation needs.

Enhancing the Impact of Behavioral Activation via Prospection

Author(s): Chelsey Maxson, Craig McFarland, Victoria Templin, Caelan Cummings
UM Faculty Mentor: Craig McFarland, Psychology
Category: Social Sciences/Humanities

Abstract / Artist Statement:
Prospection involves imagining future events. When people engage in positive prospections, they report increased engagement in imagined future behaviors. This study sought to increase behavioral engagement by combining prospection with a behavioral activation intervention (behavioral activation-based prospection [BAP]). In this experimental design, participants (N = 54) placed in two groups (the BAP group and a control group [BA]) identified two target activities they wanted to engage in (phase one) over a one-week intervention period (phase two). After identifying the target activities, participants in the BAP group imagined themselves engaging in these activities and completing their frequency goals. In support of our hypothesis, behavioral activation-based prospection engendered more detailed representations of prospective activities than behavioral activation (BA) alone. However, contrary, to our hypothesis increased access to details of prospective activities did not result in significant between group differences in behavioral engagement. That is, both groups increased engagement in target activities from time one (baseline) to time two (post-intervention week). A variety of clinical populations have deficits in prospection, specifically, detail generation. Relevance of results to behavioral activation-based prospection interventions for clinical and non-clinical populations will be discussed.

The Proximity Principle as used in Blocking 360 Video

Author(s): David Mills-Low
UM Faculty Mentor: Bernadette Sweeney, Theatre
Category: Visual & Performing Arts

Abstract / Artist Statement:
My work involves taking my experiences working as an actor and director in the theatre and my experiences working in film, and melding them together in the medium of 360 degree filmmaking. This new medium allows the filmmaker, through the use of a Virtual Reality headset, to place the audience into the middle of the action of a performance setting. By utilizing elements of the Proximity Principle, a concept from social psychology that influences our attitudes toward one another based on proximity, and the Proximity effect, utilized by sound engineers to demonstrate intimateness of subject based on the resonances captured by microphones due to proximity to the user, I explore models for blocking performers in virtual spaces and 360 camera setups. By utilizing proximity principles, we influence the relation between audience and performers before the actors even say anything. I will be demonstrating my elements of my research through explanation, object lessons utilizing members of the audience, and samples of the effects in action for as many of the audience as I can get through my cadre of VR headsets. This research is part of a tutorial series that I am developing for teaching 360 filmmaking, which is part of my thesis work in both Theatre and Media Arts.
Understanding large-landscape conservation and global networks of practitioners

Author(s): Sanober Mirza
UM Faculty Mentor: Jennifer Thomsen, Society and Conservation
Category: Social Sciences/Humanities

Abstract / Artist Statement:
With pressing climate change and environmental degradation threatening communities and livelihoods around the world, conservationists are looking for new methods, fields, and approaches to protect the environment. These new fields of conservation are gaining momentum because they are more holistic, creative, and wide-ranging, responding to research on the increased importance of ecosystem connectivity. Large-landscape and transboundary conservation are examples of these newer concepts that are redefining how we conserve ecosystems, wildlife, and resources. Large-landscape conservation prioritizes ecological connectivity beyond traditional ecosystem boundaries, such as national park limits. Transboundary conservation, a distinct form of large-landscape conservation, operates across political and spatial scales by involving two or more countries cooperating to protect a border resource or ecosystem (Andonova et al. 2009). Large-landscape and transboundary conservation highlight larger areas and units of conservation than traditional conservation practices have in the past. Though the recognition of their importance is growing, there is little known about these fields and how they are currently being practiced. We still do not know how large-landscape conservation is best carried out and represented across the world.

This study evaluated trends and aspects of the large-landscape and transboundary conservation fields as well as factors that influence their practices. Specifically, two International Union for the Conservation of Nature (IUCN) Specialist Groups on Transboundary and Connectivity Conservation were surveyed to understand perspectives on what defines conservation success. The survey also explored topics such as local community involvement, challenges faced, and landscape-scale governance. I prepared an electronic survey using the Qualtrics Survey Platform and collaborated with the Chairs of both IUCN Groups to distribute the survey to their members. This study is the first assessment of the field of large-landscape conservation in practice. The results of this study increase our understandings of large-landscape and transboundary conservation and inform best practices to increase success of these initiatives by identifying gaps and progress. Finally, this study builds new networks of information exchange and practitioner resources to help improve conservation strategies in the future in terms of efficacy, inclusivity, and more. These improvements in the field will move our society towards better and more equitable climate change solutions as working across boundaries has become necessary to solve the world’s most pressing issue.

Social Trust and River Restoration in the Clark Fork Watershed in Montana

Author(s): Megan Moore
UM Faculty Mentor: Elizabeth Metcalf, Society and Conservation
Category: Social Sciences/Humanities

Abstract / Artist Statement:
The Clark Fork Watershed in southwest Montana comprises the northern headwaters of the Columbia River. The watershed is important for human communities such as ranchers, anglers, recreationists, and tourists as well as various ecosystems. The Clark Fork is also home to one of the largest Superfund sites in the United States. Since the Superfund designation in 1983, agencies, nonprofit organizations, and stakeholders have worked to implement cleanup strategies. River restoration has become one of the prominent cleanup strategies. River restoration often focuses on the biophysical aspects of the river, neglecting the broader social implications. There is growing recognition to better integrate the social aspect into the river restoration process. The concept of social trust has emerged in natural resource management as a potential strategy to foster public participation and collaboration. This research examines the role of social trust in community acceptance of river restoration. Previous research has identified that trust is important for the success of a river restoration project, but has not examined specific strategies to build trust in this context. Findings from interviews with stakeholders will be discussed which highlight new opportunities for engagement and participation. This research will be shared with community members and agency officials to help facilitate better trust in the future.
Collective Aspects of Mitigating Interactions Between Large Carnivores and Humans

Author(s): Holly Nesbitt
UM Faculty Mentor: Alex Metcalf, Society & Conservation, College of Forestry & Conservation
Category: Social Sciences/Humanities

Abstract / Artist Statement:
Understanding how to coexist with wildlife is of critical importance for successful conservation, particularly for large carnivores, who pose risks to human safety, livestock, and game species. In Montana (USA), black and grizzly bears occur across much of the western half of the state. In particular, grizzly bears are protected by the Endangered Species Act and their populations and ranges are expanding, resulting in increased overlap between humans and bears. Interactions with bears can be mitigated when landowners take certain actions to secure bear attractants – such as using bear resistant garbage cans and feed storage, using electric fences, removing livestock carcasses, and taking down bird feeders in the spring and fall. Few studies have examined what drives uptake of these actions, but factors include perceived risks and benefits and personal experience at the individual level. This research aims to understand how individual and collective aspects drive uptake of actions to secure bear attractants. We administered a mail-back questionnaire to Montana landowners and used the collective interest model to determine the relative effects of collective and individual factors in influencing whether landowners secure bear attractants. We developed logistic regression models for each behavior. Collective aspects that drove behavior included social norms (i.e., what individuals think they should do and what others are doing) and network centrality (i.e., how much social influence an individual has). This research suggests that outreach campaigns that only highlight the risks of large carnivores could be substantially improved by describing the collective aspects of mitigation.

Is it Human? Engaging in the academic and forensic applications of Zooarchaeology

Author(s): Haley O'Brien
UM Faculty Mentor: Kirsten Green Mink, Anthropology
Category: Social Sciences/Humanities

Abstract / Artist Statement:
Zooarchaeology is the study and identification of animal skeletal remains and their relationship with human interaction. It is a heavily methodologically based, world-wide discipline that can be uniquely tailored to the context and research question of the archaeological site/region under review. It requires a significant amount of hands-on training in order to identify bone fragments to the most specific species level and element possible using the size, shape, and density of the remains. When expanding the analyst’s view to the other variables that can be considered, measures such as burning, cut marks, tooth marks, and fracture types can build a larger picture of human relationships with animals in the environment. While looking at faunal analysis through this lens, zooarchaeology falls into a more traditional archaeological application of using animal bones to help reconstruct past environments. By shifting to a more modern context, though, species identification is an invaluable skill used to differentiate human from non-human bones in forensic contexts. This can quickly help determine the forensic significance of a set of remains and whether further recovery is necessary. While most zooarchaeologists are capable of basic species identification, many are not trained in human osteology and require further education to better round out their available skillset when in the field as educators, consultants, and researchers.

This poster will focus on two case studies on the different applications of zooarchaeological techniques in archaeology and forensics. The archaeological case study will examine the faunal remains from site 48PA551, located in the Sunlight Basin of Northwest Wyoming, dated to the Middle Archaic period (ca. 3800-4400 radiocarbon years BP). This includes a discussion of the variables analyzed and some general conclusions about human interactions with the environment based on the faunal data. The forensic case study will review a case presented to the University of Montana Forensic Anthropology Lab (UMFAL) in 2017 involving comingled human and animal remains and the ability to provide law enforcement with a well-rounded biological profile and forensic report based on the ability to identify the faunal remains more specifically than non-human and not of forensic significance.

At a university that has one of the largest comparative collections of North American animals in the country, the Philip L. Wright Zoological Museum (UMZM), and the availability of a human osteological collection, the University of Montana Forensic Collection (UMFC) housed with the anthropology department, the ability to teach and provide technical lab training for both undergraduate and graduate students alike is a real possibility. Further engagement in both the law enforcement and archaeological communities could provide students with abundant opportunities to learn
widely marketable, interdisciplinary lab skills using biology, zoology, anatomy, and anthropology not available at many higher education institutions across the country.

**Lion Hearted Originalism and the Second Amendment**

**Author(s):** Logan Olson  
**UM Faculty Mentor:** Anthony Johnstone, School of Law  
**Category:** Social Sciences/Humanities

**Abstract / Artist Statement:**  
This presentation serves as a guide to a lion hearted originalist interpretation of the Second Amendment to the United States Constitution. Part one of the presentation focuses on analyzing originalism and defining lion hearted originalism by detailing original meaning theory, the underpinning of lion hearted originalism, and explaining what lion hearted originalism is and why it is the superior theory for interpreting the Constitution. Part one ends with a brief introduction of D.C. v. Heller, the case in which the U.S. Supreme Court decided both that the Second Amendment protected an individual right to "keep and bear arms," and that the government cannot ban an entire class of weapons "commonly used by law abiding citizens for lawful purposes."

Part two provides a morth in-depth review of the late Justice Scalia’s majority opinion in D.C. v. Heller, touching on the phenomenal originalist analysis done by Scalia through the bulk of his majority opinion as well as the contradictory nature of Scalia’s opinion where it relies on U.S. v. Miller, under which Scalia erroneously restricts the individual right to keep and bear arms to only those weapons commonly used by law abiding citizens for lawful purposes. Part two also provides a brief overview of the questionable history surrounding the 1939 Miller case.

Part three provides an analysis of and answer to what sort of "arms" should rightfully be protected by the Second Amendment under a lion hearted originalist interpretation.

Part four explains why now, more than ever, the Supreme Court must act as lion hearted originalists and abandon those parts of Heller which rely on Miller if the Court is to provide the most stable interpretive foundation of the Second Amendment moving forward.

**Making Sense of Robustness Through the Modal Understanding Framework**

**Author(s):** Grayson O'Reilly  
**UM Faculty Mentor:** Soazig Le Bihan, Philosophy  
**Category:** Social Sciences/Humanities

**Abstract / Artist Statement:**  
I track the robustness discourse beginning with Richard Levins’ influential 1966 article followed by Steven Orzack and Elliott Sober’s response, and then highlight contemporary philosophers in order to demonstrate the problematic nature of robustness. Through this discourse I arrive at a clear picture of the capabilities and shortcomings of robustness and demonstrate that we require a more flexible framework of scientific understanding in order to make sense of robustness given our current intuitions and practices and in the face of an urgent climate crisis. I argue that Soazig Le Bihan’s modal view does just that. I lay out how we may make sense of robustness through the modal view of understanding by showing the way in which robustness reveals how various representations of the target phenomena could relate in possible worlds and constitutes understanding. From this type navigating power follows heuristic value. So by definition, robustness provides modal understanding and is thus epistemically valuable. This allows us to make sense of our intuition that seems to indicate that robust theorems, while they may not say anything about the real world, are still valuable. Finally, I look at several studies examining ice sheet/ice shelf models in order to demonstrate how a modal understanding of robustness may look in practice.

**The Queen of Borrowed Light: the founding of Hollywood as a trauma reaction, its consequences and possible reparations.**

**Author(s):** Gabrielle Patterson  
**UM Faculty Mentor:** Michael Murphy, Media Arts  
**Category:** Social Sciences/Humanities
Characterizing sub-micron metal particles in a mine waste contaminated river to better understand potential exposure

Author(s): Kaitlin Perkins
UM Faculty Mentor: Benjamin P. Colman, Department of Ecosystem and Conservation Sciences
Category: STEM (Science, Technology, Engineering, Mathematics)

Abstract / Artist Statement:
Mine waste is a global issue that has resulted in widespread contamination of rivers and streams with metals. Waterborne metal pollutants from mining and resource extraction adversely impact rivers and streams including altering chemical signaling by organisms, egg fertilization rates, diversity, productivity, and decomposition. The exposure of organisms to metal and metalloid contaminants is determined through measurements of metal concentrations, with those concentrations typically measured on the dissolved fraction, or that which passes through a filter. Metals in this fraction have typically been thought to be dominated by free ions, and the mode of accumulation by organisms was thought to be through their uptake. As such, these filtered concentrations are what is used to guide water quality standards and restoration goals at contaminated sites. However, this view ignores the fact that a large fraction of what is in this fraction may not be dissolved at all, but rather, may be colloidal particles. These colloidal particles are may be important in driving the exposure of aquatic organisms through dietary pathways, rather than uptake of free ions. While colloidal particles have been extensively studied in laboratory settings, their abundance and composition in contaminated rivers and streams are less well understood. To better understand the forms of metals and metalloids that organisms are exposed to in a contaminated river, samples were collected from the Upper Clark Fork River during baseflow and analyzed to determine the abundance and composition of colloidal particles. Using an advanced technique in spectrometry that allows us to characterize the dominant elements in individual colloidal particles (single-particle inductively coupled plasma time of flight mass spectrometry), we characterized the composition, concentration, and size of metal and metalloid-containing particles. Preliminary results support the idea that the filtered fraction contains a high concentration of particles, with those particles containing the toxic elements arsenic, copper, lead, and zinc. This suggests that just accounting for free ion toxicity in filtered samples may not accurately assess the exposure of organisms to metal and metalloid contaminants. Further, this may help explain contradictory results between laboratory experiments with free ions and patterns in rivers and streams with both colloidal and free metal ions.

An Interpretive Endeavor to Apply Musical Interlude to The Two Character Play
By Tennessee Williams

Author(s): Peter Philips
UM Faculty Mentor: Peter Philips, Interdisciplianry Ph.D
Category: Visual & Performing Arts

Abstract / Artist Statement:
The Two Character Play, a metatheatrical masterpiece of deep expressionistic autobiographic content, presents a rare opportunity to find and blend various musical genres with immediate passionate character emotionality such that the intensity of the immediate human situation may be underscored by appropriate musical background.

Felice and Clare, brother and sister in The Two Character Play, are thought to represent Tennessee Williams’s conflicted emotions to what he perceived as man’s struggle to comprehend the loneliness and isolation suffered by human beings within their personal circumstances, suggesting not just a subjective phantasmagoric nightmarish world but the true world with all its dismaying shapes and shadows.

"...the spirit of Jewish history began to be falsified, not merely because the Jews had abandoned the desire to make themselves an individual force in history, but because they tried to relieve the tension by means of innumerable concessions to those about them... thus they hoped to create a Judaism that was inconspicuous, that is to say, to make it survive as an innocuous concept and to exterminate it as a living force with perfect and unique legitimate rights of its own." - History and Destiny of the Jews by Josef Kastein, 1933
The play deals centrally with fear, as the two “actors” Felice and Clare enact a tale of siblings living together in the home where their father, after murdering their mother, committed suicide. The play’s siblings represent Williams and his sister Rose raised within a markedly dysfunctional family, the children trapped within the confines of frightening and confusing emotional cross currents.

The character’s neurotic behavior driven by deep insecurities and fears, ambivalence toward their own personal lives and the lives of the characters they portray, lends itself to musical interpretation. After research into the psychological manifestations of such neurotic behavior I sought music I felt would best describe the atmospheric ambience of distress, fear, hopelessness, manic behavioral moments, solitude, loneliness and personal entrapment. A musical plot structure has been developed to test the effect music might generate within an audience experiencing the troubling pathos of the two protagonists.

The project would be best served by stage readings with knowledgeable actors and audience members fully engage to determine how applying various musical backgrounds to specific moments outlined in the musical plot structure affects audience response to difficult moments of humanistic disquiet.

Diet-Breadth Analysis in the Southwest: Comparison of Metabarcoding and Shotgun Sequencing Methods with Coprolites

Author(s): Paige Plattner
UM Faculty Mentor: Meradeth Snow, Anthropology
Category: Social Sciences/Humanities

Abstract / Artist Statement:
Maize was a dietary staple in the Southwest, but the full breadth and extent to which the population was dependent on crop yield has remained unclear across time and space. The ability to capture diet-breadth from past populations using the archaeological record can be potentially biased due to lack of preservation. Several new techniques have been developed to study this further through genomic analysis of human coprolites. Samples from two sites across the American Southwest have been analyzed with two different techniques in order to aid in establishing a better baseline for the molecular approaches available for the reconstruction of past diets. These sites allow for a cross-cut of time and region in order to better estimate the timing and extent of the intensification of maize and other components of the diet in the Basketmaker/Pueblo periods. The Boomerang Shelter archaeological site is located in the southeast corner of the contemporary state of Utah in the Four Corners region of the United States. The Boomerang site is an early example of Basketmaker II in the Cedar Mesa region. The second site, the Marsh Pass Marsh Pass alcove, actually consists of the sites of White Dog Cave, Kinboko Caves I and II, and the Woodchuck Cave excavated in 1934. They belong to the Black Mesa site group and the Marsh Pass alcove specifically has produced radiocarbon dates on maize that range from 500 B.C. to 100 B.C.

This research quantifies and compares the results of the economical metabarcoding (PCR-based NGS sequencing) and deep HiSeq shotgun sequencing methods for future inquiries regarding the agricultural integration process in past populations. With the drop in Next Generation sequencing prices, the PCR-based method of targeted metabarcoding diet analysis provides a more economical approach for molecular anthropologists and archeologists. However, metabarcoding cannot produce the same number of reads as deep shotgun HiSeq runs. Additionally, metabarcoding has the potential of missing species and data due to drop-out, or out-competition by more abundant species. It was hypothesized that the deep-reads of the HiSeq sequencing will yield more data on the flora and fauna DNA present in the coprolites than the metabarcoding data due to HiSeq shotgun method providing a wider scope of DNA without the problematic loss of data anticipated with the metabarcoding protocol.

To test this, the DNA strands of different known species were isolated from background bacterial sequences and compared in the NCIB (National Center for Biotechnology Information) database using the nucleotide BLAST feature. The results of metabarcoding were limited to plants and vertebrate animals consumed, due to the nature of the PCR-primers that targeted these species. Alternatively, the broad range and deep data of shotgun sequencing has yielded higher quality results with more coverage and confidence. This research concludes that the choice of ancientDNA techniques ought to be considered with a cost-value comparison for the needs of individual projects.
DNA integrity in forensic samples
Author(s): Samantha Ramey, Meradeth Snow
UM Faculty Mentor: Meradeth Snow, Anthropology
Category: Social Sciences/Humanities

Abstract / Artist Statement:
DNA can be a vital piece of evidence in a court of law; therefore, the integrity of the DNA is essential. If cross-contamination occurs during storage, then the integrity of the evidence becomes jeopardized. Not only does cross-contamination render the genetic evidence problematic, but if left undetected, it has the potential to link an individual to a case they were not previously associated with or compromise DNA what is associated with a case so that it is unusable. Either scenario is not ideal, and every step should be taken to avoid such a situation. The goal of this project is to test DNA storage methods and environments to determine the best way to avoid potential cross-contamination. Known protocols for storing different types of genetic evidence samples are evaluated. When packaged genetic evidence samples are stored in close proximity to one another, there is a higher chance for cross-contamination.

Studies have been conducted on cross-contamination throughout the investigation process. However, no published studies have examined the potential for contamination during the storage process. This study tested two DNA collection methods for the potential of cross-contamination during storage. Three different dry times of buccal swabs and Whatman cards were tested: none, one hour and 24 hours, in triplicate, and then placed into storage with an uncontaminated sample for one of the following times: 72 hours, 14 days, or 45 days. Cross-contamination was detected in the 72 hours and 45 days blank samples. There was no detection of cross-contamination in any of the blank 14 days samples. The statistics revealed there is a statistical significance for the storage time but not dry time. The fisher exact test yielded a 0.00 p-value (α = 0.05) for the Whatman card, while the buccal swabs yielded a 0.054 p-value (α = 0.05). Cross-contamination was detected upon removal from storage demonstrating that further research is needed to better understand cross-contamination during storage.

Sex-differences in lung disease: the role of hormones and the immune system
Author(s): Jessica Ray
UM Faculty Mentor: Andrij Holian, Center for Environmental Health Sciences
Category: STEM (Science, Technology, Engineering, Mathematics)

Abstract / Artist Statement:
Adverse outcomes following the inhalation of engineered nanomaterials, such as multi-walled carbon nanotubes (MWCNTs), have been identified in occupational settings. Unfortunately, long-term consequences and sensitive populations remain undefined. Chronic respiratory diseases often demonstrate sex-biases in disease prevalence. For example, asthma occurs more often and with increased severity in adult women compared to men. My research has shown that this bias also occurs in a mouse model of MWCNT-induced lung injury. MWCNT-treated female mice develop greater acute lung inflammation and airway hyper-reactivity (AHR) compared to male mice. Therefore, it is logical and necessary to investigate the biological factors that may contribute to these sex-differences. There is experimental and clinical evidence that sex-steroid hormones influence the development of lung disease. A likely target of hormone signaling is alveolar macrophages (AMs), the primary resident immune cell within the lungs. The phenotype and function of AMs is an important factor in promoting specific immune responses to inhaled materials, and may contribute to inadvertent immune-mediated lung injury. My project investigates the role of hormone signaling on AM phenotype and how this contributes to impaired lung function after exposure to MWCNTs. Current literature suggests that estrogen receptor a (ERa) signaling promotes an exaggerated M2a macrophage phenotype. The M2a phenotype promotes antibody production by B cells and is therefore associated with allergy and asthma; MWCNTs have also been shown to induce an M2a phenotype in AMs. Amplification of M2a phenotype polarization can lead to increased production of signaling molecules that cause inappropriate immune cell recruitment and inflammation, which eventually results in increased lung injury and decreased function. These data, combined with my results, provide a potential hormone-dependent mechanism for the increased susceptibility of women to allergens and nanomaterials. This project will address the hypothesis that estrogen signaling through ERa promotes an exaggerated M2a phenotype in female AMs, which contributes to the increased occurrence and severity of particle-induced respiratory diseases in women.
Screening assays fail to predict the full extent of variation caused by PPAR\(\gamma\) drugs

**Author(s):** Mariah Rayl  
**UM Faculty Mentor:** Travis Hughes, Department of Biomedical & Pharmaceutical Sciences  
**Category:** STEM (Science, Technology, Engineering, Mathematics)

**Abstract / Artist Statement:**
As obesity and obesity related diseases become an increasingly common medical problem, drugs to manage the conditions become increasingly necessary. Peroxisome proliferator related receptor gamma (PPAR\(\gamma\)) is a protein targeted by two FDA approved drugs that treat insulin sensitivity in patients with type 2 diabetes mellitus. PPAR\(\gamma\); binds DNA and recruits other proteins to alter cellular transcription in a drug dependent manner. The use of PPAR\(\gamma\); drugs has been limited by significant side effects, leading to the search for selective PPAR\(\gamma\); drugs that induce fewer side effects.

A PPAR response element (PPRE) transactivation assay uses a luminescence reporter which allows researchers to screen drugs based on how they alter transcription. Agonists increase transcription, thereby increasing luminescence. Some partial agonists only slightly increase transcription. Inverse agonists decrease transcription, thereby decreasing luminescence. Most of these drugs never successfully pass clinical trials, but some partial agonists have been found to increase insulin sensitization in mouse models, making PPAR\(\gamma\); partial agonists an attractive drug type.

We compared the RNA sequencing profiles of 11 PPAR\(\gamma\); drugs in human adipocytes to the PPRE luminescence and found that each drug induces a unique transcriptional profile that cannot be entirely explained by the PPRE. The genes whose transcription can be explained by the PPRE are enriched for expected biological processes such as insulin response, cell differeniation and nucleic acid synthesis. The genes whose transcription deviates from the PPRE are enriched for biological processes such as phosphorylation, apoptosis, and many others. Even drugs that are predicted to behave similarly based on the PPRE deviate from one another. This study shows that screening on the drug’s ability to increase transcription fails to capture the true breadth of the drug’s effects.

Cough Desensitization Treatment: A randomized controlled trial

**Author(s):** Jane Reynolds, Sarah Popp  
**UM Faculty Mentor:** Laurie Slovarp, Speech-Language-Hearing & Occupational Sciences  
**Category:** STEM (Science, Technology, Engineering, Mathematics)

**Abstract / Artist Statement:**
Our preliminary work completed last year suggested that progressive desensitization using a controlled cough stimulant (aerosolized capsaicin) paired with behavioral cough suppression techniques may be helpful in decreasing cough sensitivity in healthy individuals. We hypothesize that patients with refractory chronic cough (RCC) who participated in behavioral cough suppression therapy (BCST) with a speech-language pathologist or other professional and did not experience resolution of their symptoms may benefit from this treatment using the combined controlled stimulation and suppression approach. In this study, participants with RCC will be randomly assigned to the treatment or placebo group and blinded to their assignment. Individuals in both groups will complete the baseline tests: (1) Leicester Cough Questionnaire; (2) urge-to-cough (UTC) testing; (3) identification of known cough triggers (self-report); and (4) cough sensitivity testing using pharmaceutical-grade aerosolized capsaicin delivered via a Koko digidoser with nebulizer in doubling doses (cough response and UTC will be recorded up to the dose that causes five coughs (C5) or the maximum dose of 1000 μMol/L). Participants will then complete treatment sessions twice per week for three weeks. Participants in the treatment group will be exposed to aerosolized capsaicin in progressive incremental doses while implementing behavioral cough suppression techniques. The capsaicin concentration will increase following two successfully suppressed coughs at a single concentration. Participants in the placebo group will receive subthreshold doses of capsaicin (i.e., a concentration that does not make them cough). Participants in both groups will be asked to complete and track daily home practice of the behavioral cough suppression techniques. Outcome measures, as in the baseline phase, will be taken at one and three-weeks post-treatment. The LCQ will be repeated at three months post-treatment. This study presents a potential treatment model for patients with RCC who have completed BCST and did not see full resolution in their symptoms. Participant recruitment for this study is currently underway. We anticipate having complete data on at least 12 participants by GradCon 2020.
Investigating the underlying mechanisms responsible for the effectiveness of behavioral cough suppression therapy: Preliminary findings

Author(s): Jane Reynolds, Sarah Popp

UM Faculty Mentor: Laurie Slovarp, PhD, Speech-Language-Hearing & Occupational Sciences

Category: STEM (Science, Technology, Engineering, Mathematics)

Abstract / Artist Statement:
Chronic cough (CC), a cough that lasts longer than eight weeks, is one of the most common complaints of adults seeking non-emergent medical care. An estimated 20% of patients with CC do not respond to medical treatment, and are said to have refractory chronic cough (RCC). Several studies provide evidence to support that RCC may be related to hypersensitivity of afferent protein receptors in the airway epithelium known to regulate cough. The primary sensory receptor is the transient receptor potential vanilloid 1 (TRPV1). These TRPV1 receptors can be found in the epithelial layer of the bronchus, larynx and nose. These receptors are very plastic; in other words, they are easily influenced by endogenous and exogenous stimulants. Speech-language pathologists and other trained professionals can deliver behavioral cough suppression therapy (BCST) that has been shown to improve RCC symptoms in some patients. The improvements experienced by patients following BCST may include a reduction in coughing frequency and intensity as well as a decreased urge to cough and improvements related to quality of life. However, the underlying mechanism that results in reduced cough sensitivity is unknown. We hypothesize that the improvement seen after BCST is due to down-modulation of TRPV1 receptors through a neuroplastic mechanism. To test this hypothesis, we will use Western Blot analysis and quantitative polymerase chain reaction (qPCR) to estimate TRPV1 expression in biopsies of epithelial tissue obtained from the nose and larynx (epiglottis) of patients pre and post-BCST. An improved understanding of the mechanism behind BCST may help to increase its application in the clinical setting as well as open doors to other potential treatments for RCC.

Applying Structural Realism and Political Liberalism to Regime Interference in Latin America

Author(s): Quincy Riordan

UM Faculty Mentor: Karen Ruth Adams, Political Science

Category: Social Sciences/Humanities

Abstract / Artist Statement:
In this research, I am addressing the overall question of “when and why have Latin American States had their governments changed by outside actors” in order to test the explanatory power of two theories of international relations (IR). I have chosen this topic because I am interested in the ways in which change in government occurs as a result of intervention between states, and what the motivations for the intervening states may be. I have specifically chosen Latin America because it has a long history of interference from outside states, which provides a rich and complex base that lends itself well to multiple theoretical viewpoints, and will provide some interesting (and differing) conclusions to my question based on the different theories used in this research.

I will be applying the theories of structural realism and political liberalism to my overarching question in order to test their ability to account for regime change as the product of foreign interference. Applying these theories to real-world problems tests their explanatory power and therefore their overall strength as theories of IR. Political liberalism is a classic liberal theory of IR that centers itself in the importance of the spread of democracy in establishing world peace, while structural realism focuses on systemic pressures and power dynamics that may or may not be contributing to certain behaviors of states within the international system. Under political liberalism, expect to see the spread of democracy as the main motivator for regime change in Latin America. I hypothesize that non-democratic nations would have had their regimes changed by outside actors in order to be more democratic, while already democratic nations will have been free from interference. Under structural realism, I hypothesize that regime change during the Cold War is the product of direct interference of great powers, where the United States and the Soviet Union imposed regime change on weaker Latin American states that are not compliant with their wishes in order to install a government that is favorable to their interests rather than their adversary’s.

To test these theories, I am building off of previous research that INSCR Coup d’États data of South American states from 1990-2014 and New York Times archives to examine the causes of coups and the motivations of outside actors involved in these uprisings. In the expanded research, I have extended the time period to include the 1980s in order to
compare the differences between the ways interference occurred in Latin America during bipolarity versus the ways it occurred during unipolarity. Expanding the time period of my previous research will allow me to fully view the causes and effects of interference in Latin American regimes. I will be using INCSR coup data from 1980-1990, as well as revolution data for the same time period and articles from the New York Times archives in order to determine the “causes” for each regime change and whether or not they were tied to U.S. or Soviet interests, or the spread of democracy.

Changing Student’s Attitudes About Rape Myths

Author(s): Daniel Salois
UM Faculty Mentor: Veronica Johnson, Counselor Education and Supervision
Category: Social Sciences/Humanities

Abstract / Artist Statement:
Experts in the social sciences largely agree that myths about rape pose a threat to victims. Rape myths are stereotypic thinking in regard to rape that serves to not only blame victims, but acquit perpetrators (Burt 1980). Rape myth acceptance is also correlated with rape proclivity, some authors suggest that higher acceptance of rape myths may go hand in hand with a certain readiness to commit atrocious violence (Bohner, Jarvis, Eyssel, and Siebler, 2005). Common rape myths include beliefs that the way women act or dress indicates she was asking for sex. Another example is that men cannot control sexual impulses (McMahon and Farmer, 2018). It should be noted that not all not rape is committed by a male perpetrator towards a female victim though statistically this is the largest area of concern.

Not enough research has been done to find effective interventions on college campuses to dispel rape myths. The Federal Bureau of Investigation reported an estimated 79,770 rapes reported to law enforcement in 2013 (ucr.fbi.gov). Such high numbers of victims has led to the implementation of rape prevention programs in a variety of settings. In particular college campuses have been in the spotlight in recent years. Organizations such as the Rape, Abuse & Incest National Network (RAINN) report that as many as 23% of females and 5.4% of males experience rape or sexual assault on college campuses. Historically prevention programs in schools are often geared towards changing long held sexist and prejudice beliefs by students about rape (Burt, 1980). This prevention model is not new, but college campuses continue to revisit the way they handle issues of rape on campuses. The Intimate Relationships course and model at the University of Montana can become a prevention model for dispelling rape myths on college campuses.

Data has been collected for fall and spring semester in 2017 and 2018 for the Intimate Relationships courses at the University of Montana. Students took the Illinois Rape Myth Acceptance questionnaire (IRMA) at the beginning of the semester they were enrolled in the course and identified their gender as male, female, or other. At the end of the semester the students took the IRMA again and their answers were matched based on a pretest code word only the student knew. An ANOVA test will be used to determine if statistically significant differences exist within the 3X2 design on the IRMA pretest and posttest controlling for gender.

Comparing the Effectiveness of Cryotherapy and Compression Modalities on Skin Temperature Cooling

Author(s): Kayla Schmidt, Luke McCarthy, Zachary Wisniewski, Marlon Pamiwulf
UM Faculty Mentor: Valerie Moody, Integrative Physiology and Athletic Training
Category: STEM (Science, Technology, Engineering, Mathematics)

Abstract / Artist Statement:
Context: Cold and compression are common therapeutic interventions used in the treatment of acute musculoskeletal injuries. Cryotherapy uses extreme cold to decrease cell metabolism and pain following injury. Compression works to decrease overall blood flow and control edema. The benefit of combining cold and compression is to increase the rate and depth of the temperature drop, while utilizing the effects of both modalities. The objective of this study was to determine which cold compression technology created the largest decrease in skin temperature to produce analgesic effects.

Methods: A convenience sample of six healthy, college-aged students were selected for this study (2 females, 4 males; average age 24 ± 3 years, height 70.5 ±3.4 inches, and weight 221.5 ± 58.5 lbs). A repeated measures design was used whereby subjects completed both trials with a week between each trial. The two trials included a 20-minute
treatment of either Game Ready or crushed ice pack with Recovery Pump (RP) Lite Compression pants. Subjects were asked to lay supine on the table while baseline skin temperatures were recorded using a Ryobi Infrared thermometer. Skin temperatures were recorded over the center of the right patella and right popliteal fossa of each subject’s knee before and after each trial. Three measurements were obtained and an average was recorded. Treatments were randomly drawn out of a hat and the selected treatment was applied for 20 minutes (Game Ready or RP Lite with crushed ice pack). Subjects were asked to return one week later to complete the other trial. Microsoft Excel was used to calculate descriptive statistics for each participant’s height, weight, and age along with their skin temperature measurements. A 2x2 repeated measures ANOVA using SPSS 25.0 was used to compare mean differences in skin temperature between the Game Ready® treatment and the RP® Lite with ice. Significance was set a priori at p = 0.05.

Results: A 2x2 (time x trial) repeated measures ANOVA was conducted for anterior knee skin temperature and there was no statistical significance found (p = 0.78). Similarly, when the same ANOVA was completed for posterior knee skin temperature, it was not determined to be statistically significant (p = 0.11). However, there were main effects for both anterior knee skin temperature (p=0.00) and posterior knee skin temperature (p=0.00) suggesting that both the Game Ready® and RP® Lite with ice bags effectively cooled skin temperature equally.

Conclusion: Our study showed that there is no significant difference between the Game Ready® and the RP® Lite pants with ice with both effectively decreasing skin temperature. Both modalities reached therapeutic range achieving analgesia; however, it is unclear if there is a corresponding decrease in intramuscular temperature to achieve a decrease in cellular metabolism.

Chiral Effects on Nonactate-scaffold based Antibiotic Activity

Author(s): Evelyn Schwartz
UM Faculty Mentor: Nigel Priestley, Chemistry
Category: STEM (Science, Technology, Engineering, Mathematics)

Abstract / Artist Statement:
Over the past several years the introduction of new antibiotic drugs on the pharmaceutical market has decreased yet antibiotic resistance in bacteria is still present and growing. The Center for Disease Control (CDC) estimates there are 2.8 million infections per year resulting in 35,000 deaths from antibiotic resistant microbes.1 It is imperative that new antibiotics are discovered, studied and introduced to the market as new antimicrobial resistance develops. Currently the CDC has designated 18 bacteria and fungi having resistance threats including methicillin-resistant Staphylococcus aureus (MRSA) and the fungus Candida auris. Nonactin, a macrotetrolide, is a fermentation product from Streptomyces griseus, and its precursor nonactate is a potential scaffold for novel antibiotics.2,3 The target of our novel nonactate antibiotics is still unknown and the selectivity between mammalian and bacterial cells is poor. DNA and proteins are chiral targets which have the potential to selectively bind to a complementary chiral compound, like nonactate. Initial extraction and methanolation of the nonactin core will result with two nonactate isomers as a set of (+) and (-) enantiomers. The nonactate core though has four chiral centers resulting in several other potential stereoisomers. Two of the chiral centers can easily be set to different positions resulting in four stereoisomers and their four enantiomers. A stereoselective Mitsunobu reaction has been used to switch one chiral center resulting in a total of four isomers. Creating an enol of the using the neighboring carbonyl group which can be an intermediate to an inverted center potentially providing the other four isomers. Three compounds from out library will be prepared from each of these eight stereoisomers, and then tested against several strains of microbes. Variation in the minimum inhibitory concentrations (MIC) between the stereoisomers would strongly indicate a potential chiral target, while retained MIC values indicate that it is unlikely to be a chiral target. Indication of a chiral target will help with understanding where the drug is binding therefore the development and modification for increased selectivity.

References

(3)        Luesse, S. B.; Wells, G.; Nayek, A.; Smith, A. E.; Kutsche, B. R.; Bergmeier, S. C.; McMills, M. C.; Priestley, N.
Filamentous Pf bacteriophage suppress type IV pili in Pseudomonas aeruginosa to prevent superinfection and secondary bacteriophage infections

Author(s): Caleb Schwartzkopf, Camilla de Mattos, Lia Michaels, Laura Jennings, Matthew Boggs, Alison Coluccio, Margie Kinnersley, Madilyn Head, Autumn Robinson, Devin Hunt, Valery Roman-Cruz
UM Faculty Mentor: Patrick Secor, Cellular, Molecular, and Microbial Biology
Category: STEM (Science, Technology, Engineering, Mathematics)

Abstract / Artist Statement:
Pseudomonas aeruginosa is an opportunistic bacterial pathogen that causes numerous human infections. Several P. aeruginosaisolates contain temperate Pf bacteriophages. Pf phages can be produced in abundance (up to 1010 per ml) without lysing their bacterial host. However, cell lysis ensues when P. aeruginosa is superinfected by Pf phages. Superinfection occurs as an already infected bacterial cell is re-infected by the same, or similar phage. We observed that a subpopulation of P. aeruginosa became transiently resistant to Pf superinfection and hypothesized that Pf phages encode a mechanism that protects P. aeruginosa from superinfection by Pf phage. To test this, we conducted a genetic screen where each Pf gene was overexpressed individually in P. aeruginosa and challenged by Pf superinfection. We performed plaque assays to measure P. aeruginosa’s susceptibility to Pf phage. This screen revealed a single Pf gene, pfsE, that was necessary and sufficient to protect P. aeruginosa against superinfection. Expression of PfsE provided robust protection against Pf superinfection, suggesting Pf phage were not able to enter P. aeruginosa, possibly due to the modulation of a cell surface receptor. The cell surface receptor used by Pf phage are type IV pili (T4P), a virulence factor which mediates twitching motility. Using twitch motility assays, we observed suppression of T4P-dependent motility in response to both Pf superinfection and overexpression of PfsE. Because T4P are a common cell surface receptor used by several species of phages to infect P. aeruginosa, we next hypothesized that PfsE would provide protection from other pili-dependent phages. When P. aeruginosa was superinfected by Pf phage or PfsE was overexpressed, we observed broad and robust protection against other T4P-dependent phages. However, neither Pf superinfection nor PfsE expression was sufficient to provide protection against T4P-independent phages. Collectively, our results indicate that PtsE is a Pf phage encoded superinfection exclusion mechanism that suppresses T4P and protects P. aeruginosa against infection from T4P-dependent phages. Because Pf phages are found in abundance at sites of human infection, these results have implications for the use of phage therapy as they may prove beneficial for selecting and troubleshooting the most efficacious phages to combat P. aeruginosa.

Adoption of Pasture Management Practices in Rondônia, Brazil: The Influence of Information from Social Media

Author(s): Cassandra Sevigny
UM Faculty Mentor: Katrina Mullan, Economics
Category: Social Sciences/Humanities

Abstract / Artist Statement:
The welfare of rural households depends upon income from agricultural production. The adoption of new agricultural practices can improve farmer welfare by increasing yield and/or lowering production costs. But farmers do not always adopt beneficial new practices. Barriers include uncertainty about effectiveness, high up-front costs, or lack of information about the new practices. I will examine whether the use of social media for information influences pasture management practices among cattle farmers in Rondônia, Brazil. Rondônia is on the edge of the Amazon region. The state is heavily deforested for use as farmland. Farms in this state predominantly raise cattle for dairy and beef production, relying heavily on pastures for feed. Traditional pasture management in Rondônia entails extensive grazing that degrades the soil over time. Farmers address degraded pasture through periodic, costly, input-intensive interventions to restore pasture health, or deforestation for new land. Sustainable practices exist which reduce degradation and household production costs. Existing literature on adoption of agricultural practices widely explores the influence of risk, credit access, and access to information from agricultural extension or neighbors. Farmers tend to trust information from other farmers most, as they have the kind of practical experience that farmers care about. The use of social media connects farmers to a greater variety of other farmers than before. Such a connection provides more access to information and at a much lower cost than typical avenues like agricultural extension.
Social media use increases the potential to learn about and adopt new agricultural practices, but few researchers have investigated to what extent it causes farmers to actually change their agricultural decisions. If any correlation exists, it may suffer from selection bias. Farmers who tend to adopt all kinds of new technologies or who prefer novelty may be more likely to use both social media and new pasture practices. I will estimate the effect of information from social media on the adoption of pasture management practices using regression with covariates, propensity score matching, and an endogenous switching regression. Results will be compared across each estimation method, as well as between farmers who use traditional and sustainable management practices. Increased adoption of pasture practices would provide evidence in favor of using social media to spread information about other agricultural practices and in other countries. Data comes from the Connections between Water and Rural Production project, which surveyed farm households in Rondônia on a variety of agricultural topics. This dataset contains 1385 households who responded to questions on pasture management and social media use.

**Autonomous In Situ measurements of Freshwater Alkalinity**

**Author(s):** Qipei Shangguan  
**UM Faculty Mentor:** Mike DeGrandpre, Department of Chemistry and Biochemistry  
**Category:** STEM (Science, Technology, Engineering, Mathematics)

**Abstract / Artist Statement:**

Total Alkalinity (AT) in rivers and streams is an extremely useful parameter in identifying and assessing both hydrological and biogeochemical processes, such as groundwater discharge and dissolution/precipitation of calcium carbonate minerals. AT is also one of the most commonly measured parameters to characterize the inorganic carbon cycle.

Traditionally, determination of AT involves a titration where acid is added sequentially to a water sample and the resulting pH is measured using a pH electrode. The amount of sample and acid added in each step needs to be accurately known. Each analysis takes ~15 minutes. Sensor technology will not only help to eliminate the steps of sample collection and measurements, but improve the data resolution to capture isotopic events.

SAMI-alk (Submersible Autonomous Moored Instrument for alkalinity) is a robust sensor, developed in our lab, which is capable of performing in-situ measurements hourly over one-month period. This sensor utilizes a novel Tracer Monitored Titrati

on (TMT) technique where a colorimetric pH indicator quantifies both pH and relative volumes of sample and titrant, circumventing the need for gravimetric and volumetric measurements. SAMI-alk has demonstrated good precision, accuracy and long-term stability through testing in the lab.

SAMI-alk was deployed in the Clark Fork River (CFR) at Gold Creek, Montana from September 19 to October 11, 2019. A total of 265 measurements were made, which revealed that riverine AT has strong correlations with conductivity. This time-series data also clearly showed that AT has strong diel cycles in CFR, but this regular pattern is disrupted by a sudden increase in river discharge associated with snow melting. Together with other sensors (oxygen, pH, etc.) deployed at the same site during this period, we can better understand the controlling mechanism of AT fluxes and carbon cycles in CFR.

Our current work focuses on extending the deployment length, which primarily includes testing of titrant stability, reduction in size and reagent consumption. As SAMI-alk becomes more available to researchers in related fields, it will advance our knowledge of AT variability and anthropogenic effects on our natural environment.

**Octopamine-dependent aggression requires dVGLUT from dual-transmitting neurons**

**Author(s):** Lewis Sherer, Elizabeth Catudio Garrett, Hannah Morgan, Edmond Brewer, Lucy Sirrs, Harold Shearin, Jessica Williams, Brian McCabe, R. Steven Stowers, Sarah Certel,  
**UM Faculty Mentor:** Sarah Certel, Division of Biological Sciences  
**Category:** STEM (Science, Technology, Engineering, Mathematics)

**Abstract / Artist Statement:**

PURPOSE: Neuromodulators such as monoamines are often expressed in neurons that also release at least one fast-acting neurotransmitter. The release of a combination of transmitters provides both “classical” and “modulatory” signals that could produce diverse and/or complementary effects in associated circuits. Here we demonstrate the majority of octopamine (OA) neurons in the adult CNS also express the Drosophila vesicular glutamate transporter (dVGLUT) and identify the individual contributions of each neurotransmitter on sex-specific behaviors. Determining
how dual transmission mediates behaviors including aggression will help establish new drug targets for treating aggressive behavior that is symptomatic of many human neurological disease states.

METHODS: The experiments described below will determine the contributions of glutamate and OA-glutamate dual transmission on aggression and courtship behaviors by achieving three main objectives:

1) Genetically eliminate dVGLUT specifically in OA/glutamate dual transmitting neurons (OGNs) in the brain and assay changes in male aggression, reproductive behavior, and the critical balance between aggression-promoting and courtship-suppression circuitry output.

2) Determine where OA and glutamate are trafficked within OGNs using fluorescently-labelled OA and glutamate transporters.

3) Reduce expression of GLU and OA autoreceptors in OGNs and quantify the resulting changes in male aggression and courtship behavior to determine the role of autoreceptor activity in dual neurotransmission.

These experiments will be performed using genetic tools such as B3 recombination and RNAi, as well as Drosophila mutant lines, in combination with each other to determine the effects of glutamate loss on aggressive and courtship behaviors.

ORIGINALITY: Deciphering how dual transmission impacts behavior in any organism has been difficult to address. This is because it is challenging to manipulate individual neurotransmitter levels within the same neuron. Using the extensive genetic toolkit available to Drosophila, we are able to eliminate either octopamine, glutamate, or both in OGNs only.

SIGNIFICANCE: In this study, we determined that males deficient for dVGLUT solely in OGNs exhibit a reduction in aggression without a concurrent increase in inter-male courtship. The requirement for dVGLUT function in brain OGNs was established with the addition of tsh-Gal80 and all RNAi-mediated phenotypes were confirmed by completely removing dVGLUT function in OGNs using a new conditional allele of dVGLUT, B3RT-dVGlut. Together these results suggest: 1) dVGLUT is not required for the OA-dependent inhibition of inter-male courtship, and 2) dVGLUT is required at OGN synapses to promote aggression.

Our behavioral results suggest GLU and OA signals converge on aggression circuitry while the OA courtship-related signal may be spatially segregated. By visualizing both transporters using a newly generated conditional epitope-tagged VMAT and dVGLUT antibody, we show that VMAT and dVGLUT puncta can differ in localization within OGNs. Our results show that aggressive behavior requires the release of both neurotransmitters in dual-transmitting neurons and suggests within this set of neurons, glutamate may provide a new therapeutic target to modulate aggression in pathological conditions.

Public Lands and Patriotism: Wylie Camping Company and the Role of Tourism in 19th Century American West

Author(s): Jennifer Simpson
UM Faculty Mentor: Jody Pavilack, History
Category: Social Sciences/Humanities

Abstract / Artist Statement:
In the period following the Civil War and Reconstruction, land grants and the Homestead Acts led many Americans to seek out a new life in the West. However, for many the area developed a cultural value beyond property, offering a uniquely American landscape and lifestyle in which to they could take pride. Though many materials that idealized the “West” were created by explorers and settlers, people from across the nation were captivated by the rugged individualism that the region represented. This national fascination with the West along with the expansion of the leisure class and the growth of accessible transportation introduced a new character – the western tourist. Instead of the traditional focus on settlers in the west and early progressives in the east, this study explores a different cross-section of America in this period and addresses multiple interdisciplinary concepts, including: environmental impact, politics and state power, as well as human behavior and social norms. In order to establish tourism’s role, this project evaluates three primary source types: brochures, advertisements, and other ephemera from tourism companies; diaries and travel recollections from visitors; and political/legal documentation highlighting the state’s role in helping establish tourism.
Using the Wylie Permanent Camping Company of Yellowstone Park as a lens, this project will explore the social, cultural, and political conditions that encouraged and affected western tourism as well as some environmental effects of temporary visitors traveling through America’s first national park. Established in 1893, the Wylie Camping Company was granted exclusive permission by the United States government to erect permanent camps throughout the park. In order to attract visitors from the expanding middle class, Wylie joined others in his industry in creating a highly cultivated image and experience of “The West” for tourists, investors, and lawmakers. The “West” sold by Wylie and other tourism boosters was filled with appealing contradictions that emphasized the tamability of the area: wild enough to be exciting but civilized enough to be attractive to visitors with more refined standards. They also framed seeing the west as a form of patriotism, adopting the language of exceptionalism to emphasize that the landmarks, people, and experiences of the American West were unique and unparalleled in the world, and it was the civic responsibility of tourists to “see America first.”

Student Immediacy: The key to collaborative learning dynamics?

Author(s): Rebekah Skoog, Sisilia Kusumaningsih

UM Faculty Mentor: Jingjing Sun, Teaching and Learning

Category: Social Sciences/Humanities

Abstract / Artist Statement:

Dialogic learning, or the process of learning via peer discussion groups, has been deemed an effective means to students' cognitive and social growth (Howe et al., 2019). Among the various approaches, Collaborative Reasoning (CR) discussion has become a leader in the educational literature. This dialogic learning aims to provide students with a form of group discussion pedagogy wherein students engage in controversial topics in scientific, moral, and policy issues. Thus far, the research suggests that CR helps students develop and transfer reasoning and social skills, such as analogical reasoning and emergent leadership skills (Sun et al., 2015). CR is an integration of both substantive and procedural aspects of dialogue-based pedagogy. It represents “a promising research site for investigating provocative, yet under-researched propositions regarding the educative power of a dialogue for teaching students not what to think, but how to think” (Reznitskaya et al., 2009, p. 35).

Despite the research and need for dialogic learning in classrooms, teachers still hesitate to implement this method, as understanding what makes it effective or what factors go into making it ineffective. As many of the studies done on CR, focus on pre-and post discussion essays, there is still a need to understand the interactive processes that take place during these discussions that have led to promising outcomes. During interactive situations, people make use of verbal or non-verbal communication with an intention to bring a group’s members closer together, which is known as an immediacy move. Verbal immediacy refers to “the extent to which selected communicative behaviors enhance physical or psychological closeness in interpersonal communication” (Woods & Baker, 2004, p. 4). Studies have shown that effective teacher immediacy contributes to more successful student discussions, however, much less is known about the role of student immediacy in collaborative discussions. This research examines how verbal immediacy moves among learners evolved during CR discussions. Using socio-cultural theory on communication by Hymes (1996), the communicative situation structure by Hennessey (2016) and the concepts of verbal immediacy by Lin et al. (2018), this study explored the questions of (1) How do supporting verbal immediacy moves or opposing verbal immediacy moves evolve over the course of CR discussions? and (2) What implications can be drawn from such changes on how teachers should organize their student groups?

The methods used in this study included the examination of four groups of fourth-grade students with four CR discussions per group, and two teachers over a period of six months. Four groups from each classroom were randomly selected to be video recorded as they went through eight CR discussions, with an average of about one CR every other week. The discussion transcripts were analyzed and coded based on a communicative situation scheme and a verbal immediacy lens. The overall implications of this research could lead to a better understanding of how teachers organize their groups as well as the interactive benefits of CR discussions.

Keyword: collaborative reasoning, verbal immediacy, immediacy moves
A Snapshot of Care: Creating models of care for Individuals included in the Terry Collection

Abstract / Artist Statement:
Twenty-four individuals were selected from the Terry collection, housed at the Smithsonian, based on the presence of pathology on the skeletal remains and the records associated with the individual. A model of care was produced for each individual utilizing the model to compare the impact written documentation had on the finished model. Additionally, individuals that demonstrate skeletal markers associated with disease, traumatic injury, or both were compared to see if the model provided more information on the cost or length of care.

The Bioarchaeology of Care includes numerous studies focused on periods of time where written documentation was rare and nonspecific and relied on skeletal remains to form a model of care or caregiving. A model of care identifies evidence of caregiving in the bioarchaeological record and helps determine the resources required to aid a person through injury or disability. The index of care is the method used to create models of care and requires social, cultural, economic, environmental, and mortuary contexts. Additionally, the method requires primary source records and historical research, combined with modern clinical data, to create a contemporary model of care.

My current research investigates the impact of known medical, occupational, and morgue records that accompanied each selected individual in the skeletal collection. This additional information, beyond what is gained from skeletal analysis, generates a complex model of care. This model of care can better estimate cost of care, length of care, resource requirements and availability. Information provided by the records allows for a better understanding of the individual's life and care received. My research elucidates the nuances of individualized care through time and space in order to gain a bottom's up perspective of the late 19th to early 20th century life and healthcare. This additional information can better inform on how individuals of the past understood and treated people with disabilities or impairment. Studying multiple models of care built around individuals from different time periods can illuminate how caregiving has evolved to what we practice today.

NATO's future with China according to Europe

Abstract / Artist Statement:
Will the main NATO member-states France, Germany and Great Britain follow the USA in considering Russia to have been replaced by China as the new main opponent?

This paper's purpose to understand how NATO's future will look like. This is being accomplished by asking, whether the three main European NATO members -- Germany, France and the UK -- and NATO as a whole will follow the US in replacing Russia with China as the main opponent. The reason for asking this question is China's unprecedented economic, political and military rise in the last two decades. The paper answers the question by applying structural realism (especially the concepts "balance of power" and balance of threat) and neoliberal interdependence theory. They are different concepts in the field of International Relations on how and why states interact with each other. My method of comparing how each of the three states interacts with China on military, political and economic levels before and after China became a superpower is a comprehensive way to find the necessary answers for my questions. I see this as an important contribution to international relations because we are now in a world of two superpowers again and the US-China relationship will influence world politics for the coming decades. NATO is a US-led alliance which still accumulates the greatest military capabilities on the planet. If the US would lose Europe's support, the balance of power between China and the US could shift. I come to the conclusion, that economically, it makes sense for NATO and NATO member-states to follow the US because it still is their most important trading partner, but the main objective would be to find a way to not alienate either the US or China. Neither balance of power nor balance of threat would lead the three countries to support a paradigm shift in NATO foreign policy, as China isn't seen as a major threat yet and because Europe isn't as dependent on the US to defend it from Russia as the media sometimes make it seems like.
The Radicalism of Rebecca Felton: Reforming Southern Masculinity

Author(s): John Stefanek
UM Faculty Mentor: Anya Jabour, History
Category: Social Sciences/Humanities

Abstract / Artist Statement:
In 1897, Rebecca Latimer Felton spoke to the Georgia Agricultural Society. Felton, a native Georgian who would later become the first female U.S. senator, gained prominence in the U.S. South as a politician, suffragist, and white supremacist. Her speech, “Woman on the Farm,” discussed the economic struggles of southern farmers. Felton’s speech also addressed a variety of controversial issues including agricultural economics on the farm, prison reform, and temperance. From the 1870s until her death in 1930, Felton used these specific issues to attack what she saw was the greatest threat to southern white women: southern white men.

In this speech and in her other published writings and public appearances, Felton primarily targeted the failure of white southern men and the Democratic Party. She further believed that these issues were linked to the physical violence towards white women brought on by white men. These issues would become the most important in her goal of reforming southern masculinity and to empower white women socially and politically while protecting white women from the violence of men.

Historians have not adequately understood Felton’s radical feminism on the issues of agricultural economics, prison reform, temperance, and the overarching theme of violence that connected them. To better illustrate these issues, this research is a case study of these issues in connection to threat of violence towards women. A case study of how Felton’s increasingly radical calls for southern masculinity reform adds a new lens to not only examine Felton but also on the issues of agricultural economics, prison reform, temperance, and violence towards women at the time. Past scholars have recognized that the issue of farm women played an integral role in Felton’s suffrage activism but have not fully explained how it was a starting point for Felton’s increasingly radical opposition to southern masculinity. While past scholars have shown the extreme measures she was willing to employ against white men in her later years, the evolution of her beliefs has been examined her sympathies for black women on the issue of prison reform. However, Felton did not simply become more sympathetic to black women. She actually became more radical in her beliefs that white men needed to be curtailed through lynching.

While Felton lived from 1835-1930, this analysis primarily examines her life from the 1880s-1920s. These years take place during the Progressive Era to compare Felton’s activism with other reformers at the time. Felton adopted the issues of prison reform and temperance—while sometimes overlapping with both southern suffrage and progressive movements—as her own issue of reforming southern masculinity to protect white women. In conducting this research, the Rebecca Latimer Felton Papers available digitally through the University of Georgia Library were essential. These papers document her life from 1851-1930 and remain the most detailed regarding Felton’s life and career. These papers have been utilized in some form in any modern study on Felton. Throughout these papers are Felton’s correspondence, personal papers, drafts of speeches and sermons given, and articles written throughout her career.

Investigating Maya Terminal Classic Period Architecture at Plaza H, Cahal Pech, Belize

Author(s): Rachel Steffen
UM Faculty Mentor: John Douglas, Anthropology
Category: Social Sciences/Humanities

Abstract / Artist Statement:
Located in the Upper Belize River Valley, Cahal Pech sits on a large hilltop overlooking the town of San Ignacio, Belize. The site represents a medium size ceremonial/administrative center active from the Preclassic through Classic Maya; it is one of 14 archaeological preserves interpreted and open to the general public in Belize. The final occupation of the center has been the subject of intensive ongoing research through a partnership between the University of Montana Anthropology Department and the Belize Valley Archaeological Reconnaissance Project (BVAR). This research has focused on Plaza H, located in the northeastern portion of the site. The plaza was primarily occupied during the Terminal Classic Period (750 A.D. - 1050 A.D.), which is characterized by the end of elite systems, monumental architecture, trading of prestige goods, and population decline at most centers in the Maya lowlands. In this presentation, the significance of research conducted during the summer of 2019, chiefly focused on the architectural features and construction phases of the plaza, is considered. These excavations were centered on
the complete exposure of structure C-3, a range structure at the plaza that may have served the residential needs of the last elite family at the site, exposed and evaluated through vertical and horizontal excavations. With previous limited research conducted during the Terminal Classic at Cahal Pech, this research is transformational in providing further insights into the last occupation of the site. Results allow us to have a deeper understanding into the development of the architecture at Plaza H and how it connects to the social power of a family using the long history of Cahal Pech to project leadership.

**Titanium Dioxide and Zinc Oxide Nanomaterials Change Lipid Order and Increase Permeability in Model Systems**

**Author(s):** Matthew Sydor, Donald Anderson, Harmen Steele, J.B. Alexander Ross, Andrij Holian  
**UM Faculty Mentor:** Andrij Holian, Department of Biomedical & Pharmaceutical Sciences  
**Category:** STEM (Science, Technology, Engineering, Mathematics)

**Abstract / Artist Statement:**

The expanded use of nanotechnology has led to increased production and use of engineered nanomaterials (ENM), resulting in an increased risk of human exposure. ENM generated occupationally can be airborne and are taken-up by immune cells (macrophages) in the lung, where the ENM accumulate in phagolysosome organelles. Some ENM have been reported to be bioactive and to trigger a pro-inflammatory response when inhaled. Alveolar macrophages have been demonstrated to be responsible for this inflammatory response due to their release of the cytokine, IL-1β. A key step preceding and linked to IL-1β release is phagolysosomal membrane permeability (LMP). This suggests that ENM may interact directly with the lipid membrane of the phagolysosomes, disrupting their normal state, resulting in LMP. The way in which various ENM disrupt lipid membranes, is not fully understood. Time-resolved fluorescence anisotropy measurements, using suitable lipid probes, can measure changes in membrane characteristics, such as lipid order (Lo) and disorder (Ld). Using appropriate model systems can help to describe mechanisms of ENM-induced membrane permeability. In this work, 100 and 400 nm liposomes made of DOPC (1,2-dioleoyl-sn-glycero-3-phosphocholine), POPC (1-palmitoyl-2-oleoyl-glycero-3-phosphocholine) and DOPS (1,2-dioleoyl-sn-glycero-3-phospho-L-serine) were used as model systems to determine phospholipid interaction with ENM. These models were exposed to 25 and 100 µg/ml of titanium dioxide (TiO2) or zinc oxide (ZnO) nanospheres for 2 hours at 37°C. The fluorescence membrane probe Di-4-ANEPPDHQ and a time-resolved fluorometer were used to determine the changes in lipid Lo/Ld of the liposomes by anisotropy. Liposome lysis was measured by a calcein leakage assay. Again, these liposomes were exposed to the same doses and incubation time as described above. Treatment with both ENM produced significant increases in calcein leakage at the 100 µg/ml dose. This happened in all three models tested. POPC liposomes exposed to 100 µg/ml TiO2 had an increase in lipid order, but no significant change was observed using DOPC or DOPS liposomes. ZnO exposure (100 µg/ml) to DOPS liposomes also showed an increase in lipid order, but again there was no change using DOPC or POPC liposomes. These results indicate that there is a consistency in term of changes to the order of the membranes, in which there is increased order around the probe. These results also demonstrate that both of these ENM are able to cause leakage of the small molecule calcein from inside the liposomes. Funding: NSF MRI CHE-1531520 M.J. Murdock Charitable Trust, NIH R01ES023209, 1F32ES027324, P20GM103546 and P30GM103338

**Who Did You Tell? Victims’ Perceived Helpfulness of Formal vs. Informal Support Sources After Campus Victimization: Sexual Assault, Intimate Partner Violence, and Stalking**

**Author(s):** Nora Uhrich  
**UM Faculty Mentor:** Chris Fiore, Psychology  
**Category:** Social Sciences/Humanities

**Abstract / Artist Statement:**

Violence against women is recognized as a serious public health concern in the United States. The prevalence and rates of victimization occurring on college campuses is problematic, and has captured the attention of researchers and campus officials nation-wide. Research has shown that women ages 18 to 24 years old are at a particularly high risk of experiencing sexual assault, intimate partner violence (IPV), and stalking (Breiding et al., 2011). Despite the negative outcomes associated with victimization, many victims, particularly college students, do not seek help for these crimes. There is already a considerable body of literature that explores the reasons why victims of sexual
violence do not disclose their experiences, and the barriers they may face in disclosure (Sable, Danis, Mauzy, & Gallagher, 2010; Starzynski, Ullman, Filipas, & Townsend, 2005; Ullman, 1996a; Ullman & Filipas, 2001a; Walsh, Banyard, Moynihan, Ward, & Cohn, 2010; Zinzow & Thompson, 2011). However, there is a dearth of research that systematically examines the correlates of disclosure across additional types of victimization, such as IPV and stalking. In addition, previous research has established how social reactions to disclosures of sexual assault or IPV have significant effects on women’s post-assault recovery (Sylaska & Edwards, 2013; Ullman, 1996b). However, these studies did not quantify the level of helpfulness victims perceived from the sources they disclosed to, nor did they analyze possible correlates that may help explain the reasons a support source is perceived as more or less helpful. Overall, there appears to be several important gaps in the literature that account for victims’ disclosure decisions and perceptions of disclosure across different types of campus victimization. From a modified ecological framework, this study explored how demographic, intrapersonal, and situational variables account for the variance in disclosure across experiences of sexual assault, IPV, and stalking in a college student sample. This study also examined victims’ perceived helpfulness of support sources and how helpfulness relates to psychological functioning. In addition to replicating previous work, results from this study may provide new evidence for overlap of predictors across victimization type. The results provide needed information that could help colleges and universities develop ways to encourage support-seeking and reporting among students, as well as provide opportunities for improved prevention and intervention efforts.

**Congenitally Missing Maxillary First Molars and FSD 19-161**

**Author(s):** Hope Vance  
**UM Faculty Mentor:** Kirsten Green-Mink, Anthropology  
**Category:** Social Sciences/Humanities

**Abstract / Artist Statement:**
Congenitally missing maxillary first molars are considered a trait that is indicative of Asian ancestry, specifically Japanese. Previous studies, including the one conducted by Ryota Abea et. al (2010), have linked the absence of this tooth with groupings of individuals that originate in this region of the world. In the forensic context, understanding the congenital absence of this molar can allow for greater interpretation of the skeletal remains and provide the forensic anthropologist the ability to create a more accurate biological profile of the individual in question.

FSD 19-161 arrived at the University of Montana from the Petroleum County Coroner’s Office in September of 2019 when forensic anthropological analysis began. After conducting the analysis of the remains presented, it was originally profiled as a European Male through metric and non-metric methods. However, several methods assessed contradictory ancestry estimations. One method indicated European ancestry, while another indicated Japanese descent.

Dental x-rays were also taken of the decedent and analyzed to provide a greater understanding of the individual and their pathologies. After reviewing the dental x-rays, it was confirmed that the maxillary first molars were actually missing and that these molars are congenitally absent and were not pulled antemortem, due to the placement and angle of the second molar root. Taking what was already known about the ancestral relationship of this pathology, with the new information provided by the dental x-rays we were able to readjust the biological profile of the decedent and included that the individual was likely of mixed European and Japanese descent.

The congenital absence of the first maxillary molars is indicative of Japanese descent and understanding that this pathology is associated with certain ancestral populations can assist forensic anthropologists in creating a more accurate and complete biological profile, as evidenced by case FSD 19-161. Understanding the significance of the congenital absence of teeth, specifically the first maxillary molar, will result in more accurate biological profiles in the future. In depth analyses of a decedent’s teeth may allow for a more reliable interpretation and analysis of remains, which in turn would increase the likelihood of correctly identifying a decedent.
Physical and chemical constraints on emergent aquatic ecosystem metabolism

Author(s): Joseph Vanderwall
UM Faculty Mentor: Ashley Ballantyne, Forestry
Category: STEM (Science, Technology, Engineering, Mathematics)

Abstract / Artist Statement:
Alpine glacial loss is resulting in the rapid change and even emergence of downstream lakes; however, little is known about the processes regulating development in these new ecosystems. The unique properties of glacial meltwater impose physical and chemical constraints on lake ecosystem processes, but the degree to which these constraints interact or relax as glaciers recede is not well understood. The nature of these constraints have direct consequences for the fundamental ecological characteristics of the ecosystem. For example, glacial inputs rich in sediment may reduce light thereby limiting primary production, whereas glacial inputs rich nutrients may promote primary production. As these inputs fade, the response of lake biota determine the corresponding changes in biogeochemical cycling. Understanding the relative importance of glacial inputs to the metabolism of emerging aquatic ecosystems may help preserve them and build a framework to predict their trajectory of ecosystem development and future ecological state. In addition, aquatic systems will likely shift from net autotrophic carbon sinks to net heterotrophic carbon sources as glaciers disappear and vegetation colonizes alpine catchments.

Preliminary Investigation of an Aphasia-Friendly Version of the PHQ-8 Compared to other Patient and Proxy Reported Outcome Measures of Depression

Author(s): Kaylee Walter
UM Faculty Mentor: Catherine Off, School of Speech, Language, Hearing, and Occupational Sciences
Category: Social Sciences/Humanities

Abstract / Artist Statement:
Background & Significance: Persons with aphasia (PWA) experience post-stroke depression more frequently than stroke survivors who do not have aphasia. This increased depression has been attributed to the similarities in lesion locations that lead to aphasia and lesion locations that lead to depression. Currently no patient reported outcome measures that screen for depression have been created specifically for PWA or modified to be aphasia friendly for PWA. The purpose of this preliminary study is to modify the Patient Health Questionnaire-8 (PHQ-8) to an aphasia friendly format and to assess the feasibility of administering the modified assessment compared to other patient-reported and proxy outcome measures of depression.

Methods: This retrospective analysis examined pre- and post-treatment outcome measures of depression for stroke-survivors with aphasia. The Patient Health Questionnaire-8 (PHQ-8) was modified to an aphasia friendly format through simplification of questions, increased font size, addition of a calendar representation of possible answers, and addition of pictures related to the emotion of the question being asked. Prior to and immediately following an intensive comprehensive aphasia program (ICAP) lasting four weeks, seven stroke-survivors with aphasia were administered the modified PHQ-8 (mPHQ-8). Each individual also completed the Geriatric Depression Scale (GDS) and the Modified Perceived Stress Scale (mPSS); family caregivers completed a proxy measure, the Stroke Aphasia Depression Questionnaire -10 (SADQ-10). The GDS and SADQ-10 were administered in their original formats. The mPSS was administered in its designed format as an aphasia friendly version of the Perceived Stress Scale.

Data Collection and Analysis: Scores for the GDS, mPHQ-8, and SADQ-10 were collected immediately before and after the summer 2019 ICAP at the University of Montana. Undergraduate research assistants not involved in the data collection/blind to all research procedures are currently rescoring all outcome measures for accuracy and reliability purposes. Analysis pending. Feedback about the feasibility and ease of administration of these measures was collected from clinicians and a director of the ICAP immediately following pre-testing and post-testing, and again approximately three months later. This qualitative data has been compiled and organized in Excel. Coding and analysis pending.

Key words: aphasia, depression, patient-reported outcome measures, proxy outcome measures, aphasia-friendly modification, psychosocial well-being
A New Classification System for Analyzing Burned Human Remains

Author(s): Amanda Williams
UM Faculty Mentor: Meradeth Snow, Anthropology
Category: Social Sciences/Humanities

Abstract / Artist Statement:
Fires can alter human remains in various ways; however, complete destruction of a human body by burning is impossible and skeletal remains can almost always be recovered. Fatal fires produce a range of physical alterations to the body, from blistering of soft tissue to the calcination of bones. These physical alterations leave patterns that can be studied and analyzed to interpret perimortem events. A variety of forensic professionals interact with and analyze these remains postmortem, which can lead to variation in how remains are described.

Currently, the forensic community lacks a consistent, objective, and detailed scale to describe burn injuries or patterns in a variety of settings and conditions. There is a need to create a scale based on quantitative experimental data (e.g. duration and temperature of fire) that provides insight into the nature of the fire and cause of injuries contributing to the condition of the remains. This research develops a new standardized method that would encompass all physical alterations of burned remains and be more applicable to the broader forensic community.

The new classification system is based on observational experiments conducted as part of the Fatal Fire Death Investigation Course by the San Luis Obispo Fire Investigation Strike Team. Observational experiments consisted of 11 to 12 different scenarios covering a wide range of fire environments. The range of fire environments provided through the training course, make it possible to collect a wide range of data that may be more representative of burned forensic cases. All physical alterations to both soft and skeletal tissues were documented with digital photography and thermocouples. Temperature data was collected through use of thermal couples and thermal imaging devices placed on multiple locations and depths directly on the human remains. Time was also recorded manually while each temperature was being read from the data logger. Statistical analyses were performed to identify patterns between physical alterations of remains, environment, time, and temperature. Additionally, the new scoring system and model was tested on a separate sample of case studies provided by medical examiner/coroner’s offices to test and validate the method created. This new model provides investigators with a tool for developing a more precise timeline of death events, and aids in narrowing down a perpetrator. Information gained from the model can also be used to better predict when and at what temperatures these physical alterations may occur on the human body. It can also prove important in reconstructing events involved in fatal fires and aid investigators building a legal case.

The Link Between Diet and Metal Accumulation in Aquatic Insects

Author(s): Chelsea Wisotzkey, Ben Colman
UM Faculty Mentor: Ben Colman, Systems Ecology
Category: STEM (Science, Technology, Engineering, Mathematics)

Abstract / Artist Statement:
Aquatic insects have been used extensively to measure the structure and function of aquatic ecosystems, in part because of their ability to accumulate contaminants such as metals from surrounding water. Concentrations of metals in insect tissue provides an excellent way to track extent of metal contamination in streams and rivers that results from anthropogenic activities such as mining, farming, and manufacturing. It is well established metals in water can accumulate both via uptake of dissolved metals through gills and through ingestion of metals contained in food. However, only concentrations of dissolved metals are used to establish water quality criteria meant to protect aquatic life. This is problematic, since an increasing body of evidence supports the important role that contaminated food sources may play in overall metal accumulation. Given the challenge of disentangling each of these accumulation pathways in the natural environment, there is a dearth of field-based studies exploring the relative importance of aquatic and dietary metal accumulation. In my research, I work to fill this niche by establishing patterns between aquatic insects, their food sources, and metal concentrations in their bodies in a field setting in order to illustrate the hypothesized importance of dietary exposure pathways in insects. This will be done by integrating both gut content and isotopic signatures of insect diets with measurements of metal concentrations in the insects and their food sources. This is a novel approach, since tools such as isotopic analysis and gut content analysis have traditionally been used to determine patterns of short term and long term ingestion patterns but have less commonly been used in
conjunction with metal analysis to establish the effect diet has on accumulation patterns. Results of this work are anticipated to address the omission of dietary exposure in current water quality criteria, and may support developing updated models which incorporate all exposure pathways in order to appropriately safeguard aquatic ecosystems.

Satellite based remote sensing to monitor crop status in the contiguous United States

**Author(s):** Patrick Wurster, Marco Maneta, John Kimball, Arthur Endsley, Santiago Begueria  
**UM Faculty Mentor:** Marco Maneta, Geosciences  
**Category:** STEM (Science, Technology, Engineering, Mathematics)

**Abstract / Artist Statement:**
The carbon flux between the land and atmosphere is critical to supporting life on Earth and provides many of the ecosystem services required to maintain our society. Gross primary production (GPP) refers to the total atmospheric carbon fixed by vegetation (CO2) at the ecosystem scale through photosynthesis. GPP is a useful metric for understanding the interactions between carbon and water cycles; and also mass and energy transfers between the land and atmosphere. Further, accurate estimates of cropland GPP can be integrated into crop production models, thus having implications to improving farm management practices and food security. Satellite-based models have been developed to monitor the GPP of several plant function types (PFT; e.g., forests, grasslands, cereal crops, broadleaf crops). Soil moisture has been indicated as an important variable for estimating carbon exchanges between the land and atmosphere. However, soil moisture conditions have historically been unavailable at scales appropriate for estimating GPP across regional or global scales. Resolving the limitation of soil moisture in estimating carbon flux is a key objective of NASA’s Soil Moisture Active Passive (SMAP) satellite mission, which has culminated in the development of the SMAP Level 4 Carbon (L4C). The L4C daily GPP record is available globally and uses NASA’s MODIS and SMAP satellites and also daily surface meteorology inputs (i.e., solar radiation, humidity, temperature). Validation of models like the L4C has been generally limited to areas where CO2 measurement towers are present. Here, we validate the L4C GPP model using a crop condition survey index (CCI) for two cereal crops (barley and spring wheat) and two broadleaf crops (corn and soybeans). The CCSI is a continuous representation of weekly crop condition surveys conducted at the field scale by farmers and provided by the United States Department of Agriculture (USDA) National Agricultural Statistics Service (NASS). The advantages of using the CCSI to validate the L4C are the two data sets are independent, and the CCSI is available at a high temporal resolution (weekly). We found moderate to very strong correlations (Pearson r values ranging between 0.5 and 0.8) between the CCSI and L4C. We also found that the correlations between the CCSI and L4C improves as the phenology progresses, with the highest correlations being observed when crops are mature (e.g., r: 0.8 for corn in Kansas), and observed lower correlations at earlier stages (e.g., r: 0.55 for silking corn in Kansas). The CCl is only available for individual US states but not for smaller areas like counties or agricultural districts. However, the L4C is available at a 9-km scale. As a result, we use the L4C to represent crop condition at each week during the growing season at a finer resolution that what is currently available through NASS. Finally, the potential for identifying the advent of crop stressing events based on daily GPP values from satellite driven models is discussed.

Discrete and continuous spatiotemporal trends of organic and inorganic carbon along the upper Clark Fork River, Montana, USA

**Author(s):** Fischer Young, Michael DeGrandpre, Maury Valett, Cory Beatty  
**UM Faculty Mentor:** Michael DeGrandpre, Chemistry and Biochemistry  
**Category:** STEM (Science, Technology, Engineering, Mathematics)

**Abstract / Artist Statement:**
As global climate continues to change, inland waters are increasingly recognized for their role in the global carbon budget. Uncertainties surrounding their role in how various forms of carbon are transported and transformed through these systems remain. Spatial and seasonal interactions between river and floodplain result in dynamic systems that exhibit different biogeochemical patterns through time. This study will focus on two key concepts to address inorganic and organic carbon characterization; (1) developing a method to accurately compute the partial pressure of CO2 (pCO2) from total alkalinity (AT) and spectrophotometric pH and (2) accurately characterizing the spatial and temporal variability of inorganic and organic carbon and their relationships along the upper Clark Fork River (UCFR), MT, USA. Dissolved organic carbon (DOC), an important carbon cycle parameter, has demonstrated large variability year-to-year (>83-1500 μmol carbon L-1) in the UCFR. This non-conservative annual trend of DOC highlights the potential to...
increase AT concentrations from non-carbonate species. Errors in carbonate system modeling (i.e. CO2sys) can arise from the presence of non-carbonate species and therefore contribute to the overall error in pCO2 computation. Furthermore, spectrophotometric pH has been proven to provide highly reproducible measurements over pH glass electrodes, which are known to produce systematically low pH values. Thus, using the characterized AT values in tandem with spectrophotometric pH will provide highly reproducible measurements for computing pCO2. Accurate characterization and measurements of inorganic and organic carbon through space and time is pertinent in strengthening our understanding of inland waters role in the global carbon budget.

Behavioral Stability in Old vs Young Rats
Author(s): Briana Young
UM Faculty Mentor: Nathan Insel, Psychology
Category: STEM (Science, Technology, Engineering, Mathematics)

Abstract / Artist Statement:
Neurons in the hippocampus fire action potentials when an animal is in a particular place in its environment (“place cells”). The population of place cells are thought to make a “cognitive map” of the environment, enabling the animal to remember and navigate locations upon revisiting them. The ability to accurately and predictably navigate an environment upon revisiting it may depend on the stability of this internal map. Some research has shown that map destabilization occurs more frequently in aged animals than young; although this is normally measured as a change of the whole map, less work has looked at more subtle measures of stability. The current study set out to examine the relationship between map stability and behavioral stability and whether there were differences in these relationships between young and aged animals.

The dataset was collected from 6 aged and 6 young rats over the course of roughly 30 spatial learning sessions per rat as they ran around a circular platform. Neuron activity data was collected from hippocampal area CA1, with over 20,000 spike trains (possible single neurons) recorded across all rats and sessions. Each rat ran approximately 40 laps in both directions (forward and backward) during a given session.

Prior analysis of the dataset showed some reduced map stability in older rats, as well as some behavioral impairment in older rats as they completed a Morris water maze (water-based navigation task). While previous analyses assessed large-scale changes in map stability (Schimanski et al., Journal of Neuroscience, 2013), detailed analyses on the consistency of behavior and neuron firing patterns from one lap to the next were not assessed.

We analyzed the change in mean radius (the animal’s distance from the center of the circular platform), over forward and backward laps around the circle. Our preliminary analysis of the data suggests that the behavioral patterns of younger animals stabilize more than those of older animals, both across multiple sessions (including exit from and reintroduction to the maze) as well as across laps within a single session. The next step in this process will be analysis of the neural data.

This research is important because, although much information has been gathered about the internal patterns of activity within the hippocampus, far less is known about 1) the relationship between internal map stability and the development of consistent movement behavior and 2) whether these patterns differ between young and old animals. A better understanding of these relationships will enable us to form hypotheses about how spatial representations and their relationship with behavior might vary depending on age.

Determination of relative contribution of non-dissolved fractions of zinc oxide nanoparticles on membrane permeability
Author(s): Tahereh Ziglari, Andrij Holian, Donald Anderson
UM Faculty Mentor: Andrij Holian, Department of Biomedical & Pharmaceutical Sciences
Category: STEM (Science, Technology, Engineering, Mathematics)

Abstract / Artist Statement:
Inhalation exposure of zinc oxide nanoparticles (ZnO NP) leads to acute pulmonary inflammation. While the crucial role of lysosomal membrane permeabilization (LMP) in NP-induced inflammatory responses has been recognized, the underlying mechanism of LMP is still unclear. Some studies have related ZnO-induced LMP to zinc ions, however, little is known about the role of ZnO NP in ZnO toxicity. We examined the contribution of ZnO NP on plasma membrane permeability using red blood cells (RBC) and undifferentiated THP-1 as models of particle-membrane
interactions. The integrity of plasma membranes was evaluated by transmission electron microscopy and confocal microscopy following staining with Di-4-ANEPPDHQ. ZnO NP dissolution was determined using ZnAF-2F, a fluorescent probe for quantitation of zinc ions. The stability of ZnO NP was determined inside the phagolysosomes of professional phagocytic cells. With negligible dissolution in the hemolysis buffer or RPMI media, ZnO NP caused significant hemolysis or cytotoxicity. Fully ionized zinc sulphate as positive control of zinc ion caused slight hemolysis. In comparison, partially ionized ZnO caused significant hemolysis. Confocal microscopy and transmission electron microscopy images did not reveal membrane disruption in RBC and THP-1, respectively. ZnO NP remained intact inside the phagolysosomes after a 4-hr incubation with professional phagocytic cells. The results suggest that ZnO NP independent of zinc ion could cause plasma membrane permeability.

Control on Bedrock Recharge and Discharge in Mountainous, Headwater Catchments

Author(s): Kimberly Bolhuis
UM Faculty Mentor: W. Payton Gardner, Geosciences
Category: STEM (Science, Technology, Engineering, Mathematics)

Abstract / Artist Statement:
Mountains in arid and semi-arid regions receive a disproportionately large amount of precipitation compared to their bounding valley aquifers due to orographic effects. These mountain blocks are responsible for supplying over half of intermountain aquifer water resources. However, little is known about how much and where mountain precipitation infiltrates into the mountain block bedrock. Many conceptual and numerical hydrologic models treat the bedrock as an impermeable barrier relative to the soil mantle, partitioning flow on the hillslope and in the catchment to subsurface (e.g. the soil mantle) and surface (e.g. streams) reservoirs. Recent research has illuminated dynamic interactions between soil and bedrock reservoirs on research hillslopes around the world, indicating that bedrock permeability strongly influences the magnitude of bedrock groundwater recharge and watershed response dynamics.

This study focuses on a) the controls on the magnitude and variance of recharge to the bedrock in space and time, and b) the role the bedrock reservoir plays in storing and releasing water. Recharge and hydrologic connection at the hillslope scale is evaluated using observations of water table dynamics in nested soil and bedrock wells across a various landscape position. Bedrock permeability is estimated using core samples and outcrop fracture mapping. Stable water isotope and geochemical samples of precipitation, soil and bedrock groundwater, and stream water are used to evaluate the recharge magnitude to the mountain block at the hillslope and watershed scale. Well hydrographs and discharge observations in two watersheds underlain by bedrock of disparate permeabilities are used to evaluate the response of the watershed to snowmelt and storm events.

The watershed with more permeable bedrock showed a slow and subdued response to precipitation inputs, while the catchment with less permeable bedrock exhibited a more rapid and flashy response to precipitation inputs. Observation wells screened below the soil-bedrock interface exhibited a hydraulic response to snowmelt. There was a distinct difference in timing and shape of bedrock well hydrographs between the two watersheds. The observed d2H and d18O values for bedrock groundwater and for baseflow are similar. The bedrock groundwater and baseflow isotopic values are heavier compared to depth-integrated snowpack isotope values.

These results indicate the significant role bedrock architecture and bedrock groundwater play in upland catchments. This research expands the current knowledge of the seasonality, magnitude, and controls on recharge to the bedrock reservoir in mountainous terrain. Recharge and groundwater flow within mountain blocks in the Western U.S. constitute the source of intermountain valley water resources. This illustrates the importance of understanding the role that bedrock architecture plays in partitioning and transmitting flow within mountain blocks. Thus, the study of recharge and mountain block hydrology is imperative for evaluating water resources in a changing climate.
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