Trinity University
Summer Undergraduate Research Conference

July 25-26, 2017

33rd Annual
Department of Chemistry Research Symposium

12th Annual
Summer Undergraduate Research Conference
Summer Undergraduate Research at Trinity

The first Undergraduate Research Symposium was sponsored by Trinity’s Chemistry department in 1984 and involved 10 participants, although summer undergraduate research has been going on at Trinity since the 1950s. Since the first symposium, Trinity’s Summer Undergraduate Research Program has grown to involve more than 150 students and 70 faculty members in 2017.

The Welch Foundation has supported student and faculty researchers in chemistry since 1997. In addition, grants from the Merck Foundation (2001-2009) and the W. M. Keck Foundation (2003) supported research collaborations between biologists and chemists. The Tim and Karen Hixon Endowment (2013) supports students in summer research in environmental studies, and is awarded for work in the physical sciences, environmental policy or justice, and the humanities.

Grants in 2004 and 2008 from the Howard Hughes Medical Institute provided summer research fellowships for students in addition to transforming Trinity’s curricular offerings in the sciences and enhancing outreach to local schools.

The National Science Foundation (NSF) supported Research Experiences for Undergraduate (REU) Programs at Trinity in chemistry (1989-2000), mathematics (1997-2008) and computer science (2008-2010). In addition to individual faculty research grants, NSF currently supports Trinity programs for scholarships for STEM majors (FAST and FASTER Programs). In addition, the Beckman Foundation supports undergraduate research in Biology, Chemistry, and Neuroscience.

In recent years, undergraduate research in non-STEM fields have developed and grown. In 2008, Trinity started a Ronald E. McNair Post-Baccalaureate Achievement Program with funding from the U.S. Department of Education. In 2011, Trinity launched the Murchison Fellowships program, which funds summer projects proposed by faculty-student teams. The University also supports research opportunities through operating funds. In 2013, Trinity received support from the Andrew W. Mellon Foundation to support undergraduate research in the arts and humanities. Summer research experiences are also supported in Urban Studies thanks to a grant from the San Antonio Housing Authority. Entrepreneurship students are also engaged in scholarly experiential learning due to grant funding from the Stumberg Foundation and the 80/20 Foundation.

This year’s conference will include more than 150 posters and oral presentations as well as presentations from undergraduates at other institutions in San Antonio.

I hope that you enjoy the 2017 Trinity University Undergraduate Research Conference.

-Scott M. Brown, Ph.D., Assistant Director of Experiential Learning
Conference Schedule At-A-Glance

Tuesday, July 25, 2017
3:00 – 5:30 p.m.
Opening Reception & Poster Session
Location: Center for Sciences & Innovation Atrium & Design Cube

Wednesday, July 26, 2017
8:15 – 10:00  Multidisciplinary Session A  CSI 102
8:15 – 10:00  Multidisciplinary Session B  CSI 104
8:45 – 10:25  Chemistry Symposium Session A  CSI 437
10:15 – 12:00 Multidisciplinary Session C  CSI 102
10:15 – 12:00 Multidisciplinary Session D  CSI 104
10:35 – 12:10 Chemistry Symposium Session B  CSI 437
11:45 – 1:15  Lunch (for presenters & mentors)  CSI Atrium
1:15 – 3:00  Multidisciplinary Session E  CSI 102
1:15 – 3:00  Multidisciplinary Session F  CSI 104
1:30 – 3:25  Chemistry Symposium Session C  CSI 437
3:15 – 4:30  Multidisciplinary Session G  CSI 102

*Pre-conference Chemistry, Neuroscience, and Biology presentation schedule (Nos. 135-140) comes after general poster and oral presentation schedule.
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<td>Images, Administrators, and Archives: Seals in the Persepolis Fortification Archive</td>
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## Oral Presentations

**Multidisciplinary Session A ● Wednesday, 8:15-10:00 AM**

**Moderator: Dr. Heather Sullivan**

**CSI 102**

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<td>76</td>
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## Multidisciplinary Session B ● Wednesday, 8:15-10:00 AM

**Moderator: Dr. Kimberlyn Montford**

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**Moderator: Dr. Norma Cantu**  
**CSI 102**

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### Multidisciplinary Session D  ●  Wednesday, 10:15 – 12:00 PM
**Moderator: Dr. Benjamin Stevens**  
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### Multidisciplinary Session E ● Wednesday, 1:15 – 3:00 PM
**Moderator: Dr. Mario Gonzalez-Fuentes**
**CSI 102**

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<tr>
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<tbody>
<tr>
<td>100</td>
<td>1:15</td>
<td>Feeney</td>
<td>Dual-stream Neural Network for Camera Localization</td>
<td>Zhang</td>
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<tr>
<td>101</td>
<td>1:30</td>
<td>Grand</td>
<td>Politics, Religion, and The British Armed Associations of the 1790's</td>
<td>Coltharp</td>
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<tr>
<td>102</td>
<td>1:45</td>
<td>Phillips</td>
<td>Western Perspectives of Chinese-Language Cinema</td>
<td>Zhang</td>
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<tr>
<td>103</td>
<td>2:00</td>
<td>Edwards</td>
<td>Estimating the Effects of Media Narratives on Asset Prices</td>
<td>Huston &amp; Spencer</td>
</tr>
<tr>
<td>104</td>
<td>2:15</td>
<td>Rodriguez, C.</td>
<td>Writers of the Borderlands</td>
<td>Cantú</td>
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<tr>
<td>105</td>
<td>2:30</td>
<td>Stein</td>
<td>Visualizing Dynamical Systems With dsmodels</td>
<td>Fogarty</td>
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<tr>
<td>106</td>
<td>2:45</td>
<td>Stone</td>
<td>Mapping Star Formation in the Nearby Universe</td>
<td>Pooley</td>
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### Multidisciplinary Session F ● Wednesday, 1:15 – 3:00 PM
**Moderator: Dr. Dennis Ugolini**
**CSI 104**

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<tr>
<td>107</td>
<td>1:15</td>
<td>Azua</td>
<td>Dos Lenguas: Codeswitching in Contemporary Poetry</td>
<td>Browne</td>
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<tr>
<td>108</td>
<td>1:30</td>
<td>Payne &amp; Horr</td>
<td>Use It and Lose It? Behavioral and Energetic Influences on Lizard Tail Autotomy</td>
<td>Johnson</td>
</tr>
<tr>
<td>109</td>
<td>1:45</td>
<td>Tincher</td>
<td>X-Ray Sources in Dense Star Clusters</td>
<td>Pooley</td>
</tr>
<tr>
<td>110</td>
<td>2:00</td>
<td>Sun</td>
<td>Rationality of Attacker Decisions in Stackelberg Games</td>
<td>Jiang</td>
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<td>111</td>
<td>2:15</td>
<td>Mitchell</td>
<td>Machetes, Mutants and Music: Orpheus in Modern Myth</td>
<td>Stevens</td>
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<tr>
<td>112</td>
<td>2:30</td>
<td>Nguyen, T.</td>
<td>What’s Done is Donne: Analyzing Misogyny in Elegy 19</td>
<td>Salomon</td>
</tr>
<tr>
<td>113</td>
<td>2:45</td>
<td>Tickner</td>
<td>Using Star Formation to Investigate Intermediate Mass Black Holes</td>
<td>Pooley</td>
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### Multidisciplinary Session G ● Wednesday, 3:15 – 4:45 PM

**Moderator:** Dr. Kelly Lyons  
**CSI 102**

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<tr>
<td>115</td>
<td>3:30</td>
<td>Turner</td>
<td>Correcting Vision in Virtual Reality</td>
<td>Hibbs</td>
</tr>
<tr>
<td>116</td>
<td>3:45</td>
<td>Whitacre</td>
<td>Roman World Lab: The Walking Talking Cross</td>
<td>Dupertuis</td>
</tr>
<tr>
<td>117</td>
<td>4:00</td>
<td>Yang</td>
<td>Music Genre Classification Using Neural Networks</td>
<td>Hibbs</td>
</tr>
<tr>
<td>118</td>
<td>4:15</td>
<td>Nguyen, N.</td>
<td>Anti-Chinese Sentiment in Contemporary Vietnam</td>
<td>Montoya</td>
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### 33rd Annual Department of Chemistry Research Symposium

**Chemistry Session A ● Wednesday, 8:30-10:25 AM**  
**Moderator:** Dr. Laura Hunsicker-Wang  
**Center for Sciences & Innovation 437 (Treehouse)**

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<tbody>
<tr>
<td>119</td>
<td>8:45</td>
<td>Karla &amp; Kodadek</td>
<td>Induced Fit Binding of Insulin B1-11 With Cucurbit[7]uril in Aqueous Solution</td>
<td>Urbach</td>
</tr>
<tr>
<td>120</td>
<td>9:00</td>
<td>Anderson</td>
<td>Fluorogenic Polymerization for Signal Amplification: Monomer Synthesis and Characterization</td>
<td>Cooley</td>
</tr>
<tr>
<td>121</td>
<td>9:15</td>
<td>Peterson &amp; Whittaker</td>
<td>Understanding the Role of Water in H 2 Oxidation over Gold Nanoparticle Catalysts</td>
<td>Pursell &amp; Chandler</td>
</tr>
<tr>
<td>122</td>
<td>9:30</td>
<td>Schreib, Goldstein, Hernandez, Bowman, Lucas, &amp; Potts</td>
<td>Elucidating the role of Dib1 in pre-mRNA splicing</td>
<td>Maeder</td>
</tr>
<tr>
<td>123</td>
<td>9:50</td>
<td>Hopps &amp; Tahseen</td>
<td>Fluorogenic Polymerization for Signal Amplification: Optimization in Aqueous Media</td>
<td>Cooley</td>
</tr>
<tr>
<td>124</td>
<td>10:10</td>
<td>Contreras</td>
<td>First survey of solution-state carbon-13 NMR spectra of ambers</td>
<td>Lambert</td>
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</table>
**Chemistry Session B ● Wednesday, 10:35 – 12:10 PM**  
**Moderator: Dr. Christina Cooley**  
**Center for Sciences & Innovation 437 (Treehouse)**

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<tbody>
<tr>
<td>125</td>
<td>10:35</td>
<td>Devlin &amp; Hofman</td>
<td>Investigating the role of reactive ligating histidines in H+ translocation at the CuA site of cytochrome c oxidase</td>
<td>Hunsicker-Wang</td>
</tr>
<tr>
<td>126</td>
<td>10:55</td>
<td>Potts</td>
<td>U5 and Dib1: Exploring interactions between essential splicing components</td>
<td>Maeder</td>
</tr>
<tr>
<td>127</td>
<td>11:10</td>
<td>Boms, Hirani, &amp; Taylor</td>
<td>Structure-Activity Studies of Dipeptide Recognition by Cucurbit[8]uril</td>
<td>Urbach</td>
</tr>
<tr>
<td>128</td>
<td>11:40</td>
<td>Hand, Guzman, &amp; St. John</td>
<td>Using 1-Octyne Hydrogenation and Selective Titrations to Characterize Gold Catalysts</td>
<td>Chandler</td>
</tr>
</tbody>
</table>

**Chemistry Session C ● Thursday, 1:30 – 3:25 PM**  
**Moderator: Dr. Adam Urbach**  
**Center for Sciences & Innovation 437 (Treehouse)**

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<tbody>
<tr>
<td>130</td>
<td>1:50</td>
<td>Allen &amp; Sackey-Addo</td>
<td>Fluorogenic Polymerization for Signal Amplification: Real-World Applications</td>
<td>Cooley</td>
</tr>
<tr>
<td>131</td>
<td>2:10</td>
<td>Kohler</td>
<td>Using Chemical Modification to Understand the Reduction Potential and Reactivity of Ligating Histidines in the Rieske Protein</td>
<td>Hunsicker-Wang &amp; Hoke</td>
</tr>
<tr>
<td>132</td>
<td>2:25</td>
<td>Babcock &amp; Koeller</td>
<td>Multivalent Studies with Cucurbit[n]uril Hosts</td>
<td>Urbach</td>
</tr>
<tr>
<td>133</td>
<td>2:40</td>
<td>Moore</td>
<td>Gold Nanoparticle Selective Hydrogenation of Alkynes</td>
<td>Chandler &amp; Pursell</td>
</tr>
<tr>
<td>134</td>
<td>2:55</td>
<td>Wheatley</td>
<td>Structure-Activity Studies of Multivalency in DNA Recognition</td>
<td>Urbach</td>
</tr>
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</table>
**Pre-Conference Oral Presentations ● Tuesday, 1:00 – 2:30 PM**  
Chemistry, Neuroscience, & Biology Session  
**Moderator: Dr. Frank Healy**  
CSI 102

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<tbody>
<tr>
<td>135</td>
<td>1:00</td>
<td>Henderson</td>
<td>Establishing the Role of Rieske Protein Reduction Potential in the Formation of Reactive Oxygen Species in Complex III</td>
<td>Hunsicker-Wang</td>
</tr>
<tr>
<td>136</td>
<td>1:15</td>
<td>Lee &amp; Mask</td>
<td>Exploring the Tail Region and Stability of Protein Dib1</td>
<td>Maeder</td>
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<tr>
<td>137</td>
<td>1:30</td>
<td>Alvarez &amp; Nguyen</td>
<td>Lipid Composition of Astrocyte Secretions: Change as a Function of Age</td>
<td>Roberts</td>
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<tr>
<td>138</td>
<td>1:45</td>
<td>Pu</td>
<td>Purification and analysis of WS5995 angucyclinones from <em>Streptomyces acidiscabies</em></td>
<td>Healy</td>
</tr>
<tr>
<td>139</td>
<td>2:00</td>
<td>White &amp; Mudekunye</td>
<td>ZO-1 Plays a Role in the Stability of Tight Junction and Cytoskeleton of Epithelial Cells</td>
<td>King</td>
</tr>
<tr>
<td>140</td>
<td>2:15</td>
<td>Brietske &amp; Palmer</td>
<td>Synthesis and Evaluation of ROS-Activatable Proteostasis Regulators</td>
<td>Cooley</td>
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**Abstracts**

The following pages are presentation abstracts. This legend may be used for authors:

Names in **bold** are current undergraduate students.  
Names followed by an asterisk (*) are presenters.  
Names underlined are current faculty mentors.
The Federal Swing Band: A Lost Chapter in San Antonio’s Jazz History, 1936-1943

Dillon Akins*, Carl Leafstedt, Ph.D.

Inspired by a recently discovered, World War 2-era photograph of nine unidentified San Antonio jazz musicians playing together, our research focuses on a widely popular swing band funded by the Federal Music Project, a subprogram of FDR’s Works Progress Administration (WPA). This ensemble had no formal name; instead, it was colloquially referred to with titles such as the “WPA Negro Band,” the “WPA Colored Orchestra,” and sometimes — with an air of pride — the “Federal Swing Band.” Formed in 1936, San Antonio’s Federal Swing Band frequently played in public community centers, such as the Library Auditorium and St. Philip’s College, and on the city’s military bases. It is little remembered today. Using oral history interviews, archival research, historic newspaper databases, and background readings, we’ve successfully begun the process of resurrecting the Federal Swing Band from the dustbin of history. We’ve identified several of its musicians. Its place within the Federal Music Project in San Antonio is becoming clearer, too, in part due to a research trip to Washington, D.C., where we spent three days reviewing WPA records held at the Library of Congress and the National Archives.

In an era of segregation, the Federal Swing Band quickly became an important part of San Antonio’s music history for African Americans. It sustained the careers of talented musicians in our city, including, perhaps most prominently, the talented boogie woogie pianist Lloyd Glenn, who went on to a successful West Coast career. Documenting the activities of this long-forgotten ensemble helps restore a broader sense of San Antonio’s leading position in the history of jazz music in Texas.

Funding: Murchison
Images, Administrators, and Archives: Seals in the Persepolis Fortification Archive

Dr. Mark B. Garrison and Benjamin F. Brody*

This project is part of a larger research initiative, based out of the University of Chicago, to study the Persepolis Fortification archive, a massive hoard of clay administrative documents discovered at Persepolis in southwestern Iran in 1933. The archive represents the records of an agency that managed the storage, transfer, and disbursement of rations in the region of Persepolis and an area stretching to the northwest. The records, written in Elamite and Aramaic, date to the years 509-493 BCE.

Individuals involved in this administrative system signified their presence at transactions and/or their authorization for transactions via the application of seals. These seals, generally cylindrical pieces of stone or metal, had imagery carved in the negative. When rolled across the still damp clay document, the seal left a raised impression of the figural imagery. These impressions then functioned much the same as signatures do now.

This project involves linking particular seals, or signatures, to individuals named in the tablets. My goal has been to establish an “administrative commentary” for a cluster of seals in the archive. These commentaries provide for each seal a summary that articulates: 1) how a seal is applied to tablets (i.e., on what surfaces); 2) in what types of transactions it is involved; 3) with what type of commodities it is involved; and 4) with which named officials/offices it is linked.

The poster provides a case study of the research process required for seal attribution; in this instance seal PFS 82*. This case study is accompanied by background information on the Fortification archive as well as examples of the insights into ancient life that have resulted from its study. As a whole, the poster demonstrates both the physical and cognitive processes that attribution entails and invites the viewer to engage in them directly.

The linkage of seals to individuals/offices is a critical first step in understanding the ways in which images functioned in the greater socio-administrative landscape of southwestern Iran in the early Achaemenid period. The ability to attribute specific images to specific individuals, individuals about whom (via the tablets in the archive) we often know quite detailed information, has shown that images communicated multiple messages of social significance. The greater our understanding of these linkages between individuals and images, the greater our ability to explore the social dimensions of art.

Funding Source: Mellon Foundation
How to Make a City

Beverly Morabito*, Kyle Gillette

The novel *Invisible Cities* by Italo Calvino serves as the inspiration for the performances of the same name created by the theater company Teatro Potlach based in Fara Sabina, Italy. Dr. Gillette is working on a book entitled *The Invisible City*, which combines documentation of the history of the performances with his own travel experiences and memories. I am creating illustrations for this book as well as writing and illustrating my own children’s book.

My book is a collection of stories that explore what it means for something to be a city. It is inspired by the imagination of the original novel by Calvino, the performances by Teatro Potlach, and our travel this summer to Fara Sabina. My research consists primarily of making observant sketches, writing travel notes, and reading through the archives of Potlach’s past performances. In my book I suggest by slowly taking away the things that make up a city, such as buildings, people, and underground pipes, that the essence of a city is not dependent on any one thing or any specific combination of things. The stories are meant to evoke the feeling of travel and the impossible amount of invisible details that give a city its identity.

Funding Source: Mellon Initiative
The Butterfly Project

Andrea Acevedo*, Aaron Delwiche

Immigration is at the center of political debate around the world. The dialogue behind the debate is rooted in the effects that immigrants have once they get to a country, largely ignoring the stories of immigrant’s journeys. When the perspectives of immigrants are told, they exist within the realms of written journalism and video. While these stories are meant to reach wide audiences, most journalistic mediums give the viewer a role of an observer rather than a participant. The Butterfly Project seeks to bridge this gap using virtual world development tools to recreate a variety of immigration detention centers, which are a part of the US immigration system, in an interactive virtual reality simulation. The virtual environment will give users an opportunity to immersively experience and participate in a simulation of the immigration system, revealing the difficulties that refugees must encounter when entering the US. For this project, models of real world places were digitally recreated in 3D to be viewed in virtual reality using existing photographs, videos, and written records of immigration detention centers like the Karnes County Residential Center for reference points. Using a virtual reality headset, participants will be guided through different immigration detention centers where they can enter the rooms and see how refugees are processed and housed under the care of U.S. Immigrations and Customs Enforcement. Social virtual worlds offer unique forms of immersion and engagement and are an ideal medium for documenting and sharing stories. Within these digital environments, embodied users are introduced into simulations of real-world physical spaces, where they can interact with other embodied users, navigate a vast ocean of multimedia content, and transcend limitations associated with the physical world. This immersive project will allow users to be active participants as they learn more about the conditions that refugees encounter in order to create a wider understanding of the obstacles that immigrants encounter on a search for a better life.

Funding Source: Mellon Initiative at Trinity University
Posters Session

Presentation 5

**Surveying Classical Traditions in Science Fiction: Ancient Epic in The Works of Ursula K. Le Guin**

Ariana Fletcher-Bai*, Dr. Benjamin Eldon Stevens

Reception studies is a relatively new field in Classics that was pioneered by scholars such as Charles Martindale and Lorna Hardwick. Building on the original paradigm of viewing classical texts as transmitted through time, it focuses on the importance of adaptation and interpretation. The field still involves some controversy; perhaps as a result, reception studies has tended to focus on media that are viewed as “high culture.” Studies of classical receptions in popular culture are thus less adequately explored and lack some essential scholarly tools to aid research.

To help address the lack of resources available to scholars wishing to study receptions in popular culture, Isaiah Mitchell and I have worked under Dr. Stevens’ supervision to create and to start populating a database of classical receptions in science fiction and fantasy. We are pleased to report that there is a vast and rich store of classical receptions within science fiction and fantasy in our compiled database, ready for more detailed examination. I will be creating a poster to display our findings and to spread awareness and access to our scholarly database.

That work has involved historical and critical surveys of science fiction. In that context, I have also worked on personal research into ancient epic themes in Ursula K. Le Guin’s ‘Hainish Cycle’ including The Dispossessed and Rocannon’s World. My research has led me to argue that Le Guin’s works have both historically backed connections and structural parallels to epic poetry—for example, Virgil’s *Aeneid* and Homer’s *Odyssey*—that are worthy of study as classical receptions.

By creating both in-depth individual studies in classical receptions and a growing database of classical receptions in science fiction and fantasy, this project provides both new input and a much needed scholarly resource for a burgeoning modern field in classical studies.

Funding Source: Mellon Foundation
St. Anthony’s Lost and Found: Letters to San Antonio

Madeline Kennedy*, Jenny Browne

San Antonio’s upcoming Tricentennial celebration will commemorate the complex culture and history of our city with special attention to lesser-known people, events, and institutions. While most San Antonians are familiar with the more celebrated stories of the city, other elements of San Antonio’s past have been overlooked by both history and common memory. Building on St. Anthony’s Lost and Found: A Poetry Exchange, San Antonio Poet Laureate Jenny Browne’s signature initiative, St. Anthony’s Lost and Found: Letters to San Antonio will return lost or forgotten stories from our city’s history in the imagined voice of St. Anthony. By examining and illuminating fourteen moments, individuals, and scenes that we feel deserve wider recognition and rendering them in an epistolary form, St. Anthony will guide visitors on a journey that will introduce them to concrete moments of lost history. His letters will inform visitors about stories from across the city’s spatial and temporal history, including the development of St. Phillip’s College, the first Supreme Court case addressing Mexican-American rights, Hernandez v. Texas, and the grassroots efforts behind the founding of Government Canyon State Natural Area. After viewing the exhibit (March-May 2018), each visitor will be asked to write a letter back to San Antonio to moments of their own story they would like to be found. This collaborative project will bring light to overlooked pieces of San Antonio and will connect the public to an array of the figures and events that made San Antonio what it is today.

Funding Sources: The Herndon Fund, Trinity University’s Department of English, and the City of San Antonio, support from the Mellon Foundation.
Roman World Lab: The Relationship Between the Canonical Gospels and *The Gospel of Peter*

Caroline Kerley*, Dr. Ruben Dupertuis

Since its discovery in the winter of 1886/1887, much of the scholarly conversation and debate on *The Gospel of Peter* has centered on the question of the relationship between this fragmentary passion narrative and the more well-known canonical gospels. While a consensus about the relationship is emerging, access to these debates has been limited to specialists. This is in part because tools that facilitate comparison for canonical texts, such as side-by-side comparison, have not included *The Gospel of Peter*.

This summer, I have created a review of the scholarship on this question and a comparison tool that places the passion narratives from all four of the canonical gospels and *The Gospel of Peter* side-by-side. This will make it easier to see content parallels and make interpretations. A synoptic view of *The Gospel of Peter* alongside the canonical gospels helps support the conclusion of scholars such as Paul Foster that *The Gospel of Peter* is dependent on some canonical gospels more than others, and that even where there are clear parallels *The Gospel of Peter* can vary significantly. My goal is to publish both of these tools on an open source website in order to make them available to students and professional researchers alike.

Funding Source: Mellon Initiative
Mentes Fuertes: A Mental Health Initiative at The Martinez Street Women’s Center

Janett Muñoz*, Dr. Alfred Montoya and Norma Gonzalez

The Martinez Street Women’s Center (MSWC) is located in the Eastside Promise Neighborhood territory, an area that has been segregated from the rest of San Antonio physically, financially, and educationally. The disparities in poverty, education, and health have previously been linked to mental health problems. Due to the lack of mental health support and access of services for the Eastside community, Mentes Fuertes: A Mental Health Initiative has been created using the framework of the social determinants of health model. Specifically, our goals include reducing the stigma associated with mental illness, fostering a public positive learning environment for what it means to be mentally healthy through lectures, and providing direct services to support personal growth. For example, yoga is an activity that is shown to reduce the factors that may lead to mental health issues. A three question pre and post survey were collected from elementary school students in the MSWC Girls Zone summer camp. The results showed a positive statistical significance in terms of the girls’ happiness and calmness.

Funding source: Ronald E. McNair Postbaccalaureate Achievement Program
Stigma, Discrimination, and the Social/ Cultural Determinants Surrounding HIV/AIDS Individuals

Michelle Nguyen*, Robert Huesca

The experiences of individuals living with HIV/AIDS are strongly affected by and shaped through misconceptions, stigma, discrimination, and the cultural/ social determinants surrounding this pandemic. The limited knowledge and silence surrounding HIV/AIDS often cause hesitation when it comes to disclosing one’s status, seeking treatment, and maintaining care, fueling further feelings of negativity and self-stigma. Likewise, the social meaning and cultural context surrounding HIV/AIDS can lead to risky behavior and increase one’s exposure to HIV. This study seeks to better understand ways in which individuals with HIV are stigmatized and discriminated against. It includes a literature review regarding HIV-related stigma and original research drawing on ethnographic research, client interactions, and interviews with 40 participants. Purposive sampling was used to recruit participants who previously received an HIV test and were willing to share their perceptions, experiences, feelings, and thoughts about HIV/AIDS. This data illustrates that stigma manifests itself in highly variable ways and that everyone’s experiences differ depending on their support systems.

Funding Source: McNair Scholars Program.
Paradoxes of Gender Equality Policies and Domestic Working Conditions in Madrid

Zabdi Salazar*, Dr. Blanco-Cano

Madrid has experienced a significant integration of Latin American immigrant women in its domestic service labor market since 2005. The general sentiment among Madrileños is that the phenomenon benefits both Spanish working mothers and immigrant women, but despite the ILO’s (International Labour Organization) 2011 convention on expanding the rights of domestic workers, the implementation of such rights under Spanish law has fallen short. Current academic literature on the issue of migration focuses on immigration law, attitudes, and practices. It also examines the intersection of gender, race, age, and educational attainment. We explored paradoxes between the Spanish government’s goals of gender equality and some of the realities of domestic working conditions for Latin American women. Subsequently, we asked the question: Do gender equality policies of Madrid’s local government exclude and marginalize Latin American immigrant women in the domestic service sector or to what extent do they benefit such women? Through survey data, personal interviews with Latin American women in the domestic service sector, and a review of literature on gender equality theory, we found that the local government’s priorities on gender equality are contradictory and myopic, even purposely blind. Even though domestic workers report relative respect and economic gains, they experience the effects of inequality under the law and limited opportunities for advancement. Such findings warrant further investigation of gender equality policies and analyzing the extent of societal integration of Latin American women immigrants.

Funding Source: Ronald E. McNair Post-baccalaureate Achievement Program
Maury Maverick was one of the strongest defenders of civil liberties of his time. Mayor of San Antonio from 1939 - 1941 and formerly a United States Congressman, Maverick’s political philosophy was defined by his beliefs in extending civil liberties - especially the rights to free speech and assembly – to all citizens, regardless of political beliefs. In August 1939, Maverick approved a permit to allow the local Communist Party use of the Municipal Auditorium. The auditorium had been dedicated as a memorial to those who had died in World War I, and his opponents fought the meeting permit bitterly. The clash culminated in 5,000 people, including leaders of the Catholic Church, American Legion, Elks Club, and KKK, gathering to protest the meeting. Ultimately, the protesters caused thousands of dollars in damage to the auditorium. The fallout from the meeting began two movements to recall Maverick from the mayor’s office and eventually lead to his indictment on felony charges of paying the poll taxes of the International Ladies’ Garment Workers Union members. Despite the intense backlash Maverick received from his decision, his stance remains one of the strongest displays of support for civil liberties in San Antonio history.
Roman World Lab: Making Apuleius’ *Metamorphoses* Accessible

Andrew Tao*, Dr. Timothy O’Sullivan

The peculiar nature of Apuleius’ *Metamorphoses*, also known as the *Golden Ass*, has raised many questions in classical scholarship. This 2nd-century CE novel relates the adventures of Lucius, whose curiosity about magic leads him to be transformed accidentally into an ass. In the eleventh and final book, Lucius finally returns to his human form but also unexpectedly becomes a priest of the Egyptian goddess Isis, with religious, philosophical, and even autobiographical elements that strongly oppose the comic and, at times, erotic tone of the rest of the novel. Hence, there has been much work done in analyzing the so-called “Isis Book”, resulting in three major commentaries: one by Griffiths (Brill 1975); another by Keulen et al. (Brill 2015), part of the *Groningen Commentaries on Apuleius* series; and a third by Frédocuille (*Presses Universitaires de France* 1975). In contrast, there is a noticeable lack of material intended for the intermediate Latin student, which hinders the accessibility of the work. There exist two intermediate commentaries by Murgatroyd (Cambridge UP 2009) and Finkelpard (Bolchazy-Carducci 2012), but neither encompasses the unsimplified Latin of the entire book.

In my project, I aim to remedy this problem by creating an intermediate commentary on Book 11 that includes notes on vocabulary, grammar, and culture that will help an intermediate Latin student not only translate the text into English, but also understand more broadly what the text is saying. To do so, I have been performing close readings of the Latin while keeping in mind what supplementary information would be necessary for full comprehension.

This summer, I focused on the first six chapters (of the 30 in Book 11) and am looking towards continuing my work in the fall semester. When completed, this commentary will be published on an open-source model and will be available for use by readers of the *Metamorphoses* (e.g. HUMA and upper-division Latin students at Trinity and elsewhere); making the commentary available as an open-source text will allow for the widest possible distribution of the work.

Funding Source: Mellon Initiative
Do Borderline Personality Features and Attachment Insecurity Predict Outcome of Day Treatment for Personality Disorders?

Chase Acuff* & William Ellison

The presence of Borderline Personality (BP) features or attachment insecurity can negatively affect the outcome of psychotherapy. Clients with BP features have a high risk of dropping out of treatment, have slower remission of co-occurring disorders, and often disrupt other clients’ progress in therapy groups. High attachment anxiety has also been found to relate to poorer therapy outcome for a variety of disorders. Complicating this picture, individuals with BP features often have insecure attachment patterns (especially high attachment anxiety).

The current project investigated the influence of BP features and insecure attachment on outcome of a day treatment program for personality disorders in Edmonton, Canada. Specifically, hierarchical multiple regression was used to investigate whether BP features and attachment independently predict symptoms and functioning after treatment, controlling for pretreatment scores on the symptoms and functioning measures.

As expected, BP features, attachment insecurity, and symptom measures at pretreatment were strongly correlated. The regression analyses showed that higher scores on pretreatment measures consistently predicted higher posttreatment scores. Controlling for initial scores, neither attachment anxiety nor attachment avoidance were associated with outcome. BP features predicted outcome over and above initial scores in one instance: more severe BP features predicted worse outcome on the Brief Symptom Inventory. But for other measures, pretreatment scores were the only predictors of outcome. Implications of these findings for treatment of personality disorders are discussed.
The Effects of Wharton’s Jelly Mesenchymal Stem Cells in an *In-Vitro* Model of Bronchopulmonary Dysplasia

Yasmeen Alayli,* Samuel Kahlenberg, Alexis Corral, Caitlyn Winter, Alvaro Moreira

Bronchopulmonary dysplasia (BPD) is a chronic lung disease that develops in preterm neonates exposed to prolonged oxygen therapy and mechanical ventilation. Although BPD affects approximately 10-15,000 neonates annually, current methods to treat the condition remain palliative rather than curative. Advances in regenerative medicine suggest that mesenchymal stem cells (MSCs) may serve as potential therapeutic agents for BPD via their release of paracrine factors, engraftment into the host tissue, and/or organelle transfer. The purpose of this study was to investigate the effects of WJ-MSCs in an *in-vitro* model of BPD-induced oxidative stress.

MSCs were derived from human Wharton’s jelly umbilical cord tissue (WJ-MSCs) and identified according to the criteria (plastic adherence, specific surface antigen expression, and multipotent differentiation potential) set forth by the International Society for Cellular Therapy. Immortalized rat lung epithelial cells (RLE-6) were used to model the lung epithelium in neonates. RLE-6 cells were separated into three groups; a control group, an injured group, and a treatment group. Oxidative stress was induced in RLE-6 cells via exposure to 100 μM H2O2 as a means to emulate ischemic tissue damage. Afterwards, injured RLE-6 cells were exposed to either WJ-MSC conditioned media (treatment group) or a placebo treatment (injured group).

In this study, we are quantifying oxidative damage to the cells by RT-PCR, Lumigen reduction assay, and Western blot as well as examining cellular proliferation, motility, and senescence. We hypothesize that RLE-6 cells exposed to WJ-MSC conditioned media will exhibit reduced expression of pro-inflammatory and pro-fibrotic markers, reduced production of ROS, reduced cellular senescence, as well as improved cellular proliferation and motility.

Funding Source: Ronald E. McNair Postbaccalaureate Achievement Program, National Center for Advancing Translational Sciences, National Institutes of Health through Grant KL2 TR 001118; University of Texas Health San Antonio School of Medicine Clinical Investigator Kickstart Pilot Grant
Game-theoretic Goal Recognition Models with Applications to Security Domains

Samuel Ang*, Hau Chan, Albert Jiang, William Yeoh

We consider game-theoretic (GT) scenarios where an adversary must reach one of many targets in a monitored environment. A defender (unaware of the adversary’s intended target) must identify the adversary’s target though observing the adversary’s actions. Additionally, in the game-theoretic goal recognition design (GTGRD) setting, the defender can alter the environment (e.g., adding roadblocks) beforehand in order to better distinguish the target of the adversary. We propose to model game-theoretic goal recognition (GTGR) and GRGRD settings as zero-sum stochastic games with incomplete information regarding the adversary’s intended target. The games are played on graphs where vertices represent states and edges represent the adversary’s available actions. For the GTGR setting, we show that if the defender is restricted to playing only stationary strategies, the problem of computing optimal strategies (for both defender and adversary) can be formulated and represented compactly as a linear program. For the GTGRD setting, where the defender can choose K edges to block at the start of the game, we formulate the problem of computing optimal strategies as a mixed integer program, and present an additional heuristic algorithm based on LP duality and greedy methods. Experiments show that our heuristic algorithm achieves good performance (i.e., close to defender’s optimal value) with better scalability compared to the mixed-integer programming approach. In contrast with our research, existing work, especially on GRD problems, has focused almost exclusively on decision-theoretic paradigms, where the adversary chooses its actions without taking into account the fact that they may be observed by the defender. As such an assumption is unrealistic in GT scenarios, our proposed models and algorithms fill a significant gap in the literature.

Funding Source: Trinity University
Two Geoscience Software Development Projects

Dan Bomer*, Dr. Glenn C. Kroeger

We present preliminary progress on two geoscience software development projects. The first is a port of *The Earthquake Channel* to the Raspberry Pi platform. The Earthquake Channel is an application developed and distributed by IRIS, the Incorporated Research Institutions for Seismology, for driving public displays of real time earthquake epicenter data in settings such as museums, universities and schools. Originally developed to run on an Apple Mac Mini, we have adapted the software to run on the low cost Raspberry Pi. This adaptation will expand the use of this software by significantly lowering the cost of an installation and allowing the distribution of a completely configured system on microSD cards.

The second project is a prototype of a ternary plotting application. Ternary plots are a common tool for displaying data that depends on three variables in an equilateral triangle. Although a variety of ternary plotting programs exist, they are either poorly supported or costly and none are cross-platform. The goal of our project is a cross-platform application (Windows, macOS and Linux) with a modern user interface that will be distributed under an LGPL 3 free software license. We use the Qt development platform to achieve the desired cross-platform capability. Most of the work to date involves internal data structures, but a preliminary user interface will be shown.

Funding Sources: Ed Roy Endowment for Geoscience Activities and Research
Program Evaluation: Camp PowerUp

Karina Bridges*, Dr. Adelita Cantu

Camp PowerUp, sponsored by the American Diabetes Association, is a weeklong day camp for youth, ages 10-12 years at high risk for developing type 2 diabetes. Despite best efforts, San Antonio still faces a high rate of childhood obesity, especially in Hispanic/Latino populations. The purpose of this project is to implement and evaluate the efficacy of Camp PowerUp. The one week program was conducted at the west side YMCA and offers an educational and fun-filled environment that focuses on diabetes prevention, healthy nutrition, physical activity, and obesity prevention education. The program was evaluated using qualitative and quantitative data through pre/post surveys given to the youth as well as quantitative data through TANITA Body composition scores of exact body mass indexes (BMIs) of the campers pre-camp and three months after. The results of this program proved that Camp PowerUp had a positive impact with a 90% improvement on survey scores post camp as well as a significant decrease in the campers BMI scores.

Funding Source: Ronald E. McNair Postbaccalaureate Achievement Program
Engineering Marianist History

Mario Cancel*, Amber McClung, PhD., Juan Ocampo, PhD.

Traditional methods for reproducing works of art that produce a piece of the same quality as the original are arduous and time consuming. For sculptures, the methods for reproduction involved some form of casting, which could affect the surface detail of the original piece. The risks involved with transporting and displaying a ceramic piece are very high. There are several ways the piece could be damaged, making incorporating such fragile art in the classroom for learning a precarious endeavor. If replicas could accurately convey the detail and hard work that went into the original, students would become interested and motivated to visit the piece in person where it is safely on display. Due to the lower value of the replica, it would be much more feasible to bring it to an event or even pass it around in a classroom. With the 2017 bicentennial of the founding of the Society of Mary (Marianists) by Fr. William Joseph Chaminade, it is the perfect time to spark an interest in the community to get people to visit the office National Marianist Archive to learn more about the history of the Society of Mary.

This project was done to create a collaboration with the National Marianist Archive housed on St. Mary’s Campus and the Department of Engineering. Through this collaboration, replicas of historical artifacts from the Marianist Archive have been recreated. This has been done to test two hypotheses; replicas can be made more safely with scanning and 3d printing than by traditional methods and the quality of the 3d printed artifacts can be improved with a smoothing algorithm before printing. The artifact that has been recreated is a bust of Fr. William Joseph Chaminade that was sculpted by Father Ralph Dyer. It was chosen because the Marianist Archives also has the mold used to create the bust.

Four items have been printed at this point; an unedited version of the bust, a personally edited version of the bust as well as the front and back halves of the mold. So far, the data shows that a good point cloud can be obtained from the Einscan turn table scanner. The replica and the original bust are almost identical save for a few minor imperfections. A Laplacian smoothing algorithm will be used to smooth out the bust and will be compared to the original. In the future a Faro Scanarm will be used in place of the Einscan turn table scanner. Then, the scanner and Laplacian smoothing will be used to replicate the complex shapes of a propeller along with other aerospace components.

Funding Source: This research was supported by St. Mary’s University Summer Undergraduate Research Fellowship (SURF)
Steered MD Simulations of Binding Affinities of Multi-Purpose Anti-Alzheimer’s Drugs to Acetylcholinesterase

Skylar Cho*, Kelvin Kwan Cheng

Low acetylcholine signaling, high oxidative stress and high beta-amyloid load are known contributing factors to Alzheimer’s pathogenesis. Donepezil (ligand-Do) is the FDA approved drug to alleviate the symptoms of Alzheimer’s by inhibiting the acetylcholinesterase (AChE) activities in the brain. Recently, multi-purpose drugs, compounds that target multiple targets, like AChE’s inhibition, oxidative stress and beta-amyloid aggregation, have been proposed for therapeutic intervention of Alzheimer’s. In collaboration with the Pharmaceutical Sciences Department of the University of Incarnate World, we have initiated a multi-disciplinary project on investigating the binding affinity of several rationally designed compounds to various protein targets for Alzheimer’s treatments. Our current project focuses on AChE inhibition.

Using molecular docking, we have ranked a group of 15 compounds, including Do, according to the binding affinity energy with AChE. A high affinity binding candidate, ligand-9a and a low affinity candidate, ligand-9b, were identified. Unfortunately, conventional docking technique is performed on the crystal protein structure in vacuum, i.e., in the absence of water and salts. Here, we have designed three complexes in the presence of water and salts. They are Do/AChE, 9a/AChE and 9b/AChE. The initial structures were obtained from the corresponding docked structures in vacuum. We have successfully obtained equilibrated structures using a 100ps-position-restrained and 100ns-unrestrained Molecular Dynamics (MD) simulations at atmospheric pressure and room temperature. From the equilibrated structures, we have further performed a steered MD simulation/sampling procedure on each complex that involves a unidirectional pulling following by an umbrella sampling. The major goal of this integrated docking and MD simulation approach is to obtained biologically relevant
free energy of binding between the new drugs and targeted protein receptor.

Future work will involve a concerted effort of rational multi-purpose drug design, in-silico drug screening, and biochemical assays related to AChE inhibition, free radical scavenging (anti-oxidation) and inhibition of protein aggregation.

Funding Source:
1. NSF MRI-ACI-1531594
2. Williams Endowment Fund
Elevational distribution, abundance, and diversity of small mammals from Osa to the Tilaran Mountains

Javier De Luna*, Michaela Lieb*, Dr. David Ribble

Changing climates is affecting distribution and abundance of organisms across the globe. Costa Rica is an exceptional place to study the effects of climate change due to its topography and rich biodiversity. We studied the distribution and abundance of mammals from sea level to 1600 meters in order to begin to document any change. We live trapped small mammals using Sherman traps and recorded larger mammals using camera traps during the dry season of April 2016 and the wet seasons of December 2016 and June 2017. We documented ten species of small mammals and six species of large mammals including ocelots and a puma. Species richness of small mammals varied from a low of two species to a high of five. Locations within similar ecological life zones tended to have the same small mammal species. Finally, we observed variation in abundance across seasons and some variation in species presence or absence. This data will serve as an important starting point for the continued monitoring of mammals in Costa Rica.

Funding Source: Trinity University
Differentiating cell types and observing the time dependency of neuroplasticity caused by cocaine in Murine Dopaminergic neurons

Pierre Ferrer*, Dr. Gerard Beaudoin, Adam Litch, Parker Voit, Aamuktha Karla, Sarosha Hemani

Dopaminergic neurons located in Substantia Nigra pars Compacta (SNc) are theorized to play an important role in the learning and reward pathways of the brain. These pathways are directly responsible for the processes that can lead to the fixation of a behavior and even the development of an addiction. In the Beaudoin Lab, we use single cell patch clamp electrophysiology to study the effects of cocaine on murine dopaminergic neurons. A month prior to recording neural activity we inject the mouse with a virus. This virus forces the expression of Channelrhodopsin (a non-selective cation channel that activates with blue light). The injection is localized such that it only infects Glutamatergic cells of the Pedunculopontine Nucleus (PPN) which projects input to SNc. By innervating the Glutamatergic inputs with a blue laser we can observe any changes in the electrical behavior of the neuron. Such changes in activity help us discern how cocaine modifies the physiology of Dopaminergic neurons. Furthermore, by altering the timespans at which cocaine is introduced into the system we will be able to determine if its remodeling effects occur immediately after exposure or rather as an aggregate delayed response.

With this study we could further define how does cocaine directly affect the midbrain reward pathways. This could show that cocaine remolds cells individually and/or alters the Glutamatergic pathways which inevitably alters the fixating behaviors like addiction.

Funding Source: Trinity University, BSRF Fellowship
Analyzing Human Methylation Data using Multiple Open Source Computational Methods

Fordin, Sarah A.*; Rizzo, Heather E.*; Hibbs, Matthew A.; King, Jonathan M.

Methylation is a known epigenetic regulator in gene expression, and is of great interest to many researchers. There are multiple methods of detecting methylation on the genome, most yield extremely large data sets. These data sets may be perceived as difficult to process or describe in articles. Using data collected from the Illumina Infinium MethylationEPIC BeadChip, our objective is to demonstrate the processing pathway to study differential methylation in cord blood samples. Participants were selected based on approved IRB inclusion criteria, and cord blood samples were collected from neonates of non-diabetic normal weight mothers (n = 10), diabetic (gestational diabetes) normal weight mothers (n = 7), non-diabetic obese (BMI ≥ 30) mothers (n = 9), and diabetic (type II diabetes n = 2, gestational diabetes n = 4) obese mothers (n = 6), for a total sample size of n = 32. The collected DNA was purified from agranular leukocytes, treated through bisulfite conversion, and processed on an Illumina Infinium MethylationEPIC BeadChip to analyze over 850,000 different probe sites to determine methylation on a site-specific basis.

Data was preprocessed through RStudio by eliminating probe readings which were determined to be defective or faulty. Normalized data was analyzed in RStudio using the m-values derived from probe intensity levels, which measures the methylation intensity per probe. Statistical tests performed include Student’s t-test, false discovery rate (FDR) applied to t-tests, analysis of variance (ANOVA), and peak detection tests using a bump hunting function. These methods permitted investigators to narrow the search for differentially methylated sites. Additional tests were conducted through Gene Ontology Enrichment Analysis and Visualization Tools (GORilla) and the Database for Annotation, Visualization and Integrated Discovery (DAVID) to detect statistically overrepresented functions and/or processes at significantly differentially methylated regions. Using the processing pathway discussed we identified multiple significantly differentially methylated regions, from which we identified more than 100 significant genes between 32 individual samples and a total of eight different comparison groupings between samples. This processing pathway enabled us to extract the most relevant results, figures, and data out of our large data set; we narrowed our exploration from 850,000 probes to roughly 100 significant genes.

Funding Sources:
San Antonio Medical Foundation Grant,
Ronald E. McNair Postbaccalaureate Achievement Program Grant
Charles Darwin’s Abominable Mystery and The Sublime

Madelyn Gaharan*, Dr. Gregory Hazleton

On March 8, 1875, Darwin wrote a letter to the Swiss botanist Oswald Heer expressing deep confusion surrounding the pollination mechanisms of angiosperms after encountering the rapid diversification of the earliest fossils dating back 100 million years ago in the Cretaceous period. In result, Darwin declared this diversification the “abominable mystery.” In 1877, French paleo-botanist Gaston de Saporta wrote to Darwin describing a biological feedback loop, explaining the increase in angiosperms, or flowering plants. Saporta suggested that flowering plants co-evolved with insects, causing the diversification of both species. The relationships between many insects and their pollinating counterparts, namely the moth, xanthopan morganii praedicta and orchid, Angraecum Sesquipedale incited this discussion. The interaction between the insects and angiosperms spurred new questions of aesthetics and sexual attraction. The Voyage of the Beagle carefully explains every specimen and experience Darwin had as he travelled around the globe; however, Darwin’s observations reveal a deeper line of thought associated with the Victorian period, and the obsession with form, color, and attention to beauty. Religious thought in the Victorian period surrounded Darwin’s conceptions of, and reflections on, the sublime. Specifically, Burke’s writing on aesthetics and sublime, John Milton’s Paradise Lost, and William Wordsworth’s The Excursion were the foundation of his religious thought. Burke helped Darwin to formulate his response to physiological and visual responses to nature, influencing Darwin’s journey beyond simply scientific observation and record, but aiding in demonstration of the aesthetic and emotional experiences of the sublime found in even the smallest parts of nature.

Source of Funding: Hixon Foundation, Environmental Science Department
Two-Color Confocal Imaging of Mitochondrial Function in Live Neurons and Astrocytes Under Oxidative Stress and Membrane Cholesterol Depletion

Taylor Garza* and K. Kelvin Cheng

For years, researchers have been eager to discover the neurotoxic origins of Alzheimer’s Disease (AD) from a more linear approach, such as using the amyloid cascade hypothesis as a basis for their studies. This hypothesis focuses on the accumulation of beta amyloid plaques in the brain and their hypothesized mechanistic effects. However, recent research has paved the way for the consideration of multiple risk factors, such as oxidative damage to the mitochondria and age-related cholesterol depletion within different regions of the brain. Due to the age-related nature of AD, it is hypothesized that neurons exhibiting a lower cholesterol content are more susceptible to oxidative damage.

Using neurons (HT22) from human tissue culture and primary cultured astrocytes of different ages (4 and 17M) from mice models, the goal of this project was to observe changes in mitochondrial function under different treatments, oxidative stress (0-15 min of 25 µM H₂O₂) with and without cholesterol depletion (0-5 min of 4 mM methyl-beta-cyclodextrin). Here we used a single-photon counting confocal microscopic method to detect the change in the emissions of a membrane-potential sensitive dye (MitoTracker®) at the green (560 nm) and orange (620 nm) channels upon a blue (488 nm) excitation. A spot-based post-image analysis method was used to extract the orange-to-red intensity ratio (I₆₂₀/I₅₆₀) map pixel-by-pixel of the cells.

Our results suggest that an acute treatment of oxidative stress impairs the mitochondrial function as evident by a decrease in the intensity of the ratio map, and that the depletion of cholesterol enhances the decline significantly. We conclude that the depletion of cholesterol in both neurons and astrocytes sensitizes the oxidation stress in brain cells. Future studies will involve the role of beta-amyloid oligomers, another major risk factor in AD, in the disruption of brain cells under oxidative stress and age-related cholesterol depletion.

Funding Source: Murchison Summer Undergraduate Research Fellowship (SURF) and Williams Endowment of Trinity University
The Effect of \textsuperscript{N}\textsuperscript{G}-nitro-l-arginine on \textit{Cucumis sativus} Response to Longwave UVB Radiation

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Previous research hypothesized that NO production is not involved in responses specific to UVB including wavelengths shorter than 300 nm (full spectrum UVB, FS-UVB); since the NO synthase inhibitor \textsc{NG-nitro-l-arginine} (LNNA) alters ultraviolet tissue optics and due to its discovered UV absorption peak at 270 nm, this lead to the possibility that LNNA’s UV absorbing properties was creating the loss of plant response to UVB rather than its NO inhibiting properties. The aim of this study was to understand if plants metabolize LNNA when exposed to LW-UVB (long wavelength UVB, 300-320nm) and finding the lowest concentration of LNNA that produces a reduction in LW-UVB response. For this experiment, \textit{Cucumis sativus} seedlings were watered with either LNNA or control solution 36 and 12 hours before LW-UVB exposure. Half of the LNNA treatment and control groups were exposed to UV-B radiation. Rates of growth over the period of 6 hours were measured in both groups and compared to the non-UV exposed plants in each treatment group. Thin-layer chromatography (TLC) was used to separate UV-absorbing plant compounds by polarity and to compare the Rf-values (the ratio of the distance traveled by the compound to the distance traveled by the solvent front) of the extracts and pure LNNA. The hypocotyls from LNNA treated plants were extracted using pure methanol for UV-absorbing pigments and used in TLC with silica gel plate stationary phase and a chloroform:methanol:ammonium hydroxide:water mobile phase to separate the compounds. The LNNA’s UV absorbing property was used to identify the LNNA taken up by the plant tissue in the extracts and isolate it on the TLC plate. The UV-absorption and Rf value corresponded to pure LNNA solution on the TLC plates. Fourier-transform Infrared (FTIR) spectrometry revealed that the UV-absorbing compound from the extracts possessed the same emission spectrum as pure LNNA. The experiments demonstrated that \textit{C. sativus} does not metabolize LNNA. In accordance with previous research, the intact \textit{C. sativus} seedlings watered with LNNA solution showed a reduced response to LW-UVB when LNNA solution concentrations were 9mM or higher. Moreover, our findings also suggest that the loss of response to UVB could be explained by the photochemical properties of LNNA in the hypocotyl tissue.

\textbf{Funding Source:} BSURF
Training Procedure & Protocol for Neuroimaging in Awake and Alert Marmosets

Gavvala, Seema*; Reusch, Ryan; Rigodanzo, Anna; Phillips, Kimberley A.

The common marmoset (*Callithrix jacchus*) is increasingly being used as an animal model to study aspects of human cognition, as neural structure between marmosets and humans is similar. Imaging studies involving nonhuman primates generally require the animal to be anesthetized; however, as anesthesia reduces aspects of cortical function, this may confound results. This may be especially noticeable in functional magnetic resonance imaging (fMRI), which models brain activity. To address this issue, we habituated and trained marmosets to undergo MRI imaging procedures while awake and without anesthesia.

For this procedure, six (6) marmosets were trained. Habituation involved four phases: 1) acclimation to the capture container, 2) transfer to transport box, 3) capture method (from transport box) and jacket restraint, and 4) placement into horizontal cradle (stimulating body position while inside MRI scanner). Throughout the procedure, animals were closely monitored for any changes in their daily routines. To allow proper adjustment, we proceeded in incremental stages, and habituation for each phase spanned 1-2 weeks. Positive reinforcement (small marshmallows, dried fruit) was used at each step to obtain desired behavior. We hypothesize that lack of anesthesia, along with proper acclimation to the procedure, will yield clearer, more accurate results than those obtained using anesthetized animals.

Funding Source: Texas Biomedical Research Institute
Perceived utility of smartphone based assessment and outcome monitoring in psychotherapy

Megan Gillespie*, Dr. William Ellison

In psychotherapy, empirically based assessment (EBA) refers to the use of standardized and validated tools to diagnose individuals. Routine outcome monitoring (ROM) refers to the use of standardized tools to provide ongoing feedback of client progress to a therapist. When therapists use EBA and ROM, they make better treatment decisions and identify clients in crisis more accurately than when they rely on their own subjective judgment. Despite this, many clinicians are reluctant to use EBA and ROM because they believe they are inefficient and burdensome to administer in treatment settings. However, new smartphone-based methods of assessment and outcome monitoring may alleviate some of these concerns, because data is collected in clients’ daily life. The current study evaluates the perceived utility of smartphone-based assessments and outcome monitoring tools among psychotherapists in the U.S and identifies characteristics of therapists who might be receptive to EBA, ROM, and these new resources. Preliminary results indicate that, in general, therapists do not find smartphone-based resources more useful for difficult cases than traditional EBA and ROM methods. Respondents who conduct research to improve the clinical services they provide were more receptive to EBA and ROM than those who do not. However, respondents who did this research were not selectively more receptive to smartphone based tools. In ongoing work, we hope to identify subgroups of therapists who are interested in implementing the smartphone based resources into their practice.

Funding Source: Office of the Vice President for Academic Affairs-Budget and Research
Constructing a Viral Plasmid for Astrocyte Expression of a Light-Gated Potassium Channel

Logan Gloster*, Gerard M. J. Beaudoin, III

Optogenetics constitutes a variety of methods utilized to control cellular activity using light-gated membrane channels. One method involves the hyperpolarization of neuronal cells using blue-light-induced K⁺ channel (BLINK) constructed from the fusion of the plant LOV2-Ja photosensory protein and small viral K⁺ channel Kcv. Opening light-gated K⁺ channels would allow K⁺ to flow out of the cell, thereby hyperpolarizing the cell. Astrocytes regulate glutamate neurotransmission by reuptaking released neurotransmitter, which is decreased by hyperpolarization. Because of their role in neurotransmitter (NT) reuptake, astrocytes are a good candidate for BLINK expression. To express this gene in astrocytes, the BLINK sequence was inserted into a plasmid encoding an astrocyte-selective promoter using standard molecular biology methods in non-recombinant E. coli. to construct and confirm its sequence. Progress in the cloning will be presented.
The Relationships Between Food Insecurity and Negative Psychological Outcomes

Francesca Gomez*, Paola Gutierrez, Calista Struby, Autumn Sutherland*, Eden White, Keesha Middlemass, and Carolyn B. Becker

Food insecurity (FI) is a global phenomenon that impacts millions in the United States (US). Based on household reports, the United States Department of Agriculture defines FI as either “low food security” consisting of reduced quality, variety, or desirability of diet with little or no indication of reduced food intake or “very low food security,” which are reports of multiple indications of disrupted eating patterns and reduced food intake (USDA, 2015). To date, a small body of research has explored the connections between FI and negative psychological outcomes, such as depression. However, despite an extensive literature investigating the association between FI and obesity, only one study has examined the relationship between FI and eating disorders (EDs), trauma, and anxiety in a FI population (Becker, Middlemass, Taylor, Johnson & Gomez, 2017). Results from this study indicated that those with the highest level of FI report significantly elevated rates of ED symptomatology. More specifically, 17% of adults who reported having hungry children in the home also met criteria for a clinically significant ED, with even higher rates of reported specific ED behaviors (e.g., night eating with distress, 40%). In partnership with the San Antonio Food Bank (SAFB), the present follow-up study builds upon the earlier study by utilizing mixed methods, including implementing surveys and conducting in-depth semi-structured interviews of SAFB clients. The goal is to further understand the relationship between FI and negative psychological outcomes in a FI population using both deductive and inductive analytical approaches. Data collected during the 2017 Summer Undergraduate Research Program extends the results of the Becker et al. (2017) study while simultaneously providing insight on social behaviors and the efficacy of policies as it relates to FI in marginalized populations.

Funding Source: McNair Scholars Program, HEB, Murchison, Department of Psychology, Department of Political Science
Cocaine-mediated Signaling Mechanisms
Augmenting Specific Neural Connections on Murine Dopamine Neurons

Sarosha Hemani*, Aamuktha Karla*, Pierre Ferrer, Adam Litch, Parker Voit, Gerard Beaudoin

The neurotransmitter dopamine plays an important role in communication between neurons and has been found to be implicated in drug addiction. Prior research has shown cocaine induces synaptic plasticity on dopamine neurons in substantia nigra (SN). Another region of the brain, pedunculopontine tegmental nucleus (PPN), projects onto substantia nigra compacta (SNc). Synapses between these two regions show changes in function of glutamate receptors 24 hours after in vivo cocaine exposure in mice. Our ultimate goal is to identify the mechanism responsible for causing these changes. In order to examine the effects of cocaine on PPN synapses to dopaminergic neurons in mice, stereotaxic surgery is used to inject a virus encoding a light-operated cation channel and a fluorescent protein. Projections from PPN to substantia nigra pars compacta (SNc) are observed using fluorescence expressed from the virus. In addition, a laser is used to artificially stimulate synapses by opening nonspecific cation channels on PPN axons. This allows activation of synaptic activity in dopamine neurons. These techniques are necessary to observe changes in glutamate receptors induced by exposure to cocaine which will allow us to study the mechanism underlying these changes.

Funding Source: Trinity University
Structure-Activity Studies of Dipeptide Recognition by Cucurbit[8]uril

Elena Boms*, Zoheb Hirani*, Hailey Taylor*, and Adam R. Urbach

Analyzing the specificity of host-guest interactions is crucial to understanding the chemical nature of living systems. Building on recent studies of cucurbit[8]uril (Q8)-peptide interactions in aqueous solution, we ran a parallel fluorescence assay with a large library of tripeptides against Q8. The results revealed alternative possibilities for targeting terminal and non-aromatic sequences. Detailed studies of structure-activity relationships by isothermal titration calorimetry, nuclear magnetic resonance spectroscopy, and electrospray ionization mass spectrometry will be presented.

Funding Sources: National Science Foundation, The Welch Foundation, Arnold and Mabel Beckman Foundation, Semmes Foundation, Trinity University
Sex-Specific Effects of Temperature and Social Behavior on the Dynamic Body Color of the Green Anole Lizard

Daisy M. Horr, Ambrose Wang, Amy A. Payne, Michele A. Johnson

Color change in diverse animal species serves many ecological functions, including camouflage, social signaling, or regulation of body temperature. The green anole lizard, *Anolis carolinensis*, is one such species that exhibits rapid body color transitions, changing between bright green and dark brown in response to both external environmental cues and social stimuli. In this study, we tested whether there are sex differences in the relationships between body color and thermoregulation, and body color and social behavior. We first examined how anole body color change may be influenced by thermoregulation when perched on different types of substrates. We conducted field work on anole populations in the San Antonio area, where we noted behavior, body color, substrate type (artificial or natural), and amount of sunlight (shaded, partial shade, or full sun) within the first three minutes of observing a lizard. We then captured each lizard, and immediately measured internal body temperature, followed by measurements of the surface temperature of the substrate, distance to the nearest available perch, and body measurements (snout-vent length, mass, and tail length). We also examined how social behavior in anoles may be linked to the rate of body color changes. We used field observational data to assess whether the rate of social display behaviors (dewlap extensions and pushups) is associated with the rate of body color changes. Together, these data will help us understand how males and females may differentially respond to a rapidly changing environment, as human activities alter the habitat structure and temperature that animals experience.

Funding: McNair Scholars Program, National Science Foundation IOS 1257021 to M.A. Johnson, East Asian Studies at Trinity University, Trustee Oliver Lee and the JK Lee Family Foundation
Development of a Probabilistic Residual Stresses for Damage Tolerance Analysis

Alexander Horwath*, Juan Ocampo, PhD., Amber McClung, PhD.

Residual stresses are used in aerospace applications to improve the fatigue performance of fatigue and fracture critical structures. Residual stresses are added to the material through a variety of processes which includes laser peening, shot peening, cold expansion, among others. There is frequently significant uncertainties regarded to the magnitude of the induced residual stresses due to variation in material properties, loading, geometry, and the thermo/mechanical processes.

Due to the variability in residual stresses there is a need for a computer software that can develop probabilistic residual stresses data. This research is developing a Matlab software to model experimental residual stresses, the stress at different points are collected experimentally, and the software uses this data, force equilibrium, and a least squares fit to determine the surface stress, interior stress, and probabilistic coefficients using the following model from the literature:

$$\sigma(x) = (\sigma_s - \sigma_i + C_1 x)e^{-C_2 x} + \sigma_i$$

The software under development includes a Graphical User Interface (GUI) to increase the ease with which data can be seen and manipulated, and the functionality to import as many data sets as needed and see the plots of these data sets individually.

The probabilistic residual stress developed by this computer software will be used on the FAA-sponsored probabilistic damage tolerance software, SMART|DT, to study the effects of different residual stress profiles on an original or repaired aerospace part.

Funding Source: This research was supported by St. Mary’s University on-campus faculty grant
Annexins Contribute to Resistance to Ultraviolet Radiation Stress in Leaves but not Roots in Arabidopsis

Nicole Jozefiak*, James Shinkle

Annexins are a collection of phospholipid-binding proteins found in many organisms, including plants. Annexins are important proteins that help regulate cellular response within a cell’s environment. They also aid in the stabilization of plasma membranes. We used Arabidopsis lines carrying mutations in two annexin genes, and the protein UVR8, which senses UVB, to investigate if these proteins confer resistance to stress caused by ultraviolet radiation. Two experiments were conducted. The first way is to examine changes in root growth after exposure to UV-B. Arabidopsis seedlings were placed on petri dishes and allowed to grow for four days. A control of each species was immediately rotated 90º and allowed to grow for another three days. The remaining dishes were exposed to UVB for either 10 minutes, 3 minutes, and 1 minute at 890mWm⁻². Following radiation, they were rotated 90º and allowed to grow for three more days. After the three days, all the plates were imaged and the roots were measured on ImageJ. The roots were measured where a kink formed due to rotation after radiation. Although there are differentiations in root growth after exposure to UV-B, Arabidopsis seedlings were placed on petri dishes and allowed to grow for four days. A control of each species was immediately rotated 90º and allowed to grow for another three days. The remaining dishes were exposed to UVB for either 10 minutes, 3 minutes, and 1 minute at 890mWm⁻². Following radiation, they were rotated 90º and allowed to grow for three more days. After the three days, all the plates were imaged and the roots were measured on ImageJ. The roots were measured where a kink formed due to rotation after radiation. Although there are differentiations in root growth after exposure to UV-B, there is no evidence of increased sensitivity to UVB. The second experiment was conducted in order to see if UVB had an effect on electrolyte leakage through the leaves of Arabidopsis containing annexin mutations. These plants were exposed to 30 minutes of UVB at 1.6 kj m⁻² for four days. After the treatment, 20 leaf discs were hole-punched from each plant. Five leaf discs were placed into a single Eppendorf tube, giving us four trials. Each tube was filled with 1 ml of 18 megaohm deionized water. They were then subjected to a cold treatment held at 4 °C for 3 hours while being shaken gently. After the 3 hour treatment, the conductivity of their solution was measured. Then the discs were removed from their Eppendorf tubes and placed into new tubes so that they could be submerged in liquid nitrogen and exposed to -80°C for 24 hours. The leaf discs were rehydrated with their original solution and set out to return to room temperature. The conductivity was then again measured and ratios between both conductivity measurements were calculated. As proof of concept, the UVR8 mutant has shown to be more sensitive to UVB than its control. While a consistent trend among the annexin mutants’ electrolyte leakage responses has not emerged, all tested mutants have behaved differently from their controls.

Funding Source: McNair Scholar Program
The Effects of Hypoxia and Inflammation on Barrier Integrity of CaCo-2 Cells a Model Intestinal Epithelium.

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Background The use of hydrocortisone in association with indomethacin often increases the risk for spontaneous intestinal perforations in extremely low birth rate infants. Hypoxia, inflammation and non-steroidal anti-inflammatory drugs like indomethacin and hydrocortisone all alter the epithelial cell tight junctions independently of one another. The combined effect of non-steroidal anti-inflammatory drugs, inflammation, and hypoxia is not well known.

Methods Through the use of CaCo-2 BBBe monolayers as an in vitro model of the intestinal epithelial barrier, we analyzed the effects of the pro-inflammatory agents (TNF and IFN) and the anti-inflammatory agents (hydrocortisone and indomethacin) on cell proliferation, ATP levels, barrier integrity, claudin-1 protein expression and localization.

Results Confocal analysis after 24-hour exposure to hypoxia showed that the combined use of hypoxia and pro-inflammatory agents elicited no significant change in cell proliferation levels. Cellular ATP levels were analyzed to corroborate proliferation studies. Protein expression analyzed by Western blotting techniques demonstrated an alteration of claudin-1, a tight junction sealing protein. The soluble and insoluble fractions of the cells were analyzed in order to determine the location of these proteins. We determined inflammatory conditions produced a higher concentration in the soluble fraction indicating impaired function. Confocal imaging under the same experimental conditions was also conducted in order to probe for claudin-1 localization within the cells.

Conclusions In our experimental design, we observed no significant difference in the cell proliferation rate or marked changes in ATP levels. This suggests alteration in barrier function is due to specific junctional mechanism. However, these conditions affect claudin-1 protein expression and localization, thus contributing to impaired barrier integrity. These cellular studies suggest claudin-1 stability may be a potential target in the progression of spontaneous intestinal perforation.

Funding Sources:
San Antonio Medical Foundation Grant
US Air Force 59th Medical Wing Clinical Research Wing
East Asian Studies at Trinity University
Trustee Oliver Lee and the JK Lee Family Foundation
Implementing a cancer cell biology themed experiment to develop pedagogical resources.

LaRochelle, Erica M.*, King, Jonathan M.

Cancer is often thought of as a modern disease, however, evidence of the disease is preserved in human remains thousands of years old and in texts left by Greek and Egyptian physicians. This misconception exists due to the commonness of cancer in modern society, a result of increased life spans. As the likelihood of having cancer increases with age, the proportion of the population affected by the disease has increased. Cancer is caused by mutations in genes that trigger an immense ability to proliferate at high rates and, potentially, continuously. The HeLa cell line, extracted from a cervical tumor from Henrietta Lacks in the early 1950s, are immortal, forever increasing their numbers long after Mrs. Lacks demise.

While chemotherapeutic drugs are an immensely important aspect of the treatment of cancer, they operate at the expense of the patient, killing healthy cells along with cancerous ones. Through an experiment comparing the effectiveness of varying concentrations (10-300 micromolar) of the chemotherapy drug 5-fluorouracil, the lowest effective concentration for killing MCF-7 breast cancer cells was determined. Classroom activities designed for Nature of Cancer students to experience how a pharmacological study were conducted and analyzed.

Additionally, discussion points for The Nature of Cancer course, were developed that spanned biological, historical, moral, and ethical spheres for the following books: *The Emperor of all Maladies*, *The Immortal Life of Henrietta Lacks*, *The Cancer Chronicles: Unlocking Medicine’s Deepest Mystery*, and *The Philadelphia Chromosome*. These texts will provide a context for students to explore the numerous approaches to their understanding cancer.

Funding:
Trinity University
Sedimentology and geochemistry of a Lower Cretaceous dinosaur track site, Heritage Museum of the Texas Hill Country, Comal County, Central Texas

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Dinosaur tracks are abundant in the Lower Cretaceous, Glen Rose Fm. of Texas. Over 300 tracks and 28 individual trackways are preserved at the Heritage Museum of the Texas Hill Country (HMTHC) in Comal County. These tracks are interpreted to have been made by theropod and ornithopod dinosaurs. They are preserved in a marginal marine carbonate facies containing marine invertebrate fauna that indicate the tracks were preserved along the shoreline of an epicontinental sea. This is an integrated investigation of the paleoenvironmental conditions, paleoclimate, and stratigraphy of the tracksite.

We described a 65m thick stratigraphic section and made detailed petrographic observations of thin sections and polished slabs. We completed a total station and differential GPS survey of the track exposures. We generated gamma ray profiles using a hand held spectral scintillometer. Elemental geochemistry, stable isotopes and clay mineralogy were used to evaluate paleoclimate and determine diagenetic alteration.

Mg is low (180-200 ppm) in the lower half of the stratigraphic section including the track horizon indicating lack of dolomitization. Elevated Mg (>3600 ppm) occurs in dolomitized oolitic grainstone horizons in the upper half of the section. Detrital proxies are elevated in the marl intervals of the lower half of the section: Al (1225-1590 ppm) and Ti (1200-1680 ppm). Proxies for organic productivity (P, Ba, and Cu) are concentrated in the marls of the lower half of the section: P (up to 980 ppm); Cu (up to 0.15 ppm) and Ba (up to 0.11 ppm). Ternary plots of K₂O, Al₂O₃, and Na₂O indicate high levels of chemical weathering of detrital components supporting extreme global warming during the Cretaceous greenhouse period. δC¹³ fluctuates between 0.8‰ and 2.8‰ except for negative shifts to 0.6‰ and -5.4‰ in the track horizon and in a grainstone 4.2 m above it. δO¹⁸ values range from −1.4‰ to -3.3‰ except for dolomitized intervals in the upper part of the section with values of 1.6‰ and 2.4‰.

Gamma ray curves indicate that the trackway horizon at HMTHC is correlated with the trackway at the spillway in the Canyon Lake Gorge and occurs at a sequence boundary. An oxidized, bored hardground surface and oolitic horizons above the track surface in the HMTHC correlate with similar facies in the uppermost gorge section.

Funding Source: American Chemical Society and Pyron Endowed Chair; East Asian Studies at Trinity University; Trustee Oliver Lee and the JK Lee Family Foundation
Effects of Urolithin A on the Differentiation of Human Mesenchymal Stem Cells

Lindsey Lubianski, Andrea Carolina Jimenez-Vergara, Dany J. Munoz-Pinto

Urolithin A (UA) is a chemical compound derived from the metabolism of ellagic acid by the microflora in the gut. UA was found to prevent the accumulation of dysfunctional mitochondria in cells with aging, and extended the lifespan in rodents. Due to the general potential restoration of mitochondria function and the connection between cell metabolic activity and aging, we hypothesized that UA could potentially exhibit similar effects on human mesenchymal stem cells (hMSC). hMSCs were cultured under varying concentration levels of UA (0 – 50 uM). Throughout the experiment, we monitored changes in the proliferative and differentiation capacity of hMSCs. Differentiation and proliferation potential were evaluated at the gene expression level using quantitative reverse transcription polymerase chain reaction (qRT-PCR). Adipsin, RUNX2, SOX9, SM22-alpha, CD105 and PCNA were selected as the differentiation and proliferative markers. Based on the qRT-PCR results, UA levels did not promote the expression of fat, bone, cartilage, or muscle markers. However, the expression of stem marker CD105 was significantly upregulated while PCNA expression was downregulated. These observations suggest an increase in stem cell stemness and a reduction on cell proliferation.

Funding Source: Financial Aid for Science and Technology Enhanced with Research Grant
Stomatal response to stimuli in cauline leaves compared to rosette leaves

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Stomatal response to numerous stimuli has been tested rigorously in Arabidopsis Thaliana rosette leaves. However, stomatal response to stimuli has not been tested in Arabidopsis thaliana cauline leaves, this study seeks to demonstrate what if any difference in response to stimuli may be present between the two leaf types. leaves of both cauline and rosette type were floated with their abaxial surfaces facing up on MES-KCl buffer (10 mM MES, 50 mM KCl, and 0.1 mM CaCl2, pH 6.15). Light treatments were: 150 µmol m-2 sec-1 white light from fluorescent light; 300 µmol m-2 sec-1 red light from a 660 nm LED source and 2.5 µmol m-2 sec-1 from a UVB source filtered by a 310 nm interference filter. Two types of experiments were performed: white light versus no light, and white light versus no light, red light, UVB and Red light with UVB. UV-B irradiation was generated by a lamp suspended directly above the abaxial surface of the leaves. Red light conditions were exposed from the underside, or perspective top of the leaf. White light conditions were accomplished by florescent lighting suspended directly above the abaxial surface of the leaves. In the basic opening/closing experiment response to dark light conditions stomatal closure differed significantly between cauline leaves and rosette leaves between white light exposure (rosette stomatal width: 17.41± 0.30 SE, cauline stomatal width: 15.06±0.54 SE, p value = 0.0001) and no light (rosette stomatal width: 6.76±0.68 SE, cauline stomatal width: 9.86±0.60 SE, p value = 0.0007). In the UV-B induced closure experiment the cauline leaves are less effected by the UV-B light, causing less stomatal closure in the UV-B light environment (rosette stomatal width: 10.50±0.80 SE, cauline stomatal width: 12.40±0.82 SE, p value = 3.028E-06). Preliminary results indicate that there are differences in response to stimuli between the cauline leaves and the rosette leaves, the cauline leaves are less sensitivity to UV-B exposure, but more responsive to absence of light. This is an important finding as it shows that different leaves on the same plant can have different responses to stimuli.

Funding Source: Trinity University
East Asian Studies at Trinity University and Trustee Oliver Lee and the JK Lee Family Foundation.
Geophysical Delineation of Geologic Controls on Sinkhole Formation, Olmos Basin, San Antonio, Texas

Lisa Ma*, Odalys Salinas*, Dr. Glenn C. Kroeger, Dr. Daniel Lehrmann

A cluster of recently expressed sinkholes has been identified in the Olmos Basin upstream of the Olmos Dam. The sinkholes range from 0.5 to 5 m across and up to 3 m deep. Some of them have voids in the limestone bedrock and show evidence of catastrophic collapse of the surface soil and trees. Root masses that are still intact along the periphery and on the surface as well as trees that have dropped into some of the sink holes indicate that collapse is continuing to the present day.

We have mapped these sinkholes using carrier-phase differential GPS post-processed with base station data from the TxDOT CORS station in downtown San Antonio. Our mapping shows that these sinkholes form a generally linear trend from northwest to southeast (0.6 km long; azimuth of 127 degrees) possibly related to a fault in the Austin Chalk or other Cretaceous units in the underlying bedrock. We have mapped our GPS data in ArcGIS along with basement geology and fault data from the U.S.G.S., E.A.A. and the Texas Bureau of Economic Geology and road data from TxDOT.

We have employed 2D electrical resistivity and seismic refraction tomography to image the subsurface structure around these sinkholes. Electrical resistivity profiles have been acquired along several profiles both parallel and transverse to the trend of the sinkholes. Electrical resistivity profiles were acquired using both dipole-dipole and Wenner array geometries. We shot seismic refraction lines with a 24-channel Geometrics Geode seismometer and 10 Hz geophones. We performed first-break picking and refraction tomography using Geogiga DW Tomo software and electrical resistivity imaging in AGI EarthImager 2D.

We will show our current maps along with initial electrical resistivity and seismic refraction tomography profiles and discuss the implications of our subsurface images on the formation of these sinkholes.

Funding Sources: Murchison Summer Research Fellowship, Ed Roy Endowment for Geoscience Activities and Research
Capek: A ROS Based Robotics Research Platform

Rolando Morales*, Dr. Kevin Nickels, Dr. Hoa Nguyen

This project focuses on Capek. Capek is a differential wheeled mobile robot platform. Capek utilizes a Raspberry Pi to interface with sonar sensors, safety bumpers (limit switches), and an MD23 motor driver. Capek’s open design and the Raspberry Pi’s multiple GPIO (general purpose input/output) pins allow for easy hardware expansion. The platform’s rigid aluminum frame provides a sturdy base for a heavy payload, allowing for specialized sensors that are not easily mountable on common robotics platforms (such as the TurtleBot).

One goal of this project was to develop a 12V power distribution system to mobilize Capek and provide power for any necessary USB peripherals. The main goal of this project was to integrate this platform with ROS (robot operating system). ROS can be defined as a meta-operating system that provides hardware abstraction, multi-system networking, and standard tools for inter-process communication. ROS is open source software. Hence, it allows for the straightforward exchange of software and promotes code reuse. Integrating Capek with ROS enables software expandability.

At the start of this project, we were supplied with two low-level drivers (written in C). They implemented interfaces to the motor driver and sonar sensors, which all communicate with the Raspberry Pi via an I2C (inter-integrated circuit) bus. Using the wiringPi library, which provides pin based access similar to the Arduino “wiring” system, we were able to write a driver to interface with the Capek’s eight safety bumpers. After completing this driver, we then had access to all the system’s components. To integrate Capek with ROS, a main nodelet was utilized to receive velocity commands and actuate the two motors. This same nodelet is used to calculate the robot’s odometry (using the encoder data produced by the motor driver), track the transforms between the robot’s coordinate frames (via tf), and present the robot’s joint states. With the provided joint states, a Robot State Publisher node publishes the transform data between the links of the tf tree. The provided odometry and tf data along with point cloud data arising from the sonar sensors and safety bumpers (in the form of point clouds) permit the Capek to be used with the ROS navigation stack. The navigation stack extends the abilities of Capek to include path planning, map making, and many more functions.

The Capek platform allows for high-level experimentation with algorithms and methods for further development in subjects such as, but not limited to, biorobotics, chemotaxis, and neurorobotics. By developing a ROS based software system for the Capek, similar to the TurtleBot stack, we are able to utilize many software packages that are compatible with TurtleBot. Thus, further research using this platform is accelerated.

Funding Source: National Science Foundation
Reproducibility of granular activated carbon for dye tracer detection

Zachary Oretsky*, Dan Lehrmann, Department of Geosciences, Geary Schindel, Edwards Aquifer Authority

The Edwards Aquifer Authority is interested in determining the reliability of using granular activated carbon (GAC) for groundwater dye tracer studies. Understanding the effectiveness of GAC dye receptors is important for conducting future studies designed to better manage the Edwards Aquifer as well as other karst aquifers.

Granular activated carbon (GAC) is commonly used to adsorb various organic materials in liquid or air. GAC is also used to adsorb fluorescent dyes used for tracing of groundwater flow paths in karst terrains. GAC offers a semi-quantitative method to passively detect dyes in water in wells, springs, and streams. Packets, made of woven nylon containing GAC, are placed in locations where dye may appear. The packets are left for a period (days to weeks) and then recovered for processing and analysis. To test whether a GAC packet has been exposed to dye, the GAC is placed in a solution of alcohol and a base (usually KOH) for 1 hour. This causes the dye to be extracted from the carbon and the eluent is then analyzed using a luminescence spectrometer (Perkin Elmer LS 50B) to determine the absence or presence of dyes. The LS 50B is capable of separating the five dyes commonly used for water tracing. There are many variables associated with the use of GAC to detect dyes and there are some uncertainties related to the reproducibility of results. This study attempts to evaluate some of the variables related to the use of GAC for tracer testing.

In order to test the reproducibility of GAC, each of the five dyes (Uranine, Rhodamine WT, Eosin, Sulforhodamine B, and Phloxine B) were diluted in deionized water to the 5-10 ppb range. 100 g of GAC were placed in a small pouch made of window screen. The pouches were suspended in 2L of dye solution and the dye was circulated through each pouch using a stirring plate. Once the charcoal was given enough time to adsorb the dye, the charcoal was divided into ten samples of 10 g after being dried and homogenized. Dye was then extracted from each sample by eluting the samples with a solution made up of 95% of a 70% isopropyl alcohol solution and 5 % potassium hydroxide for 1 hour. The dye was then extracted and analyzed with the Perkin Elmer LS 50B luminescence spectrometer. After being analyzed, the data was tested for reliability using a student’s t-test in Excel. We will present results from these experiments and the implications for reliability of GAC for dye tracer detection.

Funding Source: Department of Geosciences, Trinity University
Children’s Verb Learning: Using Information Over Time to Learn New Verbs

Blaire Porter*, Rebecca Berreth*, Tierney Thomison* & Jane B. Childers

Learning a new verb can pose a challenge to young children because, to learn a verb, they must analyze dynamic scenes and link verbs to specific elements and events within them. Deciding which set of elements in an event fit a particular new verb is a central problem. Several studies now show that children benefit from seeing and comparing several examples of events (e.g., Childers, 2011; Haryu, Imai & Okada, 2011). However, comparing varied events is difficult. In structural alignment theory (e.g., Gentner, 1983; 1988), observers learn how to compare by first comparing highly similar examples (progressive alignment). The present study asks whether progressive alignment helps children compare events and extend verbs, and also asks whether this process is affected when events are separated in time.

Two-1/2- (n=19), 3 ½- (n=34), and 4 ½- (n=14) year-old children were shown events linked to two new verbs. For each verb, children watched three related events. In one condition, they saw two similar events and then a varied event (PA) and in the other, they saw all varied events (All Far or AF); they pointed to extend verbs at test. Within each condition, events in the learning phase were presented with no delays, or were separated (with unrelated videos) by 1-minute or 3 minute delays. A preliminary univariate ANOVA was computed with 3 (Age: 2 ½-, 3 ½-, 4 ½-year-olds) X 3 (Delay: 1 minute, 3 minutes, No Delay) X 2 (Condition: PA, AF) as between-subjects factors and mean proportion correct as the dv. There was a main effect of Delay, F(2, 66)= 3.73, p=.032, and the effect for Age Group is close to significance, F(2, 66)= 3.15, p=.051. Pairwise comparisons with Sidak adjustments show that the 1 minute delay group performed significantly better than the no delay group, ps< .05, and that 2 ½-year-olds performed significantly worse than older children (ps< .05).

This study shows that children who were tested after a one minute delay perform significantly better than those in the no delay condition. This preliminary result is consistent with some studies that suggest it can be helpful for the observer to partially forget information, then relearn it at a later time. The results also suggest that type of comparisons (PA, All Far) did not make a difference in verb extensions. This could mean that children do not need a PA condition in order to extend verbs and can sufficiently extend verbs in the All Far condition. Preliminary results from this study suggest that verb learning improves with age, as three- and four-year-olds exceed chance when they extend a new verb. This study is one of the first to analyze the effect of memory on comparison processes during verb learning. Distractions and delays are natural and inevitable aspects of everyday life and this study is a first step in examining how they apply to verb learning.

Funding Source:
Murchison Scholars Fund
Purification and analysis of WS5995 angucyclinones from \textit{Streptomyces acidiscabies}

Ryan Pu*, Frank Healy

Streptomyces are morphologically complex bacteria that produce different classes of secondary metabolites with a broad spectrum of biological activities, including anticancer, antibacterial and other drugs. It is of interest to understand the assembly of these compounds to aid in the improvement of existing drugs or in the design and synthesis of novel drugs. \textit{Streptomyces acidiscabies} produces the antimicrobial WS5995 aromatic type II polyketide angucyclinones. These compounds undergo an uncommon oxidative ring cleavage reaction during assembly.

Analysis of the organism’s genome reveals a variety of secondary metabolite biosynthetic gene clusters, including one predicted to encode enzymes for type II aromatic polyketide production. We are interested in characterizing the components of this pathway and its products and intermediates. WS5995B and WS5995C were recovered from \textit{S. acidiscabies} culture filtrates using solid and liquid phase extraction. Extracts and purified compounds were analyzed using thin layer chromatography (TLC), high pressure liquid chromatography (HPLC) and proton NMR spectroscopic techniques. Mutants were also constructed to carry defective alleles of genes involved in late assembly steps of the predicted WS5995 pathway. We discovered that cultures frequently lost the ability to produce WS5995B and WS5995C. Loss of the production phenotype occurred in the wild type parent culture used for the construction of ketoacyl synthase mutants. This was confirmed through comparative analysis of parent and mutant extracts. Additionally we observed that while all non-producer variants shared the loss of the polyketide production phenotype, they differed in other aspects, such as growth morphology in liquid culture.

While the basis for these phenotypic instabilities is unknown, genetic instability has been reported in other \textit{Streptomyces} spp., and was found to result from large scale chromosomal alterations such as rearrangements and deletions. The WS5995 polyketides, and possibly metabolites made by pathways encoded by other gene clusters in the genome, are dispensable for growth under laboratory conditions and may reside in unstable genomic regions, since the phenotype is lost at high frequencies. The maintenance of large secondary metabolite biosynthetic gene clusters throughout the genome of \textit{S. acidiscabies} supports the idea that pressures are exerted on the organism in its natural environment that select for their retention. It is possible that the WS5995 polyketides may play an important role as antimicrobial compounds in nutrient-poor soil environments.
Fabrication and Characterization of Wound Dressings Using Growth Factors Binding Peptides

Gabriel Righes, Erin Tsai, Andrea Carolina Jimenez-Vergara, Ph.D., Dany Muñoz-Pinto, Ph.D.

Individuals diagnosed with diabetes encounter a number of wound-healing complications as a result of insufficient angiogenesis, premature and prolonged inflammatory responses, and limited proliferation of fibroblasts and epidermal cells which increases the risk of bacterial infection. In addition to these problems, affected tissue produces high levels of metalloproteases which cause chronic wounds and permanent ulcers. Chronic wounds are difficult to treat and commonly lead to limb amputations. We propose the fabrication of a new group of wound dressings to improve healing in diabetic ulcers. The designed wound dressings have the capacity to sequester growth factors such as TGFβ-1 and VEGF which are essential for promoting proper wound healing. Towards this end, the surface of a polyethylene glycol diacrylate (PEGDA) hydrogel, was modified with the introduction of synthetic peptides. The selected peptides have specific binding affinity for TGFβ-1 and VEGF. PEGDA was synthesized from linear polyethylene glycol (PEG) of different molecular weights using acryloyl chloride and acrylation levels were measured by proton NMR. PEGDA hydrogels were fabricated using ultraviolet crosslinking. The conjugation of the peptide binding sequence was confirmed by A-FTIR spectroscopy.

Funding Source: Southwest Research Institute
Impact of motor learning on myelination and functional connectivity networks in capuchin monkeys (Cebus apella)

Anna Rigodanzo*, Ryan Reusch*, Seema Gavvala, & Dr. Kimberley Phillips

Engaging in complex, visuospatial motor activities has been shown to have a significant impact on the brain. Activity-dependent myelination is a hypothesized pathway of learning that functions through increased myelination and alterations to myelin organization within white matter tracts. We hypothesize that these organizational changes in myelin will result in stronger functional connectivity networks, allowing for faster processing and a more robust network. Therefore, engaging in motor learning strengthens brain connectivity. The idea that behavior can create positive changes in the brain is foundational to rehabilitative medicine.

We utilized non-invasive diffusion weighted neuroimaging and resting-state fMRI to identify structural and functional brain changes associated with motor learning. Thirty-two socially housed brown capuchin monkeys (Cebus apella), naïve to prior fine motor tasks, will participate in the 12-week experiment. This summer we focused on the first phase of the experiment, which involved four monkeys. Two monkeys (male n = 1) trained daily on a fine motor task (Pegboard) for 8 weeks followed by 4 weeks of continued once-a-week practice; the control condition of two monkeys (male n = 1) did not engage in a fine motor task. Neuroimages were collected from all monkeys at three time points: baseline, 8 weeks, and 12 weeks. We have completed pre-processing of the neuroimages, including skull-stripping, motion correction, and temporal filtering. Tract based spatial statistics will be used to evaluate changes in the white matter underlying the intraparietal sulcus. Seed-based analysis approach will evaluate changes in the resting-state visuospatial and sensorimotor connectivity networks. We hypothesize that subjects will show an increase in structural integrity of myelin (quantified by fractional anisotropy, FA). We also hypothesize that this increase will be positively correlated with the strength of associated functional connectivity networks after engaging in motor learning.

Funding Source: National Institutes of Health/National Institute of Neurological Disorders and Stroke
Litter in Olmos Basin Park: Evaluating Problems and Solutions

Willa Rubin* Dr. Richard Reed

Trinity University sits on the edge of Olmos Basin Park. The park is marked by sprawling trees, a 91-year-old dam, and litter - lots of litter. My research focuses on litter in Olmos Basin Park, the causes of the litter problem and its possible mitigation. I will also highlight the major difficulties of these mitigation strategies and their possible solution.

The park’s location is basic to the litter problem. It is in a heavily urbanized area at the headwaters of Olmos Creek. During flood events, the park becomes holding tank for water and trash washed along the creek. The most concerning and abundant litter are “floatables”; they float easily down the creek or fly off of Highway 281 into the park. The litter in Olmos Basin Park impact wildlife both in the park and beyond as it continues down the San Antonio River. Litter destroys habitat and water quality, reduces recreational use and discourages care from residents.

Various city authorities have developed strategic plans or coordinated volunteer projects to eliminate litter in Olmos Basin Park. Unfortunately, the park spans borders of the Cities of San Antonio and Alamo Heights and strategic efforts fail to coordinate between these cities and the many private entities in the area. Engineering efforts are costly and limited by the elements. Finally, volunteer projects simply can not generate the power needed to eliminate litter and maintain the Park. They often suffer from a lack of human and physical resources.

Based on my research, there is a need for the cities and the private entities to coordinate and organize their efforts. City-wide measures are needed to be taken to eliminate litter. A plastic bag or Styrofoam ban is one possible initiative. Finally, educating young people about the consequences of litter is both a crucial and a simple measure for ensuring a reduction of litter in the future.

Funding Source: Hixon Summer Research Fellowship
Play Behavior in Beluga Whales- How Are They Learned?

Kimberly Salazar*, Heather M. Hill

Play behaviors in beluga whales can be simple or complex in nature. However, there is no current understanding of the roles that different forms of learning play in acquiring these behaviors. This purpose of this study is to investigate how different forms of observational learning, teaching, and independent learning are incorporated by belugas (*Delphinapterus leucas*) of different ages. Using previously recorded videos of beluga whales from SeaWorld San Antonio, it was documented which type of learning appeared to be utilized most by the whales to perform different play behaviors. Using a sample of 300 minutes of video footage with 9 individual whales, observational learning was the most frequent type of learning utilized by the beluga whales followed by teaching, then independent learning. However, the results relied heavily on the relationships of the animals in observation. For example, if it was a mother/calf relationship, the play behavior was most likely learned through teaching, as opposed to a relationship between a calf and another adult beluga, which is when observational learning is most prevalent. Play behaviors in beluga whales are a necessary part of their development, and with a better understanding of how these behaviors are acquired, it can advance our knowledge involving animal care and enrichment.

Funding Source: SURF
Elucidating the role of Dib1 in pre-mRNA splicing

Christian Schreib*, Rachel Goldstein*, Cody Hernandez, Emily Bowman, Amber Lucas, Camille Potts, and Corina Maeder

Pre-messenger RNA (pre-mRNA) splicing is a molecular process that is conserved throughout all eukaryotic organisms. It involves the excision of the non-coding parts of pre-mRNA and the ligation of the coding parts of pre-mRNA to create mature mRNA. Pre-mRNA splicing is catalyzed by the spliceosome, a large molecular complex composed of ~100 proteins and 5 small-nuclear RNAs (snRNAs). Before splicing, the spliceosome will assemble onto the pre-mRNA in a modular fashion, forming different complexes in a sequential order. The focus of our studies is Dib1, one of the proteins associated with the spliceosome. It is a small, 17 kDa protein that is essential to cell viability and is conserved from yeast to humans. Cryo-electron microscopy structures of a large portion of the spliceosome show Dib1 is found in one of the pre-mRNA binding sites of the spliceosome, suggesting that Dib1 plays an important role in pre-mRNA binding. To better understand how Dib1 works in the processes of pre-mRNA splicing, temperature sensitive mutations of Dib1 were used to observe what effect the absence of Dib1 has on splicing. Denaturing gel electrophoresis was used to observe the effect on splicing, and non-denaturing gel electrophoresis was used to observe the effect on spliceosome assembly. Our results show that without Dib1, pre-mRNA splicing is halted and the assembly of the spliceosome is arrested mid-assembly.

Funding Source: Welch Foundation, Beckman Foundation, and NIH
Tensile Testing of Polymers Digitally Manufactured Under Extreme Conditions

Jose Torres*, Amber McClung PhD., Juan Ocampo PhD.

The purpose of this study is to examine the effects of the environment on a 3D printing apparatus and its ability to produce consistent operative prints. This research compares the tensile strength of ASTM D638-14 standard PLA samples printed in a controlled environment and those printed in a 30°C, 35°C, and 40°C environments. The study shows a variation of the tensile strength between different environments. The deviation may be due to the impact of heat on the mechanical parts of the 3D printer. This research will identify the problems, if any, with printing overseas in Forward Operating Bases (FOBs) where the temperature does not represent a controlled environment.

Funding Source: This research was supported by St. Mary’s University on-campus faculty grant
Mammals of Texas Modeling; in Search of Lost Populations

Bernardo Traversari*; Dr. David Ribble

Over the past two decades there has been a rapid increase in the number of statistical spatial tools available to ecologists to create and understand the geographic distributions of species. At the same time enthusiasm from citizen-scientists has resulted in expanding depositories of species locations such as found at iNaturalist.org and the Texas Parks and Wildlife Texas Nature Trackers program. The objective of this study was to combine the predictive power of species distribution modeling with the growing database of mammal occurrences from citizen-scientists to empower and motivate the discovery of new mammal locations of species of concern in Texas. To accomplish this 10 mammal species of concern were selected and every known occurrence collected through digitized natural history collections (e.g. VertNet.org) and citizen science sources were compiled. A traditional SDM model (MAXENT) was then applied to highlight Texas counties where a species has never been recorded but should be present based on the distribution and habitat requirements of the species. Maps of these findings will be presented along with strategies to inform and motivate the citizen-scientist community throughout Texas.

Funding Source: Texas Parks and Wildlife Department.
Tuning and characterization of interpenetrating networks of varying chemical composition to create a 3D model for neurodegenerative diseases

Rachel Van Drunen*, Erin Tsai, Andrea Carolina Jimenez-Vergara, Ph.D., Dany J. Munoz-Pinto, Ph.D.

The study of neurodegenerative diseases is constrained by the 2D environment in which neuronal cells are often cultured. The difference between the 2D environment in a culture flask and the in vivo 3D microenvironment of native nerve tissue is significant. To address this limitation, 3D cell culture systems could be used as platforms to contribute to the understanding of neurodegeneration. However, replicating some of the features of a 3D extracellular matrix (ECM) environment of central nervous tissue is a challenge. The ECM of brain tissue most prominently consists of Collagen IV, elastin, proteoglycans and polysaccharides such as hyaluronic acid (HA). Interpenetrating networks (IPNs) have the potential to be constructed to resemble some of the features of nerve tissue. Yet, IPNs often fail to produce scaffolds that can promote cell proliferation and spreading while withstanding cell induced stress and degradation. In this study, we fabricated IPNs using Poly (ethylene glycol) diacrylate (PEGDA) and Collagen type I to mimic the mechanical properties of central nervous tissue. In these IPNs, we varied the concentration and molecular weight of HA while maintaining the mechanical performance of the IPN. By altering these aspects of HA in the IPNs, we modeled various HA changes seen in ECM associated with nerve damage and neural diseases. In creating these IPNs we hope to procure a 3D model of neural tissue whose variations in HA can be utilized to better investigate the mechanistic underpinnings of neural trauma and neurodegenerative diseases.

Funding Source: The Start Up Fund and Murchison Undergraduate Research Scholarship
How to Evolve a Larger Muscle: Fiber Number, Size, and Behavior in Anole Lizards

Jesus Vega*, Brittney M. Ivanov, Michele A. Johnson

Muscles that are used frequently are often larger than muscles used rarely. When species vary in their behavioral use of a muscle, that muscle may evolve to be different sizes in different species. Larger muscles may result from evolving larger muscle fibers, more muscle fibers, or both. The muscles used in lizard copulation are an excellent model to address this question. In male lizards, there are two muscles used for copulation: the first muscle (transversus penis magnus) is responsible for the eversion of the hemipenis, and the second, the retractor penis magnus (RPM), retracts the male copulatory organ back into the tail. In this study, we examine the RPM muscle of 27 species of lizards in the genus Anolis (i.e., anoles) from the Caribbean and southeastern United States. For each species, we measured the number of fibers in the RPM, the size of the fibers in the RPM, the total size of the RPM, and the rate of copulation behavior. Previous work with these species has shown that the evolution of copulation frequency is not associated with RPM fiber size, and so we predict that it will be associated with RPM fiber number. We also predict that the species with larger RPM muscles will have more and larger fibers in those muscles. This study will show how muscle size and fiber size evolve in association with the number of fibers in a muscle.

Funding Source: National Science Foundation IOS 1257021 to M.A. Johnson
Cocaine mediated expression of glutamate receptors at input-specific synapses in murine nigral dopamine cells

Parker R. Voit*, Adam Litch*, Gerard Beaudoin, PhD

In vivo cocaine exposure has been repeatedly shown to induce long term potentiation (LTP) of synaptic projections to mesolimbic dopamine neurons. These neurons are a part of the mesolimbic reward pathway that is known to be important for controlling motivation and addictive behavior. A common indicator of LTP is a change in glutamatergic receptor ratios. A change in ratios have already been observed in projections onto dopamine neurons in the substantia nigra pars compacta (SNc) originating from the pedunculopontine tegmental nucleus (PPN), but the underlying structural and functional changes are unclear. Using electrophysiology, we have begun to characterize the responses of SNc dopamine neurons to excitatory projections from PPN. Using optogenetics, we are able to inject a virus encoding for a light operated cation channel, channelrhodopsin (ChR2), and yellow fluorescent protein (YFP) directly into the center of PPN in living mice. The ChR2 protein on these projections activates excitatory signaling to SNC dopamine neurons, eliciting a measurable response. The composition of glutamatergic subtypes responsible for LTP have yet to be determined. Confocal imaging can be used to image synapses after being stained with specific antibodies that are excitable with a laser. Antibodies for tyrosine hydroxylase, bassoon, and NMDA type 1 receptors are used in conjunction with YFP to determine any changes in glutamatergic synapses. By measuring the electrical response of dopamine neurons and imaging the synapse, we have been able to begin to characterize how cocaine affects these synapses.

Funding source: Research funding was provided by Trinity University B-SURF grants.
Comparison of Robotic Chemotaxis Algorithms in Simulations and Experiments

Dominic Walsh*, Dr. Kevin Nickels, Dr. Hoa Nguyen

Robotic odor source localization has been an active field of research for several decades. This project aims to compare the performances of E-puck robots using two E. coli chemotaxis algorithms (basic vs. RapidCell) and reliable sensors. Chemotaxis is a movement of an organism toward or away from chemical stimulus. In our set-up, the E-puck robot (playing a role as an E.coli bacterium) has line sensors capable of reading the darkness of the ground and a tabletop grayscale pattern poster is used as a surrogate for the chemical attractant. With the basic algorithm, the robot performs biased random walk toward the nearby darkest spot which is good for local source detections. On the other hand, the adaptation feature in the RapidCell algorithm gives the robot the ability to traverse through all the regions whose darkness is greater than some threshold; this can be useful in finding affected areas during a chemical spill. Several environments are tested, including homogenous (no chemical present), single-effluent (a chemical with one central peak), and multiple-effluent (a chemical with multiple peaks). The comparisons reveal the advantages of each chemotactic algorithm in different scenarios which will be useful as we extend our work to other indoor chemical-seeking robots and real chemicals.
In this study, differences in plant response due to short wavelength UVB radiation (280-300 nm) were compared with responses to UVB radiation from 300-320 nm. Short wavelength UVB radiation has been observed to cause changes in plant performance caused by a combination of stress responses and photomorphogenic regulation. We predict that there will be differences in species receiving full spectrum UV radiation and those receiving radiation that blocks the short wavelength UVB. The native Texas grasses, Big Bluestem (*Andropogon gerardi*), Little Bluestem (*Schizachyrium scoparium*), and Sideoats Grama (*Bouteloua curtipendula*) were used for the experiment. The invasive grass, King Ranch Bluestem (*Bothriochloa ischaemum*) was also used in the field experiment. To test the effects of UVB radiation, both supplemental and exclusion experiments were used to account for the differences in UVB radiation. In the field, the two exclusion filters used were aclar, which allows all UV wavelengths, and cellulose acetate, which blocks short wavelength UVB. In the greenhouse studies, the grasses were treated with supplemental light that either let in full UV spectra or blocked the short wavelength UVB. UV reflectance spectra of leaves and UV absorbing pigments from leaf extracts were conducted as measurements of plant responses. Results from rural and urban field sites, as well as greenhouse studies, concluded that effects of short wavelength UV-B tend to be species specific. For example, in the greenhouse, Big Bluestem had a higher absorbance when exposed to the full spectrum. While Little Bluestem had a higher absorbance when exposed to radiation that blocked the short wavelength UVB. Because these grass species are so commonly found on Texas ranches, our results can inform the design of restoration projects to take the UV radiation factor into account.

Funding Source: Texas Ecolab
Relevance of short wavelength UVB radiation to regulation of plant growth in natural light environments

Emily Welp*, James Shinkle

In this study, differences in plant response due to short wavelength UVB radiation (280-300 nm) were compared with responses to UVB radiation from 300-320 nm. Short wavelength UVB radiation has been observed to cause changes in plant performance caused by a combination of stress responses and photomorphogenic regulation. We predict that there will be differences in species receiving full spectrum UV radiation and those receiving radiation that blocks the short wavelength UVB. The native Texas grasses, Big Bluestem (*Andropogon gerardi*), Little Bluestem (*Schizachyrium scoparium*), and Sideoats Grama (*Bouteloua curtipendula*) were used for the experiment. The invasive grass, King Ranch Bluestem (*Bothriochloa ischaemum*) was also used in the field experiment. To test the effects of UVB radiation, both supplemental and exclusion experiments were used to account for the differences in UVB radiation. In the field, the two exclusion filters used were aclar, which allows all UV wavelengths, and cellulose acetate, which blocks short wavelength UVB. In the greenhouse studies, the grasses were treated with supplemental light that either let in full UV spectra or blocked the short wavelength UVB. UV reflectance spectra of leaves and UV absorbing pigments from leaf extracts were conducted as measurements of plant responses. Results from rural and urban field sites, as well as greenhouse studies, concluded that effects of short wavelength UV-B tend to be species specific. For example, in the greenhouse, Big Bluestem had a higher absorbance when exposed to the full spectrum. While Little Bluestem had a higher absorbance when exposed to radiation that blocked the short wavelength UVB. Because these grass species are so commonly found on Texas ranches, our results can inform the design of restoration projects to take the UV radiation factor into account.

Funding Source: Texas Ecolab
ZO-1 Plays a Role in the Stability of Tight Junction and Cytoskeleton of Epithelial Cells

Addison R. White*; Gabby G. Mudekunye*; Jonathan M. King

Zonula Occludens (ZO) -1 is a cytoplasmic scaffolding protein that plays a role in tight junction barrier function in epithelial cells. ZO-1 belongs to a family of ZO proteins, which also include ZO-2 and ZO-3. ZO-1 and ZO-2 contain an actin-binding region (ABR) which is thought to help tether the tight junction to the cytoskeleton. ARHGEF11 is a Rho GTPase that has been shown to interact with both the actin cytoskeleton and ZO-1.

Our goal is to elucidate the function of the ZO-1-ZU5 domain by examining the interaction between ARHGEF11, ZO-1 and the cytoskeleton. We employed a series of electrophysiology experiments, confocal microscopy studies, and functional assays to examine these relationships. We used the model epithelium, Madin-Darby canine kidney (MDCK) cells with endogenous and knockdown levels of ZO-1.

MDCK cells were transfected with mCherry-ARHGEF11 to visualize its location within the cells. Latrunculin A (LatA) treatment causes actin cytoskeleton disruption and it is hypothesized that ZO-1 will protect from Lat A exposure. Actin levels were measured in MDCK cells following LatA exposure. Actin levels were lower in ZO-1 knockdown cells and were resistant to LatA treatment whereas actin level significantly decreased at the tight junction following treatment on wild type MDCK cells. ARHGEF11 expression in MDCK-ZO-1 knockdown cells was global with some accumulation at the junction or perijunctional actomyosin ring.

Electrophysiology studies indicate that ZO-1 knockdown cells have lower transepithelial resistance than the wild type. Indicating that ZO-1 assists in the barrier function of the tight junction.

Funding Source: San Antonio Medical Foundation
Understanding the Role of H₂O in the Preferential Oxidation of CO in H₂ using Kinetic Studies of H₂ Oxidation

Todd Whittaker*, Bert Chandler.

Over 10 million tons of H₂ gas is produced in the United States alone annually, and over half of the H₂ produced worldwide is used in the Haber-Bosch process to produce ammonia. A common impurity formed in H₂ gas production is CO and this is bad as CO is known to deactivate many metal catalysts, including the Fe catalyst used in Haber-Bosch. The preferential oxidation of CO in the presence of H₂ (PrOx) has long been proposed as a purification method, yet has not been able to be made industrially viable. Supported Au nanoparticles are known to be good CO oxidation catalysts and bad H₂ oxidation catalysts but in order for these catalysts to be viable the reactivity towards CO and the selectivity needed to be improved. In a recently proposed mechanism, we show experimentally that H₂O on the surface of the catalyst plays a massive role in both activity and selectivity of CO oxidation and PrOx. In the current study, we investigated the role H₂O plays in the H₂ oxidation reaction, in order to better understand the full mechanism for PrOx.

By studying the kinetics of the H₂ oxidation reaction, some important observations were made. Firstly, H₂ was nominally 0th order at all H₂O coverages, similar to CO in the CO oxidation reaction. Secondly, O₂ is weakly positive order (0.2-0.4) under all H₂O coverages, which is also similar to O₂ in the CO oxidation reaction. Thirdly and most importantly, H₂O was strongly negative order. This means that higher H₂O coverages actually poison the H₂ oxidation reaction. We propose that this observed deactivation of the catalyst in the H₂ oxidation reaction is caused by blocking of activation sites. Adsorbed H₂O occupies interface sites on the Au nanoparticle and it is thought that these sites are important in activating H₂. Therefore it follows that with increasing H₂O coverage, the rate of H₂ oxidation would decrease due to lower amounts of active H₂. This study shows kinetic evidence that H₂O deactivates H₂ oxidation on supported Au nanoparticles. The true value in these results however is as support for the previously reported claim that high H₂O surface coverage is crucially important for successful PROx on Au catalysts. High surface coverage of H₂O leads to the promotion of CO oxidation and the deactivation of H₂ oxidation, which is the ideal scenario for competitive PROx results.

Funding Source: National Science Foundation, Trinity University
Students + Startups Summer Internship:

Innocenti Jones, PLLC, Business Law

Abigail Baltuskonis, David Jones, Debra Innocenti, Nathan Roach

The Students + Startups (S +S) Summer Internship program is designed for students from a range of academic disciplines to pair up with local startups in the community. This experiential learning opportunity provides students with the daily concerns and practicalities of startup culture. I worked with Innocenti Jones law practice at Geekdom, a co-working office space located in downtown San Antonio, and learned about the legal logistics of starting a small business and/or startup as well as civil litigation. Among other things, an English major, I applied my research and writing experience in order to develop my mentors’ projects to educate the community about law.

While working with Innocenti Jones, I encountered an innovative approach to law practice—a combination of legal assistance with an emphasis on counseling and deep listening, essentially prioritizing communication; they are invested in relationships with their clients (and others) because they strive to resolve client’s legal issues while educating them about these matters. As an intern, I often learned alongside many of their clients, whom they educated about things like the formation of small business entities.

I created four learning objectives which focused my efforts within the timeframe of this internship, and inspired me to research legal and business matters on my own time, as well as develop more effective communication skills. My poster will display my development in the areas of communication, law, research and marketing.

Funding Sources: Trinity University, 80/20 Foundation, Geekdom, Innocenti Jones
An Analysis of Teachers’ Perception of Latinx Parent-Family Involvement and its Effect on Teaching Practices

Samsara Davalos Reyes * Dr. Delgado

Educational policies such as No Child Left Behind (NCLB, 2001) and Every Student Succeed Act (ESSA, 2015) place particular emphasis on parental involvement as a factor to student success. Parental-family involvement (PFI) is positively correlated with student success. However, critics argue that current proposals for PFI are not compatible with minority students due to the narrow, school-focused definition of these programs. The current definition recognizes and advertises visibility in the school and traditional parent-father and mother-partnership as the only forms of PFI. Much of the debate centers around the diversity in expression of PFI, such as home-based PFI like moral education, or high educational expectations, that often go unrecognized and undervalued by educators and legislators. For example, PFI in NCLB through its wording was limited to only parent involvement. It was not until ESSA of 2015 that it expanded to become parent family encouragement. Because many minority groups rely on heavy family support not just parent support, this one simple change brought to light many previously overlooked forms of PFI. Furthermore, as recent immigration patterns change the ethnic and racial makeup of the United States it is imperative that the U.S. Education system accommodates such an influx of cultural diversity in the classroom. To better understand the multiple expressions of PFI and how they reconcile with the U.S. Education system, this study focused on a specific minority group—Latinx individuals. The Latinx group is unique in that it not only covers a vast range of nationalities, languages, and races but here in the US generational status also has an important impact. All of these factors produce a heterogeneous complex identity that under current Educational approach is given a White homogenous treatment. Since the Latinx population are one of the fastest growing minority groups who hold a dual frame of reference because of immigrant status, they offer a unique side to this overarching issue. The research question guiding this study was: “what are teachers’ perceptions of Latinx PFI and what effect do their perceptions have on teaching practices.” We sought to interview teachers to further understand what educators had to say on this topic, and if a personal connection to the Latinx culture had an effect on their perceptions and practices. To better understand this topic, six open ended interviews with teachers who had experience in working with Latinx population were conducted. The analysis and implications of this research findings continue to be explored.

Funding Source: McNair Scholars Program
Students+Startups Summer Internship: Developing IoT Software in a Startup Environment

Alexander Hicks*, Luis Martinez.

The Students+Startups internship program was designed to connect students with small companies in and around downtown San Antonio. The selection process involved interviewing with multiple different startups which provided the opportunity to find the best fit for each student as well as each participating startup. As a computer science major I was able to connect with BJN Technologies which enabled me to further both my Entrepreneurial knowledge while gaining invaluable development experience.

My internship position with BJN Technologies was focused around embedded system development and thus involved lots of low-level coding. Together with my supervisor we set four learning goals centered around developing for these systems in a startup environment. Completing these goals empowered me to push my limits and become much more skilled at software development especially developing wireless communication software. This poster will explore the technical learning objectives I had and how I accomplished them by building both an over-the-air software update system and a wifi remote interface specifically for a headless microcontroller. Developing for these small “Internet of Things” devices is truly enlightening and will only become more relevant as more things become connected to the internet.

Funding Source: Students + Startups partnership between 80/20 Foundation, Trinity University, and BJN Technologies.
Dbuntu

A Startup Utilizing Data for Uganda’s Dairy Industry

Alvin Mbabazi*, Dr. Luis Martinez

Dbuntu’s mission is to create a well-designed, smart, and mobile application that delivers the opportunity to make data driven decisions to farmers in Africa. Our goal for the 2017 Summer Accelerator was to search for a repeatable and scalable business model to support our mission.

Our process followed the lean startup methodology, with a focus on agile development, testing a working minimum viable product (MVP) with customers, and rapid iterative development. Having proven our problem-solution fit for one paying dairy farmer in Uganda, Dbuntu sought to achieve a product-market fit and to distribute our dairy farm management solution systematically to the entire dairy farming population of Uganda.

During the Summer Accelerator, we allocated our time and capital resources towards the completion of three distinct primary objectives: 1) System development, 2) Preparation and schedule for trip to Uganda (31st July - 20th August), and 3) Entity formation. In addition to these, we implemented a cloud based enterprise information systems to enable remote co-working and development. We are near completion of our objectives. We are using the following software and tools for more efficient operations:

- Zoho CRM + Project Management
- Appsheets (White label apps for MVP)
- Amazon Web Services, Postgres Database, Quantum Geographical Information Systems

Currently, we expect to fully complete our MVP App (80% complete) on the 28th of July, in time to go to Uganda on the 31st of July with a strategic plan to acquire new farmers onto our system, collect data, and perform insight analysis. We have been able to increase one farms production by 38%, if we can do this to all farmers, Uganda will become a self-sufficient milk exporter.

Funding Source: F.W. Olin E-Team Endowment
The Students+Startups Summer Internship Program was created for students to experience building a company from nothing. Being a part of this program also provides the much needed help and energy that startups need from enthusiastic students. As a philosophy major, I have been able to use my communication, interpersonal, and organizational skills to work in an office environment.

Working for a startup requires a willingness to be flexible and possess a breadth of expertise. My roles at Codeup have let me experience all aspects of what running a company is like. My primary responsibility was to work with the Vice President of Student Experience, Phillip Hernandez, to help relieve some of his workload; this is especially critical during the Capstone period of the students. To help organize my accomplishments and new experiences, I created five learning objectives. These objectives, or goals, have allowed me to see what skills I excel at, and what skills I need to work on. This poster will divide my learning goals into five fields - marketing, communication, customer satisfaction, curriculum building, and networking - to properly showcase how I have accomplished each goal.

Funding Source: Students + Startups partnership between 80/20 Foundation, Trinity University, and Codeup.
Assembla Marketing Intern

Shivani Parmar*, Nick Honegger

Students + Startups gives students an opportunity to gain experience in a startup environment. The program facilitates an interview process where students and companies are able to get to know each other better and assert their expectations for their ideal intern and internship respectively. After eleven interviews, I chose to intern at Assembla, a software startup downtown. My main reasoning for choosing Assembla was because as an Economics major, I will not graduate with a technical degree per se; however, with Assembla I was able to work and contribute at a technical company regardless. This experience was invaluable as I know more about the software industry than I ever thought I would. One of my learning goals for this summer was to gain a technical skill, specifically learning SaaS. I can definitely say that through this internship I am much more familiar with SaaS via the avenue Hubspot. Through working in Hubspot, sitting in on executive team meetings, and learning the nuances of marketing, I was given a holistic learning experience.

Funding: This opportunity is made possible the Students + Startups program, which is a partnership between the 80/20 Foundation, Trinity University, and Assembla.
Trinity Summer Accelerator Program- Starting Your Own Business

James Procter*, Greg Labbe*, Dr. Luis Martinez

The Summer Accelerator Program is a prize from the Stumberg Venture Competition; providing students with the opportunities and resources to start their own businesses. The Summer Accelerator Program allowed our company, RADD, to engage with other entrepreneurs and business owners in the local san antonio community such as Geekdom and Launch SA. These communities gave us insight which allowed for rapid growth in our company. Through the program, we had the opportunity to go to Tennessee and work personally with our manufacturing team, allowing us to better execute our business.

With the insight we received this summer, we were able to conduct efficient market research. We analysed four parts of our company (Sales, Marketing, Design, and Production), and were able to make improvements in each category. We set four specific goals at the beginning of the summer, grow our sales force, find our target market, differentiate our product based on our consumers needs, and to produce our product more efficiently without sacrificing quality. This poster will show the success of our research conducted in the Summer Accelerator Program directed by Dr. Luis Martinez, and Carmen Armanda.

Funding: F.W. Olin E-Team Endowment
Modern Knights

Nick Smetzer*, James Lovett*, Meredith Peckham*, Dr. Luis Martinez

During the spring semester, the San Antonio section of Modern Knights pitched a miniature war game as a part of the Stumberg Competition. As a finalist, Modern Knights was given $5,000 as well as admission into a summer accelerator program tailored to help the company launch and expand successfully.

Over the course of the summer accelerator, Modern Knights has made a great deal of progress. Utilizing the $5,000 prize money, Modern Knights began acquiring a network of artists and sculptors to begin creating the miniatures that will form the base of our game. In addition to this, over 100 pages of text have been written for the game, in the form of rules, unit-statistics and lore. In the latter half of the accelerator, Modern Knights finished the first version of their game, and are currently playtesting it with a group of interested individuals to ensure that the game meets the desires of the consumer base.

In addition to the development of the product, particular attention was given to the cultivation of a social media following; after conducting research and selecting an aggressive social media strategy, Modern Knights achieved 500 followers within a month of launching their campaign. Not only does this benefit their initial crowdfunding efforts, but this allows for a greater pool to utilize for further playtesting events.

To summarize, Modern Knights utilized the summer period and the prize money to not only fully realize the rules of their game and design the initial game pieces, but also to develop a brand and successfully build a growing community around it.

Funding Source: F.W. Olin E-Team Endowment
Summer Accelerator: Pok-It

Diego Trevino*, Evan Murphy*, Sean Pan*, Dr. Luis Martinez

The goal of the summer accelerator program is to further the progress of Trinity University startups in preparation for the Trinity University Stumberg Venture Competition, Final Round, in October. Over the course of the summer, the Entrepreneurship Department offered daily mentorship, workshops, and the opportunity to engage in the San Antonio startup community at locations such as Geekdom and LaunchSA. Because of these resources, the team was able to recognize some of the flaws in our business structure and correct them so that we are now able to more quickly and efficiently grow our business.

Our participation in the summer accelerator required us to interact with multiple mentors, conduct extensive market research, and present our business to, and receive feedback from, the local startup community. At the beginning of the summer, our team agreed our goals for the summer were to verify our target market and find the most scalable structure for our business. With these goals in mind, we were able to more efficiently and effectively utilize the resources provided by the university. This poster will highlight the key activities that we performed and their effects on our business.

Funding Source: F.W. Olin E-Team Endowment
Trinity Summer Accelerator Program - Coldeclara

Emilio Vernaza*, Dr. Luis Martinez

The Summer Accelerator Program has been a very challenging and enriching experience that has allowed me to launch my business successfully to customers. Coldeclara, the company I created over the summer, is very grateful to the Stumberg Venture Competition for the cash prize and to Trinity University’s Entrepreneurship Department for the daily mentorship, guidance and exposure to the startup community in San Antonio.

Over the course of the summer, Coldeclara has made tremendous progress. We have best utilized our cash prize by focusing on validated learning under the lean approach. In other words, we have invested our award in product development, advertisement and legal costs (for registering trademarks and incorporating the business). We have also established rich communication channels with our customers, which has allow us to improve our operations daily.

Participating in such a program has been an opportunity to test my skills developed as a student into a real business. In summary, this poster is going to show how successful the program has been.

Funding: F.W. Olin E-Team Endowment
ZO-1 Plays a Role in the Stability of Tight Junction and Cytoskeleton of Epithelial Cells

Addison R. White*; Gabby G. Mudekunye*; Jonathan M. King

Zonula Occludens (ZO) -1 is a cytoplasmic scaffolding protein that plays a role in tight junction barrier function in epithelial cells. ZO-1 belongs to a family of ZO proteins, which also include ZO-2 and ZO-3. ZO-1 and ZO-2 contain an actin-binding region (ABR) which is thought to help tether the tight junction to the cytoskeleton. ARHGEF11 is a Rho GTPase that has been shown to interact with both the actin cytoskeleton and ZO-1.

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MDCK cells were transfected with mCherry-ARHGEF11 to visualize its location within the cells. Latrunculin A (LatA) treatment causes actin cytoskeleton disruption and it is hypothesized that ZO-1 will protect from Lat A exposure. Actin levels were measured in MDCK cells following LatA exposure. Actin levels were lower in ZO-1 knockdown cells and were resistant to LatA treatment whereas actin level significantly decreased at the tight junction following treatment on wild type MDCK cells. ARHGEF11 expression in MDCK-ZO-1 knockdown cells was global with some accumulation at the junction or perijunctional actomyosin ring.

Electrophysiology studies indicate that ZO-1 knockdown cells have lower transepithelial resistance than the wild type. Indicating that ZO-1 assists in the barrier function of the tight junction.

Funding Source: San Antonio Medical Foundation
**Experiential Learning: Student Perceptions of Course-Embedded Service-Learning**

**Cady Wills*, Heather Haynes Smith, Ph.D.**

This qualitative research study focused on student perceptions of a course-embedded experiential learning opportunity implemented in one course at Trinity University over several years. Service-learning, a form of experiential learning, is a pedagogical strategy incorporating meaningful community service with direct and purposeful application to academic goals. It is designed to be beneficial to both the students and community partners. Best practices in service-learning suggest the incorporation of structured reflection of the service-learning experience. For this study, the written reflections (n=118) were analyzed using grounded theory and narrative text analysis. Student written reflections demonstrated connections to course content and sharing of emotions around their experience. Their reflections can be understood through three domains: emotional, behavioral, and cognitive. Further, findings suggest students most readily recognize changes in these areas: improvement in interpersonal skills and understanding of disability and disability community. The presenter will elaborate on these findings, results from a review of the literature, methods used in analyzing the student work samples, use of NVivo Pro 11 software in analysis, and the connections to evidence-based practices in implementation of service-learning in higher education coursework. This research aims to translate research to improved practices in implementing service-learning in higher education coursework.

**Funding Source:** Collaborative for Learning and Teaching
Lipid Composition of Astrocyte Secretions: Change as a Function of Age

Cynthia Alvarez*, Amanda Nguyen, Dr. James L. Roberts

Astrocytes are a major type of glial cell that are responsible for the general upkeep of surrounding neurons. They secrete apolipoproteins, which bind lipids that are involved in the basic function of a neuron and serve as a protection against oxidative stress mediated neurodegenerative diseases. Some of the most notable astrocyte secreted apolipoproteins include apoE and apoA1, which when mutated, are associated with neurodegenerative illnesses such as Alzheimer’s disease. Astrocytes also secrete lipids that are vital to the structure and upkeep of surrounding neurons. We hypothesize that there is a reduction in quantity or quality of these secretions and this difference may influence the older astrocytes’ protective effects on neurons against oxidative stress that leads to neurodegeneration. We aimed to analyze the secretions from 4 month and 28 month astrocytes to identify the lipids and apolipoproteins present. The cells were placed in serum free growth medium and media was collected after 48 hours. Media purification was accomplished by precipitation with Dextran Sulfate (Cell Biolabs) to separate and concentrate the low-density lipoproteins/ very low-density lipoproteins (LDLs/VLDLs) from the high-density lipoproteins (HDLs). Cleanascite (Biotech Support Group), a lipid binding resin, was used in a different form of media purification that yielded total lipid content. Lipid samples were then further purified using chloroform and methanol to prepare for thin layer chromatography and mass spectrometry in order to identify and quantify lipid content. Western Blots will also be done to identify and quantify the amount of apolipoproteins present in the secretome of the cells. It is anticipated that there will be a difference in the overall lipid composition of secretions between the younger and older cells.

Funding Source: Ronald E. McNair Post-Baccalaureate Achievement Program Cowles Professorship
Multidisciplinary Session A

Presentation 73

Batman as Contemporary Golem: The Legendary Jewish Figure Resurrected as a Modern American Hero

Yesenia Caballero, * Dr. Victoria Aarons.

The comics industry in America was largely established by Eastern European Jews in the early twentieth century with the introduction of Superman in 1938 and Batman a year later, both heroes created by children of Jewish immigrants. As has been noted by many scholars, Superman was a comic book superhero whose mythos drew upon the Jewish legend of the Golem, a figure that was sculpted out of clay and brought to life by a Rabbi to be a champion of the Jewish people.

Despite the equal popularity of Superman and Batman among an American audience, relatively little has been written on Batman and the parallel to the legendary Jewish figure of the Golem. Created out of desperation in dark times and molded to be a fear-inducing monster that stops villains in their tracks, Batman functions as a Golem for the fictional Gotham City he resides in - a city whose troubles seem to mirror real world conflicts.

This paper argues that Batman is a hero who was created to reflect and address our social anxieties, and that his mythos has perpetuated because he is a hero made to serve the people. In conclusion, this research, by closely examining the literature of Batman and the climate under which he was created, sheds new light on the ways in which this iconic figure parallels the myth of the Golem, identifying him as a champion of the persecuted and thus resonating with a contemporary audience.

Funding Source: Mellon Summer Research Fellows Program
“Perception is a Station on the Paths of Knowledge”: Translating the Diaries of Erwin Piscator

Cole Callen*, Stacey Connelly

In this project, Erwin Piscator’s influence and work following his return to Germany in 1952 gain a voice through the translation of his journals during this period. Much completed research in studies related to translation focuses on the techniques and practices of translating literature or, more recently, on sociopolitical issues and the effects on translating source-language texts into target languages. The translation of Piscator’s journals represents the uncovering of new information about his life as a returned exile in post-war Germany because no large portion of these diaries have ever been published in any language. The process of translating previously unpublished writings relies on the translator’s consciousness of the bias that they may carry when faced with various linguistic or printing issues within the source text. Issues of missing phrases or words within sentences as well as structural and orthographical problems occur quite often in the typescript of Piscator’s original writings. There is also a certain difficulty of intelligibility due to Piscator’s uncommon uses of lexical items, some of which are morphological constructions that do not occur in other sources. A challenge presents itself to the translator: how does one use their creativity to convey the intention of the source text and remain true to the text at the same time? In order to consistently approach and solve these various problems, the translator must develop a systematic tactic for each type of problem. By this model, the translation of Erwin Piscator’s journals represent reliability in the meaning of his original writings.

Funding Sources: Ronald E. McNair Postbaccalaureate Achievement Program, Mellon Initiative
Archaism in Modern Art

Natalie Carrier*, Dr. Kathryn O’Rourke

Artists’ indebtedness to or rejection of Greek and Roman conventions has been a central preoccupation of art history since the discipline’s inception in the sixteenth century. Renaissance and eighteenth-century classicisms, along with Art Deco, are perhaps the most familiar examples of the long reach of golden-age antiquity. In turn, many artists in the 20th century rebelled against the forms and even the principles of classicism. While this reaction has been explored in discussions of primitivism, less attention has been paid to artists’ unprecedented interest in the art of the “pre-classical” Archaic period, which coincided with an efflorescence of scholarship on archaic art.

I argue that the newfound interest in Archaic Greek art among early twentieth-century artists was motivated, at least in part, by an ambition to position their own work within a long narrative of art history. As multiple forces of modernity reshaped the arts, scholars and artists used historical parallels to contextualize and shape the tumultuous developments around them. This talk focuses on works by Paul Manship, Henry Moore, and Isamu Noguchi to examine the ways these artists engaged with the forms and idea of archaic art to create works that responded powerfully to problems of the early twentieth century. Like scholars, they used history to help define their work and era as connected to and decidedly different from a distant past.

Funding Source: The Mellon Foundation
The Effects of Bleach Treatments and Stratification on the Germination Rates of Five Milkweed Species

Kelly Carroll*, Olivia Roybal*, Molly Lenihan, Kyle Reynoso, Kelly Lyons

Pollinator populations across North America are in decline as a result of stressors such as climate change, insecticide exposure, and habitat loss. Widespread efforts have been made at the federal and state level and by NGOs to improve degraded pollinator habitat, with particular emphasis on monarchs. Along their migration from Mexico to Canada, monarch adults feed on the nectar of flowering plants while their larvae feed on the leaves of milkweed species. Propagation of native milkweed species is thus critical to habitat restoration efforts; however, studies on the germination and growth requirements for individual milkweed species are lacking. For some species, researchers recommend stratification, a process that induces germination through exposure to cold temperatures and moisture. Milkweed is thought to exhibit interspecific variation in stratification needs because of the range of species ecotypes. Additionally, for some species bleach sterilization of seeds prior to imbibing may decrease the probability of pathogen colonization and improve germination rates. Our study focused on five milkweed species that are native to Texas: Asclepias asperula, A. speciosa, A. syriaca, A. tuberosa, and A. viridis. We hypothesized that stratification requirements are species-specific and that the germination of more tropical species would not change due to stratification, while more temperate species would germinate more readily after undergoing stratification. In addition, we hypothesized that higher concentration bleach treatments would have a greater effect in limiting pathogen colonization, thus improving overall germination.

The experiment was a 5 x 4 x 2 factorial design. Each treatment group had ten replicates, and each replicate consisted of ten seeds. For each replicate, the ten seeds were placed in Petri dishes on a moistened filter paper and sealed with Parafilm. Replicates were subjected to four different bleach treatments: 0%, 5%, 10%, or 15% Clorox for five minutes. The stratification treatment exposed seeds to a temperature of approximately 2º C in moist vermiculite for two weeks. For each treatment combination we measured days to radicle (embryonic root) emergence, a metric of germination, as well as the total number of radicles daily for a period of fourteen days. Our results indicate that tropical species do not require stratification, and that overall germination in temperate species improves after stratification. Pathogen colonization was less prominent in treatment groups that included a bleach treatment. We recommend that any further efforts by the government or citizens of Texas take our data demonstrating species-specific germination requirements into consideration when propagating milkweeds and planning milkweed gardens.

Funding Source: NSF Research Opportunity Award; Hixon Environmental Studies Summer Research Fellowship; Shield-Ayres Foundation.
Isabel Coixet’s *Learning to Drive* (2015): Navigating a Transatlantic Perspective of Gender and Race in New York City

Rachel Daniel*, Dr. Debra Ochoa

With the rising trend of globalization, cross cultural perspectives are becoming more widely discussed as Spanish writers and directors complicate the notion of national cinema and literature by focusing on global cities, such as New York, which provide a setting to explore immigration, cultural encounters, and identity. While scholars have focused on Spanish cultural production in New York during the twentieth century, there is a gap in knowledge concerning more recent literary and visual narratives. There is some research that focuses on the films of Isabel Coixet, a Catalonian director, but her film *Learning to Drive* (2015) has yet to receive critical attention.

As part of an exploration of the transatlantic perspective offered by Spaniards on gender and race in New York, my paper, which will be incorporated into a larger book project, will focus on the film *Learning to Drive* to identify themes of feminist empowerment and the influence of the characters’ interactions in New York. The film, which is based upon a *New Yorker* article by Katha Pollitt, centers on the main character, Wendy, who decides to take driving lessons as a means of emancipation. She quickly develops a friendship with her driving instructor, Darwan Singh, a Sikh taxi driver, and through their conversations, the film uncovers both Wendy’s and Darwan’s personal dilemmas that establish certain parallels between the two seemingly disparate characters.

I will analyze a series of clips from the movie and identify how the urban space of New York influences the main character Wendy’s process of self-discovery and independence. As a film set after 9/11 with a main character who identifies as Sikh, there are scenes that reference the events from 2001 as well as the xenophobia that surged in the following years. Darwan’s experiences will provide the opportunity to explore the racism experienced by immigrants in post 9/11 New York. To supplement my analysis of the film, I will reference canonical gender theory by Daphne Spain pertaining to the role of women in the public versus private space as well as the spatial theories of Henri Lefebvre and Michel de Certeau that inform my analysis of how characters experience space and interact with one another. I argue that an analysis of the characters’ experiences uncovers a New York that is a location of both empowerment and limitations for urban subjects as they create space through their social interactions.

Funding Source: The Mellon Initiative
African Americans In San Antonio

Nina Nevill*, Carey Latimore

Our book length project “African Americans In San Antonio” provides a narrative of the greater Civil Rights era in San Antonio. This study explores the ways that the Civil Rights era in San Antonio neither completely reflected the struggles in traditionally Southern cities nor did it completely mirror the Civil Rights struggles in Western cities. Unlike Houston and Dallas, there is a lack of historical study surrounding the political, social, and cultural climate of San Antonio during the greater Civil Rights era.

By examining documents and sources such as local newspapers and FBI files on prominent members of the community, we have been able to cultivate a greater understanding of what distinguished San Antonio from other neighboring cities during the time. Our primary focus this summer was conducting a series of oral interviews with members of the San Antonio community who lived through our era of interest. Their stories have provided a multitude of perspectives regarding demographic cleavages within the city, political organizations, social clubs, public segregation, and everything from activism through education to activism through violence.

Funding Source: Mellon Initiative Summer Undergraduate Research Fellowship
Locking an Optical Cavity with a LIGO Teaching Kit

Hanna Rafferty*, Dr. Dennis Ugolini

The Laser Interferometer Gravitational-Wave Observatory (LIGO) measures gravitational waves using a modified Michelson interferometer. We developed a small-scale teaching kit for high school and undergraduate students to simulate the LIGO enhancements with lab experiments.

We added a Fabry-Perot cavity to the basic interferometer setup to increase the distance that the laser travels thus making LIGO more sensitive. This cavity must be an integer number of wavelengths apart so that the laser doesn’t cancel itself out. In this state, called resonance, the photodiode that detects the light emerging from the cavity measures intensity, which means that the slope is zero and consequently insensitive to change. However, when we add modulation to the light and mix the photodiode output with the frequency of the modulation, the result is a Pound-Drever-Hall error signal that is linear and thus sensitive to change.

We mounted the Fabry-Perot mirror and the modulating mirror on PZTs so that we could vary the cavity’s length and add beats at 59 kHz. We then built a preamplifier, demodulator, and feedback servo that first mixes the photodiode output and the frequency of the modulation to produce the error signal and then corrects the cavity length. The servo successfully locks the cavity length and can correct for an added voltage ramp.

Funding Source: National Science Foundation grant PHY-1404269
Sessile Drop Evaporation Study: Measurement of Bi-component Vapor Cloud Concentrations

Sean Farrell*, Greg Wassom, Chris Pursell, Peter Kelly-Zion

Previous research in our lab measured the mass, evaporation rate, and composition of evaporating bi-component liquid films. This summer we focused on measuring the individual component concentration of the evaporation cloud formed above pure and bi-component sessile droplets. Knowing the vapor phase concentrate distribution enables us to analyze the transport mechanisms that control the evaporation process. In turn we can increase our understanding of how the dynamics involved with the evaporation process differ for bi-component and pure droplets.

We are utilizing an experimental technique for bi-component drops that we previously developed for pure droplets. The technique uses a Fourier transform infrared spectrometer (FT-IR) to measure the spectral absorbance along a path passing through the vapor cloud above an evaporating sessile droplet. From a set of path-averaged absorbance measurements at nine specific locations above the droplet, the vapor concentrations were determined. We measured the vapor concentration distributions for two bi-component mixtures. The first mixture was composed of 3-methylpentane and hexane because the components have nearly equal volatilities, and the second mixture was composed of 3-methylpentane and isooctane because of their differences in volatility. To help us analyze the effects of bi-component evaporation, reference measurements were made at the same nine locations using pure droplets of each component.

We demonstrated the ability to make semi-quantitative, simultaneous measurements of the vapor phase concentration of an evaporating bi-component sessile drop. Preliminary analysis shows an increased transient behavior in the vapor cloud which could be due to differences in the mixtures mole fraction ratio and non-uniform compositions on the surface of the liquid droplet, as investigated in our previous research. These are some of the first quantitative measurements of the vapor concentration distribution above a bi-component sessile drop and are important for increasing our understanding of the behavior of these droplets evaporation dynamics.

Funding Source: Petroleum Research Fund
Model of an Evaporating Drop Experiment

Nicolas Rodriguez*, Dr. Hoa Nguyen, Dr. Peter Kelly-Zion, Dr. Chris Pursell

A computational model of an experimental procedure to measure vapor distributions surrounding sessile drops is developed to evaluate the uncertainty in the experimental results. Methanol, which is expected to have predominantly diffusive vapor transport, is chosen as a validation test for our model. The experimental process first uses a Fourier transform infrared spectrometer to measure the absorbance along lines passing through the vapor cloud. Since the measurement contains some errors, our model allows adding random noises to the computational integrated absorbance to mimic this. Then the resulting data are interpolated before passing through a computed tomography routine (analogous to what is used to produce a CAT scan) to generate the vapor distribution. Next, the gradients of the vapor distribution are computed along a given control volume surrounding the drop so that the diffusive flux can be evaluated as the net rate of diffusion out of the control volume. Our model of methanol evaporation shows that the accumulated errors of the whole experimental procedure affect the diffusive fluxes at different control volumes and are sensitive to how the noisy data of integrated absorbance are interpolated. This indicates the importance of investigating a variety of data fitting methods to choose which is best to present the data.

Funding Source: Trinity Mach Fellowship
Assessing Transient Evaporation of Sessile Drops by Diffusion Models

Cameron Martin*, Dr. Hoa Nguyen, Dr. Peter Kelly-Zion, Dr. Chris Pursell

The vapor distributions surrounding sessile drops of methanol are modeled as the solutions of the steady-state and transient diffusion equations using Matlab’s PDE Toolbox. The goal is to determine how quickly the transient diffusive transport reaches its quasi-steady state as the droplet geometry is varied between a Weber’s disc, a real droplet shape, and a spherical cap with matching thickness or contact angle. We assume that the only transport mechanism at work is diffusion, and that other mechanisms such as convection are negligible. Then the quasi-steady state is defined using a number of measures, such as differences between the transient solution and the steady-state solution, and change in the transient solution over time.

Furthermore, with knowledge of the vapor distribution, the gradient is computed in order to evaluate the diffusive flux. The diffusive flux is integrated along the surface of a control volume surrounding the drop to obtain the net rate of diffusion out of the control volume. Based on the differences between the transient diffusive fluxes and the steady-state ones at the discretized points along the control-volume surface, the time to reach quasi-steady state evaporation is determined and is consistent with other proposed measurements. By varying the dimensions of the control volume, we can also assess what regimes have equivalent or different quasi-steady states for different droplet geometries.

Funding Source: Petroleum Research Fund
Modeling Hydrodynamic Effects on Choanoflagellate Feeding

Christian Oakes*, Dr. Hoa Nguyen, Dr. Mimi Koehl of UC Berkeley, Dr. Lisa Fauci of Tulane University

Choanoflagellates are unicellular organisms whose intriguing morphology includes a set of collars/microvilli emanating from the cell body, surrounding the beating flagellum. As the closest living relative to animals, they are important for both ecological and evolutionary studies. Choanoflagellates have three unicellular types: slow swimmers, fast swimmers, and thecate (attached to a surface by a stalk). Each has different morphology and feeding rate.

We use the method of regularized Stokeslets to simulate cell-fluid interactions of each type and show the hydrodynamic effects on the amount and directions of fluid flow toward the collar. After validating the swimming speeds of our models with experimental data, we calculate the rate of flow across a capture zone around the collar (flux). This sheds light on how each morphological aspect of the cell aids in bacteria capture during feeding. Among the three types, the thecate cells have the largest average flux values, implying that they take advantage of the nearby surface by creating eddies that draw bacteria into their collar for ingestion.

Funding Source: FASTER Grant SURF – National Science Foundation DUE S-STEM Award 1153796, Mach Fellowship
Measuring Black Hole Mass and Spin

Matthew Jenkins*, Dr. David Pooley

Supermassive black holes exist at the center of all galaxies and are often called “galactic nuclei.” Broadly, these black holes can be classified in terms of their luminous emission: active galactic nuclei (AGN) are black holes which emit strongly across the entire electromagnetic spectrum, while inactive nuclei do not. The most active supermassive black holes are called quasars, which are accreting enormous amounts of material to power their luminous output. This material rotates around and falls toward the central black hole in an “accretion disk”, in the process converting rotational energy into radiation. Many of the physical properties of the accretion disks around quasars are still unknown, but they do depend on two physical parameters of the central black hole: its mass and spin. Via spectral modeling in X-rays, one can measure the size of the inner edge of the accretion disk, which depends on the black hole mass and spin, the only two parameters necessary to completely specify a black hole’s properties. I have processed and analyzed observations of quasars from the European Space Agency’s XMM-Newton X-ray satellite with the goal of measuring the central black holes’ masses and spins.

Funding Source: Murchison Fellowship
The Development of Serum-free Cell Culture Methods and Immunoassays

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Background. Cell culture media often includes fetal bovine serum (FBS), an ingredient that provides an abundant source of essential growth factors and hormones. However, the use of FBS in common laboratory practice has a number of negative implications. These include inconsistencies between batches of FBS, market-dependent prices, and potential threats to animal welfare, among other issues.

Methods. To substitute FBS with a well-defined, consistent alternative, we will evaluate the effects of serum reduction and replacement for 3T3, 293T, and THP-1 cell lines. Specifically, we will investigate basic viability parameters (growth rate, morphology and adhesion capacity) as well as practical applications of the cell lines (transfection efficiency, expression of cell surface proteins, phagocytic capacity and B-cell stimulation). In addition, we will assess the efficacy and sensitivity of an enzyme-linked immunosorbent assay (ELISA) when FBS is replaced with a serum-free alternative. Lastly, we will freeze peripheral blood mononuclear cells (PBMCs) in FBS alternatives and then culture to observe any effects on the cells’ viability.

Funding Source: Lab startup funds from the Department of Microbiology, Immunology, and Molecular Biology at the University of Texas Health Science Center at San Antonio
Good Neighbor Policy?: Religion, Race, and National Identity in the Bracero program of the 1950’s and 1960’s

Thomas Harvell-DeGolier*, Dr. Lauren F. Turek

The Bracero Program, was a temporary migrant labor program, mired in controversy, that lasted from 1943-1964 which allowed American farmers to contract Mexican workers. The Bracero Program has received attention from historians of U.S. foreign relations and religion, including Richard B. Craig, who explores the foreign policy aspects of the Bracero program, specifically the actors involved in different spans of its existence and Gina Marie Pitti, who examines the role the Catholic church and other religious groups played in opposing the Bracero program. However, much of the secondary literature on these aspects of the Bracero program looks at these issues in isolation rather than as a whole. As such, this project attempts to update the existing scholarship by examining how religious lobbies raised concerns about human rights and U.S. foreign policy to primarily, but with some exceptions, oppose the Bracero Program.

Examining a combination of articles from religious periodicals, legislative texts, foreign policy agreements, and existing scholarship, this paper will show the how religious groups in the United States responded to the bracero program and immigration. Accordingly, it will reveal how religious groups talked about race, civil rights, and national identity in their publications and letters to their representatives as they advocated for their preferred policies. In this way, the paper will illuminate the intricate relationship between race, religion, and national identity during the postwar period in American history.

Funding Source: Summer Undergraduate Research Funding
Simulating Gravitational Microlensing

Jordan Koeller*, David Pooley

A quasar is one of the brightest objects in the universe, created when a supermassive black hole pulls in material at near-light-speed velocities. However, these objects are poorly understood, as their apparent size is so small they appear as a single point in our telescopes, and hence astronomers cannot observe their structure directly. Gravitational lensing, though, provides an opportunity to determine the structure of these quasars. Einstein’s Theory of General Relativity tells us that a massive object will warp spacetime and that light will feel those effects. Hence, if a significant collection of mass, such as a galaxy, exists directly between a quasar and us, the image we see is distorted from what is physically there. In order to take advantage of gravitational lensing, we have designed a robust physics simulator to better understand how observed phenomena can be used to discern the structure of quasars on spatial scales thousands of times smaller than would be possible through direct observation.

Funding Source: Startup Funds
Symphonic Music in San Antonio in the Early Twentieth Century

Ryun Howe*, Carl Leafstedt, Ph.D

The founding of the San Antonio Symphony Orchestra by Max Reiter in 1939 is remembered as an incident isolated from the rest of San Antonio’s musical history. In this perspective, San Antonio’s larger musical past is considered insignificant to the meteoric rise of the San Antonio Symphony in the 1940s. My goal this summer was to discover what institutions shaped the beginning of San Antonio’s musical culture in the early 20th century. Focusing on symphonic music, I looked for answers to the question: Why was the San Antonio Symphony Orchestra able to grow into such an esteemed orchestra so quickly? In the early 20th century at least several other symphonic organizations existed, including a “San Antonio Symphony Orchestra” led by several European-born conductors in the period 1905-22. So I began my investigation by looking into this first iteration of the San Antonio Symphony Orchestra.

The typical conception of classical music culture holds the idea of the symphony orchestra as an anchoring institution as the norm. From this perspective, the first iteration of the San Antonio Symphony Orchestra would be the institution that was the centerpiece of classical music in San Antonio, along with the institution responsible for the abundance of skilled musicians that helped the rise of the current San Antonio Symphony Orchestra in 1939. In reality, it was the abundance of amateur groups such as the Tuesday Musical Club and Beethoven Maennerchor, along with a smaller professional circle that included local pedagogues and theater orchestras, that incubated the abundance of musical talent that enabled the rise of today’s San Antonio Symphony Orchestra.
Lost & Found: Creating an Accessible Poetry Curriculum

Derek Hudson*, Jenny Browne

Accessibility is perhaps the greatest issue in poetry education. For both students, and non-poetry specific educators poetry can be seen as mystical, opaque, and esoteric. This project’s goal is to provide a flexible curriculum that will begin the process of demystifying the workings of poetry through both practical analysis of contemporary poetry and the creation of original material. As a compliment to the larger St. Anthony’s Lost & Found project, this project compiles a diverse selection of contemporary poems and accompanying original writing exercises. Throughout this project, I have been writing poetry in response to these writing exercises as a way to reflect on and evaluate their effectiveness, limitations, and generative potential. By creating an expansive and accessible method of teaching poetry, this project widens the influence of the humanities and brings poetry to new groups of people.

Funding Source: Mellon Foundation
Many Visions of Theatre

Alexis Jarrett

Invisible Cities is a site-specific performance made by the Italian theatre company Teatro Potlach. It is inspired by the novel of the same title by Italo Calvino which imagines the many possible sides of a city. The performance is in the style of a reverse parade; the spectators walk through the city in a pre-determined course and come upon performances throughout their journey. Its intention is to change the space that people are familiar with, bringing out something new and surprising about things that are often overlooked. My research comes together in the form a video essay/documentary that reveals the technical work behind the elaborate, site-specific work. Because of the location and magnitude of the project, the technical aspects are ambitious. The audacious scenery is a performance itself as it interacts with the outdoor space and the residents. Elements are added to the route in order to transform the city, such as: fabric tunnels, fabric paths, projections and video mapping, and lighting. I followed the technical team as they set up the performance to learn how each aspect is made and installed, as well as the amount of work that goes into this production.

The documentation of the technical aspects done for my project will be used for Dr. Gillette’s book. My work will allow him to have a detailed account of the work done for the performance, as a point of reference as he writes about Invisible Cities performances, the city, and his own travel experiences.

Funding Source: Mellon Foundation
The Sextuply Gravitationally Lensed Quasar

Brian Guerrero*, David Pooley

The system SDSS J2222+2745 consists of an actively accreting, supermassive black hole that has been gravitationally lensed by a cluster of 3 galaxies. This is the first known system in the universe (and perhaps the only one) that produces six images of the background quasar, making it cosmologically important because it sets constraints on the makeup of our universe. Three of the six images produced are difficult to directly detect in optical light, but our data obtained from NASA’s Chandra X-ray Observatory clearly confirm all six images. The lensing system’s mass model predicts flux ratios that disagree with the optical observations, and our data will help determine whether this is due to an inaccurate mass model or to microlensing-induced flux ratio anomalies by networks of stars in the lensing galaxies.

Funding Source: FASTER Grant Summer Undergraduate Research Fellowship
Solving Large Games of Incomplete Information

Stephen Hough*, Albert Xin Jiang

Game theory is the study of rational decision making, with far reaching applications in economics, sociology, and computer science, for example. However, many models of game theory are too large, or involve too many unknowns, to be easily solved. Most techniques of solving games do not scale well to large games of incomplete information. To explore these games effectively, we will need to use state of the art artificial intelligence techniques.

In our study, we’ve used various games as models with a focus on poker games, as they contain many interesting elements: massive size (10^160 decision points), both private and public chance events, and complex action spaces. The solving algorithm is Counterfactual Regret Minimization (CFR) and its variants. The focus of the study is on optimizing CFR for large game spaces, and many other related techniques for game solving, including pruning, action abstraction, and subgame solving.

Funding Source: Department of Computer Science Student Summer Research Fellowship
Study: An Unattributed Renaissance Manuscript in the Trinity University Special Collections

Kristina Kummerer*, Dr. Kimberlyn Montford

A gradual is a liturgical book of the Roman Catholic Church that contains the chants sung in the Mass Proper, which change from one service to the next. Gradual manuscripts are typically large enough that the music can be read by all the members of a choir during the service. These collections are records of historical liturgical practice, and also serve as reflections of local usage, allowing a glimpse into traditions that have long been lost.

The Trinity University Special Collections possesses an anonymous early Renaissance gradual manuscript, gifted to the university by the estate of Elizabeth Huth Coates. There is no other information regarding the bequest. The manuscript lacks archival tags and bibliographic records, and scholars outside the Trinity Community are unaware of the item. As a result, the manuscript sits untouched.

This project examines and catalogues the content of this resource, seeking to both assess a preliminary compilation date for the manuscript and situate it through analysis of its contents, marginalia, physical condition and treatment, and liturgical associations. An initial transcription of the chants unique to this collection will also encourage further religious history and music research. This project enables information on this unattributed treasure to circulate in the academic world, making further research possible. At the project’s completion, the Trinity manuscript can be studied alongside and with reference to contemporary manuscripts worldwide.

Funding Source: Mellon Initiative
The Effect of Temperature and Altitude on the Distribution of Root Fungal Endophytes

Molly Lenihan*, Kyle Reynoso*, Kelly Carroll, Olivia Roybal, Kelly Lyons.

Grass species distributions are determined by precipitation, temperature, and biotic and abiotic soil conditions. Climate change-induced global warming has caused significant and observable shifts of grass species to higher elevations and altitudes. Many grass species host leaf and root-dwelling fungi (fungal endophytes) that can improve tolerance to warming and concomitant drought stress; however, little is known about the habitat ranges of these fungal symbionts or symbiont sensitivity to climate change. We collaborated with Dr. Jennifer Rudgers (Univ. of New Mexico) using previously established research plots at the Rocky Mountain Biological Laboratory, Gothic, CO, USA, to ask the following questions: 1. Which fungal endophytes are associated with grass species at the middle and extremes of their elevational gradient; and 2. Do fungal endophyte associations change with warming? Question #1 was addressed utilizing three pre-existing experimental sites in the Upper Gunnison River Valley on the Western Slope of the Rocky Mountains. From each site, roots of nine grass species were sampled from six individuals at mid- and high-elevation habitats. Question #2 was addressed utilizing a twenty-year warming study, likely the oldest running experiment of its type in the world. In this investigation, five pairs of 10 x 3 m plots are assigned to either ambient (control) or warmed (2°C) treatments. Three grass species, both present in these plots and utilized in the observational study addressing Question #1, were selected for sampling. From each plot, roots were collected from three individuals per species for a total of nine/plot. All collected roots were prepared for root staining to detect the presence of fungal endophytes and cultured to isolate individual fungal endophyte species. Isolates will be identified using Sanger sequencing with fungal specific primers. Preliminary results and techniques used in the collection and processing of these samples will be presented, as well as expected results from further analysis and identification of the fungal endophytes previously isolated.

Funding Source: NSF Research Opportunity Award; Hixon Environmental Studies Summer Research Fellowship; Shield-Ayres Foundation.
Maternal Metabolic Status Influences the Fetal Epigenome

Fordin, Sarah A*; Rizzo, Heather. E*; Hibbs, Matthew A.; King, Jonathan M.

Background: Methylation is a known epigenetic regulator of gene expression, studies of fetal development have demonstrated methylation of some genes may occur in utero. It is unknown if either maternal diabetes mellitus, or maternal obesity will influence fetal methylation status. The objective of this study is to determine if maternal obesity or diabetes mellitus results in an increased or decreased methylation in CpG islands adjacent to genes specific to obesity or diabetes, or genes not initially considered to be involved in such disease pathways. Participants were selected based on approved IRB inclusion criteria, and cord blood samples were collected from neonates of non-diabetic normal weight mothers (n = 10), diabetic (gestational diabetes) normal weight mothers (n = 7), non-diabetic obese (BMI ≥ 30) mothers (n = 9), and diabetic (type II diabetes n = 2, gestational diabetes n = 4) obese mothers (n = 6), for a total sample size of n = 32. The collected DNA was purified from agranular leukocytes, treated through bisulfite conversion, and processed on an Illumina Infinium MethylationEPIC BeadChip to analyze over 850,000 different probe sites to determine methylation on a site-specific basis. This data was then processed in RStudio using an adapted methylation array processing workflow.

Roughly 100 significantly differentially methylated genes were found using validated statistical methods such as the t-test, false discovery rate, analysis of variance (ANOVA), and Bumphunter, (q < 0.05, p < 0.0001). Genes were found to be significant in both the diabetic and obese groups compared to the control, specific genes were identified that may be associated with increased risk of diabetes mellitus type later in life; increased risk of childhood or adulthood obesity and other complications of obesity. This information may better enable pregnant women, or women considering pregnancy, to make educated choices about their child’s future health.

Funding Sources: San Antonio Medical Foundation Grant, Ronald E. McNair Postbaccalaureate Achievement Program Grant
An Exploratory Study of Instructional Strategies Used to Teach Science to English Learners

Karina Mendez-Perez*, Ellen Barnett, and Rocio Delgado

In this representative review of the literature, practices used for teaching science to English learners (ELs) in elementary schools in the United States were examined. The Next Generation Science Standards and the Texas Essential Knowledge and Skills for teaching ELs in areas of science were also explored. To learn more about teaching science to ELs, a search for empirical peer-reviewed, practitioner, and theory-based articles published from 1993 to 2017 was conducted.

An analysis and synthesis of the literature in this area was completed to identify the best practices for ELs in science education. For this representative review, inquiry science is defined by the explorative progress that allows development of students’ scientific knowledge and understandings of the natural world. Findings showed that the English language and academic development in science for ELs are often taught independently in elementary schools. Additionally, the literature suggests that a lack of professional development opportunities and resources to help ELs with science.

Two model lessons in Physics following principles of Sheltered Instruction were created for use in a pilot study. Participants in the pilot will be kindergarten students enrolled in a dual language program. Observations will be conducted to determine the participating students’ understandings of physics.

Funding Source: McNair Scholars Program
Using Convolutional Neural Networks to Detect Plasmodium in Images of Blood Smears.

Mohamed Mnete*, Dr. Mathew Hibbs

The most efficient and frequently used technique of diagnosing malaria is through manually looking at blood smears under a microscope. While this way has proven to be successful, the same cannot be said for every laboratory around the World. In Africa for instance, there have been significant cases of false positive diagnosis of malaria using that technique. The reason for this is because the technician in those places lack the expertise to perform such experiments. Since we are talking of a deadly disease – Malaria- there is a need to look for a better alternative technique that will be able to detect plasmodium parasites on blood smears. This is where the image classification using machine learning comes in. We have witnessed huge amounts of success in image classification using convolutional neural network which means we can give it a try to try and classify microscopic images of blood smears that contain plasmodium and from those that do not contain plasmodium.

But in order to do this we will need data. The data I used was from a laboratory in Uganda and the images also came in with annotations as to where in the images the plasmodium parasites were. The data was obtained from experts which is what we want. Since the Machine Learning community has seen a lot of success, this project does seem promising. If this actually brings in substantial results it means we can either try it out on other disease that can be diagnosed using computer vision and even improve their diagnoses too.

Funding Source: Summer Research Fellowship.
The Consequence of Knowledge Gaps: Missing Data Reveal Racial Bias in Capital Trial Sentencing

Faith Deckard *, Dr. Sarah Beth Kaufman, and Dr. Kathleen Denny

There is currently no known national archive of information about capital murder trials. The surprising absence of this knowledge allows for discriminatory practices to go undetected when determining who is tried capitally. In this study, we examine whether capital sentencing patterns of white and nonwhite defendants differ. To address this question, we compile a comprehensive database of capital trials that took place in the United States in 2005, 2012, and 2016 using data gathered from media outlets, state agencies, and the Death Penalty Information Center, an organization that tracks death sentences. Analysis reveals that white and non-white men are tried capitally for different types of crimes. For example, in 2005, 54% of black male defendants tried capitally were tried for cases involving only male victims, whereas only 26% of white male defendants were tried for such cases. By contrast, white defendants were much more likely than black defendants to be tried capitally if women were among the victims (74% v. 46%, respectively). We argue that the paucity of record keeping and the lower prevalence of capital trials for white male-on-male crime perpetuates white masculine privilege.

Funding Source: Ronald E. McNair Postbaccalaureate Achievement Program
Deep Reinforcement Learning: Let Computers Learn Like Humans Do

Bowen Li*, Yu Zhang

Reinforcement learning as a way of computers learning to perform tasks through interactions and rewards had been limited to simple and well-defined environments like chess. But recent advances in computing power and image recognition enable computers to learn as human do: visually observe the environment, interact with it, and observe feedback. I’ve been exploring the possible and efficient ways for computer to learn more naturally.

Funding Source: Murchison Research Fellowship
Multiple works have shown that deep learning is an effective method for camera localization. It is robust to lighting changes, motion blur, and camera type. Which can cause many other localization methods to perform poorly. We build on the state-of-the-art and propose a new architecture for estimating camera pose from a single RGB image. The architecture employs transfer learning using Inception-Resnet-V2 trained on ImageNet. It uses a massive convolutional network, followed by a small decoder which preserves the fine-grain details of the input image. The output of the decoder is processed by two separate streams which regress the camera position and orientation separately. However, information is shared across streams. The network automatically learns scalars which determine how important the shared information is. We demonstrate that this network design performs well on the 7-Scenes data set for localization.

Funding Source: Computer Science Department
Politics, Religion, and The British Armed Associations of the 1790’s

Caroline Grand*, Duane Coltharp

Threatened by social unrest at home and political turmoil abroad, the British Volunteer Corps of the 1790’s was established as a government-sanctioned civilian defense force against revolutionary insurgents both domestic and foreign. Comprised of both propertied and unpropertied men, highly localized and decentralized in their leadership, the Volunteer Corps has been described as perhaps the greatest popular movement in 18th century Great Britain. The British Volunteer Movement has generally attracted the attentions of social and political historians such as J. E. Cookson and Austin Gee, who explore the movement in its larger cultural context. However, little attention has been paid specifically to the body of published sermons delivered to volunteers at the consecration of their banners and on designated Church holidays. This paper examines a corpus of printed sermons from 1794 through 1800, delivered at the height of the Volunteer Movement. These sermons create a rhetorical portrait of a united national front of conservatism that is often at odds with the diverse political and social realities of Great Britain at the time. However, the ideological and topical differences present in these sermons hint at an underlying anxiety regarding the stability of this patriotism in a popular movement disparate in both its demographic content and individual political persuasions.

Funding Source: Mellon Initiative
Western Perspectives of Chinese-Language Cinema

Jessica Phillips*, Dr. Jie Zhang

Foreign language films have become a more popular topic for Western scholars in recent years, but in regards to academic discussions of Chinese-language cinema, little attention has been paid to the response of Western audiences. Using student questions gathered from the years in which Dr. Zhang has taught college courses on Chinese-language cinema, I have both quantitatively and qualitatively analyzed student responses to eight different Chinese-language films from Hong Kong, Taiwan, and Mainland China. These films were chosen in order to represent the work of several well-known Asian directors, and to include genres that have come to be representative of Chinese-language cinema, such as the kung fu film.

After categorizing and analyzing the various questions Trinity students asked, I gathered secondary sources from western scholars for each film. In order to create a more nuanced perspective, I employed elements of both literary and film criticism to examine these sources and compare and contrast the topics that Western academics and Western students deemed important.

While naturally the results varied from film to film, as in some cases they varied widely in plot, genre and cinematic technique, the result of my research is that for the most part both students and academics were interested in similar topics. In particular, both students and scholars questioned how various films treated the issues of modernity and globalization. The other major find was that with only a few exceptions both sides neglected feminist readings of these films.

In conclusion, while not a comprehensive study, my research offers a broader view of Western perspectives on Chinese-language films and reveals neglected avenues for film scholars to explore.

Funding Source: Mellon Summer Research Initiative
Estimating the Effects of Media Narratives on Asset Prices

John Huston, Roger Spencer, Decory Edwards*

In this study we will use multiple linear regressions and vector auto regresions on keywords found in newspaper articles and activity in the stock market to analyze the spread of economic ideas. We seek to examine the contagion of people’s views about asset markets in response to media coverage to help explain overvalued equity markets such as those in the late 1920s and late 1990s as well as the market crashes of 1929, 1987 and 2000. We will look for evidence of feedback effects where, for example, rising stocks generate more stories about stocks, which in turn creates wealth and leads to further increases in stocks. The quantitative tools will include frequency counts of key phrases describing both positive and negative activity in the stock market found in the ProQuest Historical Newspapers database, as well as S&P 500 data on market returns. We determine that both rising and declining stock prices are correlated with an increase in positive, or negative, news stories. Further, we find that, consistent with existing literature, negative media content regarding the news is more persistent and significant in its effects on stock prices than positive narratives in the news.

Funding Source: McNair Scholars Program
The United States-Mexico border region has often been portrayed as a place of violence and danger. Through my research I have explored the type of cultural environments and experiences that border regions create and that contest those visions of it as a place of violence. Border regions create unique cultures that are neither U.S. nor Mexican and are much more than what popular culture and media display. By interviewing Chicana/o writers (Benjamin Alire Saénz, Griselda Muñoz, and Emmy Pérez) from El Paso, Texas and the Rio Grande Valley, I have understood, from a creative standpoint, the ways that border cultures help shape the experiences of individuals living there. Using the feminist/border theories of Gloria Anzaldúa I identify the reasons that border regions create unique circumstances where creativity thrives. Anzaldúa’s findings support my view that, regions where cultures have clashed and continue to clash, produce individuals who are more aware of their surroundings thus making them prone to fresh creative outlets. This consciousness comes from a need to turn into oneself after having been oppressed. Along the Texas-Mexican border cultures collide and create unique environments in which creativity can flourish.

Funding Source: The Mellon Institute
Visualizing Dynamical Systems With \texttt{dsmodels}

\textbf{Charles Stein* Seth Fogarty}

Dynamical systems are used by mathematicians to analyze quantifiable systems that advance over time. Dynamical systems can model many scenarios ranging from population models to the flow of water through a pipe. During the previous year, the authors created a little programming language called \texttt{dsmodels} to facilitate the visualization of these dynamical systems. Since then, the package has been downloaded over 1300 times. We present an overview of the past, present, and future of \texttt{dsmodels} as told through user stories.

Funding Source: Trinity University Department of Computer Science SURF
Mapping Star Formation in the Nearby Universe

Frances Stone*, Dr. David Pooley

A key component of many extragalactic studies is the correlation of a galaxy’s overall star formation rate with a particular type of astronomical object (like supernovae or luminous X-ray sources). While these correlations have allowed for considerable progress in understanding the nature, formation, and diversity of these objects, the overall star formation rate is a rather blunt instrument. Star formation is not uniform across a galaxy so maps of local star formation rates are needed for further progress. The star formation rate of a galaxy can be accurately measured by combining far ultraviolet (FUV) data and 24-micron infrared (IR) data. The FUV data originates from the Galaxy Evolution Explorer Telescope (GALEX) and the IR data comes from the Spitzer Space Telescope. Corrections must be made to the datasets to account for differences in resolution, as well as a transformation to align the two images. Star formation maps are then generated by a weighted combination of the FUV and IR images in the appropriate units.

Funding Source: McNair Scholars Program
Dos Lenguas: Codeswitching in Contemporary Poetry

Brianna Azua*, Jenny Browne

My study of contemporary Latinx poetry suggests that switching languages from a base language to another one within a poem, commonly known as code-switching, offers insight into a poet’s perspective and culture. Code-switching creates an intentional argument about identity, image, diction, and emotion.

One incentive for switching between languages is to elicit particular associations in a poem that would otherwise be lost if the author could only write in English or Spanish. This includes situations where particular words and phrases evoke a sense of the intimacy of immediate family conversations and/or of broader cultural heritage. There are many cases where it seems the poet feels an obligation to explain or even translate when they switch between languages. However, there are also poets who use difficult language when code switching without any translation at all. These poetic choices concerning when and how to switch languages make an argument for how much a poet feels responsible to accommodate for the audiences who aren’t fluent in both languages. Alternately, a lack of explanation or translation can be read as a justification for the particular words, and the world, the poet evokes.

Funding Source: McNair Scholars Program
Use It and Lose It? Behavioral and Energetic Influences on Lizard Tail Autotomy

Amy A. Payne, Daisy M. Horr, Michele A. Johnson

Many species of lizards use their tails during social display, sending messages to other lizards by waving or curling the tail. Tail displays can also be used to distract potential predators, who might attack the lizard’s tail instead of its head or body. In this study, we examined the relationship between lizard tail use and the frequency of tail autotomy (or, tail loss). The frequency of tail autotomy varies among species, however the factors that cause this variation are not often studied. We predict that differences between species in tail signaling and energetic storage in the tail influence the rate of tail autotomy. If the benefit of losing the tail in a predator encounter is outweighed by the social or energetic advantages the tail provides, we expect that the rate of tail loss will be lower. We studied five lizard species that vary in tail use: Greater Earless Lizards (Cophosaurus texanus) and Curly Tailed Lizards (Leiocephalus carinatus) use tails frequently in display, Common House Geckos (Hemidactylus frenatus) and Crested Anoles (Anolis cristatellus) use tails occasionally, and Green Anoles (Anolis carolinensis) use tails rarely. First, we observed lizards of each species in the field and collected data on the use of the tail as a signaling tool in both social and predatory contexts. We will then compare the rates of autotomy in species that use their tail most often in a social context to those species that use their tail most often as a predatory deterrent. We predict decreased rates of tail loss in species that use the tail as a social tool when compared to species that use tail signaling to ward off predators. Alternatively, if the tail is an important energetic reservoir, we predict that species with large energy content in their tails will experience lower rates of tail autotomy. To collect data on the energy content of the tails, we will use bomb calorimetry for tail tissues. By studying lizard tail loss, we can better understand the evolutionary trade-offs involved in balancing the cost of tail loss to social and energetic utility with the benefit of predator evasion.

Funding: National Science Foundation IOS 1257021 to M.A. Johnson
X-Ray Sources in Dense Star Clusters

Jared Tincher, David Pooley.

Globular clusters are ancient groups of stars found in the Milky Way and other galaxies. They are extremely dense which allows for close interactions of two- and three-star systems that can lead to exotic stellar products that would be incredibly rare or even nonexistent outside of these special circumstances. Many of these exotic products — like neutron star X-ray binaries, white dwarf X-ray binaries, millisecond pulsars, and active main-sequence binaries — emit X-rays. The goal of this research is to detect globular clusters’ sources of X-ray light and then characterize their spectral shapes and luminosities.
Rationality of Attacker Decisions in Stackelberg Games

Lutfi Sun*, Albert Xin Jiang

This research is an attempt to analyze human behavior through attacker decisions in Stackelberg Games. The main questions of the research are: How rational do masses act? Are there any factors that lead to irrationality? Are there any patterns of irrationality that can help explaining the process of decision making?

Our study is targeted to understanding and predicting hacker behavior. However, applications are not limited to cybersecurity games and can be useful in many areas such as behavioral economics and psychology.

Funding Source: Trinity University
Machetes, Mutants and Music: Orpheus in Modern Myth

Isaiah Mitchell, Dr. Benjamin Eldon Stevens

In this paper, I discuss receptions of the Orpheus myth in certain examples of 20\textsuperscript{th}-century science fiction (SF) and describe how its varying emphases and departures from tradition form intertextualities of great significance. This study situates itself not only in the longstanding interest in classical influences on 20\textsuperscript{th} century thought, but also the more recent and burgeoning field of reception studies, which argues that intertextualities give new meanings to both classical and modern works alike. In those contexts, much ink has been spilled concerning the enduring force of classical material in modern texts, including increasing attention to SF, but few (if any) analyze specific mythic stories of the Greco-Roman tradition that form the subject of multiple classical texts and inspire a range of SF works. The myth of Orpheus and Eurydice provides a case in point: derived from several ancient sources and transmitted in a broad and steadily burning tradition, the myth appears in various transformation in SF texts including Samuel Delany’s \textit{The Einstein Intersection}, Russell Hoban’s \textit{The Medusa Frequency}, Patricia McKillip’s \textit{Fool’s Run}, Tim Powers’ \textit{Dinner at Deviant’s Palace}, and Constantine Fitzgibbon’s \textit{The Golden Age}. I hope that this paper can demonstrate the influence of the myth, delve into the importance of its diverse receptions, and inspire similar studies based on individual myths in modern SF.

Funding Source: Murchison Foundation
What’s Done is Donne: Analyzing Misogyny in Elegy 19

Tiffany Nguyen, Dr. Willis A. Salomon

With a complex body of work, an uncertain biography, and many varied manuscripts comprising the canon, John Donne’s poetry (1573-1631) is difficult to analyze. Donne himself adds to the complication by being ambiguous in his word play and about his attitudes towards women, especially in his Elegies. Donne often wittily ridicules the women in his elegies, but he also creates petulant speakers in these poems whose desires are unfulfilled. For example, Elegy 19: To his Mistress Going to Bed presents a man who humorously commands his lady to undress, but his wishes are never explicitly fulfilled. This ambiguity has led to a disagreement among Donne scholars on whether Donne truly expresses such disparagement of women or whether his words satire some other aspect of the erotic situations he presents in these poems, such as masculine desire or contemporary politics. This study hopes to gain a better understanding of the disagreeing claims about Donne’s representation of women, with specific focus on Elegy 19. This project will consider the different biases and reasons for why certain critics choose to analyze Donne in the way they do, whether with reference to a certain historical context or a character trait they identify in Donne himself. I argue that some scholars examine Donne’s work based on facts that are difficult to prove, such as his feelings about politics and love, which creates these disparities in readings of the poems, while ignoring other aspects, such as manuscript variations, that might undermine their readings of his texts. I hope to demonstrate that Donne’s elegies should be considered in their variety of versions with less hypothetical influence from ideas about Donne’s character or his times.

Funding Source: Mellon Initiative
Using Star Formation to Investigate Intermediate Mass Black Holes

Dr. David Pooley, Marshall Tickner*

Ultraluminous X-ray Sources (ULXs) are off-nuclear sources with X-ray power output in excess of typical stellar-mass black holes. It is believed that the ULXs are powered by accretion, but it is still unknown whether the accreting compact objects are neutron stars, stellar-mass black holes, or the long-sought intermediate mass black holes. It has been shown that ULXs are often found in galaxies with overall high star-formation rates (SFR), but little work has been done to quantify the link between ULXs and local star formation rates, and this may provide insight into their nature. We are performing statistical tests to determine the extent to which ULXs correlate with SFR maps made by other members of our research group. The scope of this project is to write procedures that would both conduct the necessary analysis for each object, as well as to create a catalog of these analyses for future use. Based on the results of the overall analysis we will gain insight into the nature of these objects and the physical processes associated with them.

Funding Source: Research Corporation
Consumer Identities and Cultural Adaptation: Challenges in the Era of Globalization

Christina Nielsen, Dr. Mario Gonzales-Fuentes

Since the end of the nineties, Japan has experienced a prolonged economic stagnation that has brought with it a variety of current social challenges. Japan’s economic authorities have tried a number of remedies without clear success in creating sustainable growth. Among the various explanations, some scholars point to challenges faced by the Japanese in the redefinition of their social or national identity after World War II. During this period Japan’s economic presence and competitiveness in the world changed significantly, a turning point in Japan’s modern history that led to significant economic, social and, possibly, cultural implications. This research contends that the last set of implications (cultural) triggered a reexamination of Japanese consumer’s national identities.

Using adapted versions of well-validated instruments of materialism, consumer ethnocentrism, national ethnic identity, and acculturation to global consumer culture, this research assesses the differences exhibited in these dimensions by Japanese consumers born before the 1990’s economic bubble and those born after it. The data was collected at Japanese higher education institutions in the Tokyo, Kyoto, and Osaka regions throughout the months of May and June of 2017. Our analysis shows significant differences in the way consumers self-identify with the global consumer culture through distinct views of materialism, use of Japanese language in their media consumption, and the nature of their interrelationships. Moreover, cluster analysis reveals significant differences in the identification with Japanese culture and global consumer culture, highlighting the existence of distinct segments among Japanese millennials as they compared to their counterparts in America.

Funding Source: Murchison Fellowship and Department of Business Administration, Trinity University
Correcting Vision in Virtual Reality

Asa Spades Turner*, Matthew A. Hibbs

In the last few years virtual reality (VR) has become increasingly popular, including multiple new hardware products, including such as the Oculus Rift, HTC Vive, PlayStation VR, etc. These wearable headsets have started a new innovations generation of both gaming and social media. However, VR headsets do not easily afford users to wear glasses corrective glasses. This causes problems when glasses are absolutely necessary for users to see clearly. To remedy this, our goal is to utilize techniques from computer graphics, specifically ray tracing methods, to generate images that are “pre-corrected” for a given user’s prescription. The authors alter the image for optimal clarity. This is achieved through lens simulation applied to the image displayed in the VR headset. While these images will appear “blurry” for people with normal vision or when the targeted user wears corrective lenses, when viewed in a VR headset without corrective lenses, the image should appear in focus for the user. Extensive Initial research and simulations suggest that success is likely.

Funding Source: Trinity University
Roman World Lab: The Walking Talking Cross

Curtis Whitacre*, Ruben Dupertuis

Ever since its initial discovery in the late 19th century, the fragmentary Gospel of Peter has eluded proper classification and interpretation by religious scholars. Described as a ‘non-canonical gospel,’ it serves as a first-hand account of the crucifixion of Christ, going into greater detail about the resurrection and ascension of Jesus than is seen in any other passion narrative, canonical or otherwise. The text details three figures coming from the tomb, whose heads reach up to the clouds; and trailing behind them is none other than the cross itself, speaking in response to a question asked from the heavens. For decades, scholars have cited these phenomena as reason enough to dismiss the Gospel of Peter entirely, depriving the text of any serious attempts at interpretation. Despite its inclusion of the most detailed account of the resurrection and ascension of Christ, the text is labelled as too fantastical and miraculous when compared to the other ‘respectable’ passion narratives.

My research hopes to eradicate the stigma surrounding the Gospel of Peter, and prove that both the gospel and its contents are worth taking seriously. In my paper, I aim to explore the different approaches that modern scholars have taken in interpreting the Gospel of Peter, evaluate their methodologies and conclusions, and ultimately posit a perspective as of yet unheard of in today’s scholarship: with respect to the walking, talking cross, there exists a reliable context for inanimate objects taking on the qualities and characteristics of the living during the 2nd century and earlier, the time when the Gospel of Peter is believed to have been written. By providing examples from contemporaneous literature and poetry, the implausible behavior of the cross is rendered as less fantastic, and places the Gospel of Peter as a text reflective of the written tradition of its time.

Funding Source: Mellon Initiative
Music Genre Classification Using Neural Networks

Jinqqing Yang, Matthew Hibbs

In recent years, new machine learning techniques, such as convolutional neural networks, have been used in various classification and recognition tasks, the most common of which are image classification and object recognition. The goal of this research is to train such neural networks to learn features in songs to perform the task of genre classification. Enabling software to determine whether a given piece of music is rock, jazz, classical, etc. has been a longstanding open question in computational music research. There are two main sources for our experimental data: the GTZAN dataset, consisting of 1000 songs in 10 genres, and the Million Song Dataset (MSD) consisting of over one million diverse songs. In order to transform audio data into proper forms for neural network inputs, we experimented with several different preprocessing representations, including spectral analysis with the Fourier transform, mel-scaled spectrograms, and mel-frequency cepstral coefficients. All three representations yielded promising results at different levels. For the next step, we hope to collect more training data to improve the performance of the algorithm, explore new approaches to preprocess the audio files, and tailor the neural network structure to better classify musical genres.

Funding Source: Trinity University
Anti-Chinese Sentiment in Contemporary Vietnam

Nhi Nguyen*, Dr. Alfred Montoya

In the late 2000s, conflict between Vietnam and China over the Spratly and Paracel Islands ignited many street protests in Vietnam. Citizens called for aggressive national defense, and engaged in sniping and trolling on the Internet. Even though historical anti-China sentiment in Vietnam has been explored in academic scholarship, no work has yet examined the contemporary anti-China movement in terms of cultural derision, stereotypic labeling, and even small-scale clashes. Moreover, very limited literature has scrutinized the situation through a bottom-up approach that focuses on the roles of unofficial media, social networks, and other factors beyond the state, and how they perpetuate and amplify Vietnamese nationalism and Sinophobia. Based on my two-month fieldwork and archival research with Dr. Alfred Montoya in Ho Chi Minh City and Nha Trang, this paper examines how unofficial media and the interests of young Vietnamese citizens in the globalized economy perpetuate and inflame anti-Chinese sentiment. We challenge the oversimplification that the Vietnamese Communist Party is the only provocative force which manipulates "its people" against China through historical accounts and political propaganda. Instead, this complex situation involves multiple social actors that engender a surge of anxiety about the Chinese, leading to social tension and consequences in contemporary Vietnam.

Funding Source: Mellon Initiative for Undergraduate Research in the Arts and Humanities
Induced Fit Binding of Insulin B1-11 With Cucurbit[7]uril in Aqueous Solution

Aamuktha Karla, Cristina Kodadek*, Adam Urbach

This presentation will describe the current state of an investigation of the binding of the insulin B1-11 peptide fragment to the synthetic host cucurbit[7]uril in aqueous solution. Circular dichroism and NMR experiments with native and single-mutant peptides establish an induced fit complex that is anchored by binding to Phe and stabilized by a secondary interaction with the distant His residue. The data are consistent with a pseudo[2]catenane, which would be the first comprising a peptide and a synthetic receptor in aqueous solution and constitutes a novel multivalent approach to sequence-specific peptide recognition.

Funding Source: Welch Foundation, National Science Foundation, Trinity University
Fluorogenic Polymerization for Signal Amplification: Monomer Synthesis and Characterization

Joseph Anderson*, Dr. Christina Cooley

An important aspect of many biological assays is being able to detect an analyte even when it is in low abundance through a detectable signal amplification step. The Cooley lab is interested in developing a new signal amplification method by a fluorogenic polymerization strategy where a chemical compound of interest can initiate the growth of a polymer allowing for the analyte’s presence to be known. Fluorogenic monomers are not fluorescent in their monomer form, but once polymerized, the polymer fluoresces under UV light and is detectable by the naked eye. Through the use of a controlled polymerization reaction such as Atom Transfer Radical Polymerization (ATRP), the polymers’ fluorescence at a given time point should correlate with the amount of analyte in solution.

Fluorogenic monomers suitable for polymerization amplification as a detection strategy will polymerize quickly when exposed to the imitator, will have high fluorescence in the visible spectrum, and will have little background glowing to prevent false positives in an assay. The synthesis of various fluorogenic methacrylamide and acrylamide monomers based on pyrene, anthracene, and acridine fluorophores will be discussed. The fluorogenic character of the various monomer families in ATRP polymerization reactions will also be described.

Funding Source: Welch Foundation
Understanding the Role of Water in H₂ Oxidation over Gold Nanoparticle Catalysts

Christine Peterson*, Todd Whittaker, Christopher Pursell, Bert Chandler.

The production of hydrogen in the United States is a multibillion-dollar industry; of the hydrogen produced, more than half of it is used in the Haber Bosch process for ammonia and fertilizer production. Carbon monoxide, an impurity formed in hydrogen production, is undesirable because CO poisons catalysts used in the subsequent Haber-Bosch process. Thus, it is imperative that all CO must be removed from hydrogen. The preferential oxidation of CO in the presence of H₂ (PrOx) has been suggested as a method to remove this CO. Our group has shown that adding water to supported Au nanoparticle catalysts dramatically improves PrOx activity and selectivity. Current studies were done to better understand the role of H₂O in H₂ oxidation to get a more complete understanding of the PrOx mechanism. Kinetic studies were performed on Au/TiO₂ catalysts to determine and compare the reaction activation energy under constant water coverage and constant water pressure. These values were significantly different and showed that constant water coverage had a lower barrier of activation than when the coverage was allowed to be varied with temperature. Also performed were oxygen and hydrogen order studies under different coverage of water.

Funding Source: National Science Foundation
Elucidating the role of Dib1 in pre-mRNA splicing

Christian Schreib*, Rachel Goldstein*, Cody Hernandez, Emily Bowman, Amber Lucas, Camille Potts, and Corina Maeder

Pre-messenger RNA (pre-mRNA) splicing is a molecular process that is conserved throughout all eukaryotic organisms. It involves the excision of the non-coding parts of pre-mRNA and the ligation of the coding parts of pre-mRNA to create mature mRNA. Pre-mRNA splicing is catalyzed by the spliceosome, a large molecular complex composed of ~100 proteins and 5 small-nuclear RNAs (snRNAs). Before splicing, the spliceosome will assemble onto the pre-mRNA in a modular fashion, forming different complexes in a sequential order. The focus of our studies is Dib1, one of the proteins associated with the spliceosome. It is a small, 17 kDa protein that is essential to cell viability and is conserved from yeast to humans. Cryo-electron microscopy structures of a large portion of the spliceosome show Dib1 is found in one of the pre-mRNA binding sites of the spliceosome, suggesting that Dib1 plays an important role in pre-mRNA binding. To better understand how Dib1 works in the processes of pre-mRNA splicing, temperature sensitive mutations of Dib1 were used to observe what effect the absence of Dib1 has on splicing. Denaturing gel electrophoresis was used to observe the effect on splicing, and non-denaturing gel electrophoresis was used to observe the effect on spliceosome assembly. Our results show that without Dib1, pre-mRNA splicing is halted and the assembly of the spliceosome is arrested mid-assembly.

Funding Source: Welch Foundation, Beckman Foundation, and NIH
Fluorogenic Polymerization for Signal Amplification: Optimization in Aqueous Media

Madeline Hopps* & Danyal Tahseen*, Dr. Christina Cooley

The diagnosis of disease at earlier stages enables the most efficient treatment, but requires very sensitive detection of low levels of analytes. To this end, several diagnostic techniques currently exist, such as Polymerase Chain Reactions (PCR) and Enzyme-Linked Immuno-Sorbent Assays (ELISA), which detect analytes and amplify the signal. However, these techniques are limited in their sensitivity, ease of operation, and affordability, curtailing their potential as universally applicable means of detection, especially in developing countries. The Cooley Lab works to develop and optimize a novel detection assay that amplifies signal via fluorogenic polymerization, thus offering a robust, relatively inexpensive, quantifiable, and sensitive technique for detection.

Building upon previous work on synthesizing fluorogenic monomers and radical initiators enabling the fluorogenic amplification, we worked on optimizing this fluorogenic atom transfer radical polymerization (ATRP) reaction to detect the smallest concentrations of analytes with the brightest fluorescence output by manipulating various variables within the ATRP reaction, such as the ratio of co-monomer to fluorogenic monomer, concentration of initiator, and temperature. The results of these studies as well as the advantages of the ATRP reaction will be discussed.

Funding Source: American Chemical Society Petroleum Research Fund, Trinity University
First survey of solution-state carbon-13 NMR spectra of ambers

Tayde A. Contreras*, Joseph B. Lambert

Amber, or fossilized plant resin, has most commonly been used as jewelry and as a source for preserving organisms throughout history. More recently, structural analysis of amber and copal (less mature amber) has gained importance in archaeological and botanical research. Infrared (IR) spectroscopy and mass spectrometry (MS) have been used to study structural characteristics of amber. However, nuclear magnetic resonance (NMR) spectroscopy has been the most successful in classifying ambers into different categories based on their structure without altering their chemical makeup. Solid-state carbon-13 NMR spectroscopy has served as an important technique in categorizing amber and copal into 5 main groups corresponding to their geographic location of origin. Solution-state carbon-13 NMR analysis, which provides more distinct peaks than solid-state NMR spectroscopy, has not previously been used for structural analysis of amber. In this study, 12 amber and copal samples soluble in deuterated chloroform (CDCl3) were used to study structural characteristics that set Groups A, B, D, and E apart. Group C was omitted from this study due to the inability to acquire quality spectra, which occurred in response to a lack of solubility in amber samples corresponding to Group C. While solution-state carbon-13 NMR analysis of the 12 amber and copal samples in this study confirmed the existence of specific structural trends that characterize Groups A, B, D, and E, this study also revealed that there is more spectral variation within each group.

Funding Source: The Welch Foundation
Investigating the role of reactive ligating histidines in H⁺ translocation at the Cu,A site of cytochrome c oxidase

Taylor Devlin,* Cristina Hofman,* Laura Hunsicker-Wang

The respiratory electron transport chain is the final set of steps in the production of adenosine triphosphate (ATP), the main form of energy used by cells. The final complex in the chain, cytochrome c oxidase, couples electron transfer with pumping protons across the membrane, which helps to create the chemical gradient that drives the production of ATP. The transferred electrons are used to reduce molecular oxygen to water. Cu,A is the initial electron acceptor in cytochrome c oxidase, and it consists of two copper ions bridged by two cysteines and ligated by two histidines, a methionine, and the carbonyl backbone of a nearby glutamine. The two ligating histidines are of particular interest as they may affect the ability of the center to accept electrons and may be involved in the movement of protons through cytochrome c oxidase. To test for the presence of reactive ligating histidines, the portion of cytochrome c oxidase from the bacteria Thermus thermophilus that contains the Cu,A site was reacted with the chemical modifiers diethyl pyrocarbonate (DEPC) and 4-hydroxyl-trans-2-nonenal (HNE) and observed through a variety of spectroscopic techniques at pH 5.0-9.0. A mutant protein with the non-ligating histidines removed was similarly tested. Results indicate that diethyl pyrocarbonate reacts with one ligating histidine in pH conditions close to those expected in the cell. Fewer equivalents of modifier were used to explore the relative reactivity of histidines compared to other reactive residues. Interestingly, reaction with HNE may result in reduction of the metal center. The existence of the reactive ligating histidine indicates that this residue could play a role in a proton pumping pathway. However, ligating histidines are ubiquitous in metalloproteins. The question remains whether all ligating histidines are reactive toward DEPC or if proteins like Rieske and Cu,A are unique in this regard. Sco from Thermus thermophilus and Azurin from Pseudomonas aeruginosa both contain histidines ligating copper ions. Mutants of these proteins that remove the non-ligating histidines will be reacted with DEPC to better understand the reactivity of ligating histidines. Additional studies are ongoing that explore the function of Sco, including the role that metal binding plays in the protein function.

Funding Source: Beckman Foundation, Semmes Distinguished Scholar in Science Award, FASTER Grant
U5 and Dib1: Exploring interactions between essential splicing components

Camille Potts*, Corina Maeder

The spliceosome is a large molecular machine that facilitates RNA splicing, the removal of introns (non-coding RNA) and ligation of exons (coding RNA) to produce mature messenger RNA. Located within the active site of the spliceosome is Dib1, a small, essential protein. The importance of this protein is highlighted by its conservation from yeast to humans. Based on recent structural work, a potential role of Dib1 is to control spliceosome assembly and activation. To understand how Dib1 interacts with other key spliceosomal components, we have designed experiments between Dib1 and the U5 snRNA. These experiments focus on examining the effects of mutations of Dib1 and U5 on each other and will be performed using Saccharomyces cerevisiae as the model organism. Both in vivo and in vitro experiments will require an S. cerevisiae strain in which both the SNR7 gene (coding for U5) and the DIB1 gene have been knocked out and replaced with genes on plasmids, which can be further manipulated. The development and construction of this strain and design of U5 mutants will be presented.

Funding Sources: The Welch Foundation, National Institute of Health, Arnold and Mabel Beckman Foundation
Structure-Activity Studies of Dipeptide Recognition by Cucurbit[8]uril

Elena Boms*, Zoheb Hirani*, Hailey Taylor*, and Adam R. Urbach

Analyzing the specificity of host-guest interactions is crucial to understanding the chemical nature of living systems. Building on recent studies of cucurbit[8]uril (Q8)-peptide interactions in aqueous solution, we ran a parallel fluorescence assay with a large library of tripeptides against Q8. The results revealed alternative possibilities for targeting terminal and non-aromatic sequences. Detailed studies of structure-activity relationships by isothermal titration calorimetry, nuclear magnetic resonance spectroscopy, and electrospray ionization mass spectrometry will be presented.

Funding Sources: National Science Foundation, The Welch Foundation, Arnold and Mabel Beckman Foundation, Semmes Foundation, Trinity University
Using 1-Octyne Hydrogenation and Selective Titrations to Characterize Gold Catalysts

Emily Rochelle Hand*, Clemente Guzman*, Allison St. John*, Bert Chandler

Gold nanoparticles (NP’s) supported on metal oxides have been the subject of catalysis research due to their ability to catalyze several important industrial reactions. In this study, we evaluated the kinetic properties of Au NPs on different metal oxide supports (MOₙ) for 1-octyne hydrogenation. This reaction is a model for acetylene and propyne hydrogenation, which is crucial for the production of plastics in industry. Reaction kinetics were evaluated with both light off curves and differential reaction kinetics. The Au catalysts were found to possess lower activity than the traditional Pd catalysts used in industry. The Au catalysts also showed much greater selectivity to 1-octene, and changing the metal oxide supports had little effect on activity or selectivity. The reaction order for 1-octyne was slightly negative to zero while the H₂ order was found to be about 1. Catalysts and supports were characterized with N₂ adsorption isotherms and BET analysis. Deposition of the Au NPs had a minimal effect on the surface area of the supports. In order to determine the number of potential active sites on the catalyst, a thiol titration experiment was developed using mercaptobenzimidazole (MBI). This involved developing a thiol assay using Alizarin Red S-Copper(II) (ARS-Cu²⁺). The metal oxide supports were further characterized with potentiometric titrations to better understand the acidity/basicity of the surface hydroxyl groups present on the support.

Funding Sources: National Science Foundation

Dr. Adam Urbach, Dr. Andrew Bockus, Dr. Wei Li, Amy Grice, Hayden Anderson*, Madeleine Gallagher*

The continuous monitoring of blood insulin levels would improve the treatment of type I diabetes by allowing us to fully optimize the administration of exogenous insulin. Toward this end, we are developing a chemical sensor for insulin that is sufficiently sensitive and reversible to allow continuous use in a clinical setting. Our approach is based on a synthetic receptor, which is sufficiently robust and non-toxic, and the current project aims to increase its affinity and selectivity for insulin to physiologically relevant levels. The current state of our synthetic and physical-organic studies will be discussed.

Funding Sources: Welch Foundation, National Science Foundation, Trinity University
Fluorogenic Polymerization for Signal Amplification: Real-World Applications

Zachary Allen*, Jemima Sackey-Addo*, Christina Cooley

With modern advances in scientific knowledge and technology, sensitive and reliable assays have been developed for the detection of several classes of analytes such as inorganic particles, organic solutes, and biological macromolecules. A common obstacle with many detection assays stems from the inability of these assays to detect low concentrations of analyte; a problem which can be circumvented through signal amplification. Using fluorogenic polymerization for signal amplification, we propose a quantifiable, sensitive, and relatively inexpensive strategy for detecting low concentrations of analyte in aqueous media.

Fluorogenic polymerization can be utilized in the detection of many different analytes in solution. The detection of disease presents one of many applications for this high demand assay. Using Atom Transfer Radical Polymerization (ATRP) initiators covalently bound to specific antibodies, we hope to amplify low concentrations of antigen in aqueous media to facilitate the detection of disease at its earliest onset. Other potential applications of fluorogenic polymerization as a sensing technique will also be discussed.

Funding Source: San Antonio Area Foundation
Using Chemical Modification to Understand the Reduction Potential and Reactivity of Ligating Histidines in the Rieske Protein

Kelsey Kohler*, Dr. Laura Hunsicker-Wang, Dr. Kevin Hoke

Rieske proteins are a class of metalloproteins which function in the electron transport chain of prokaryotic and eukaryotic respiratory systems. Rieske proteins are characterized by a [2Fe-2S] cluster ligated by two histidines and two cysteine residues and have been shown to display a conserved fold across species despite significant variance in reduction potential. As a means of characterizing and assessing reactivity of truncTtRp and mutants designed to affect factors thought to modulate reduction potential, chemical modification was performed on the Rieske protein. Comparison of reaction of Rieske with DEPC (diethyl pyrocarbonate), a chemical modifier thought to form electron withdrawing adducts with deprotonated histidines vs. MBA (methyl bromoacetate), thought to form adducts lacking this quality, resulted in reduced and oxidized protein, respectively, as indicated by UV and CD spectroscopy data. Thus, the reduction of the Rieske [2Fe-2S] cluster as a result of interaction with quinol may occur via a similar electron withdrawing mechanism. Building on previous MBA studies, different equivalents of MBA were also reacted with truncTtRp. In order to better assess how chemical modification influences reduction potential, cyclic voltammetry was used to trace changes in reduction potential as truncTtRp, H120Q/H164Q, and Y158F were reacted with DEPC. Signals observed for an isolated truncTtRp and H120Q/H164Q were similar and both displayed positive shifts in reduction potential following reaction with DEPC. Scans taken 2 min post addition of 12 eq DEPC for H120Q/H164Q displayed three peaks, suggestive of unmodified, modified and some intermediate species. Scans taken for Y158F displayed peaks negatively shifted in comparison to truncTtRp, as would be predicted from the mutation that was made. Thus, this new application of voltammetry will allow a deeper understanding of what is happening during the chemical modification reaction and of the species that are formed.

Funding Source: San Antonio Area Foundation
Multivalent Studies with Cucurbit[n]uril Hosts


Multivalency can be a useful tool in chemistry because it allows for the development of reversible ultrahigh affinity complexes. Few ultrahigh affinity multivalent system have been developed, however, due to the difficulty in synthesizing the linked hosts and the optimization of linkers. We are exploring the use of a polyvalent material to investigate the structure-activity relationships in a relatively simple multivalent system. The details of our approach and current progress will be presented.

Funding Source: The Welch Foundation, Trinity University
Gold Nanoparticle Selective Hydrogenation of Alkynes

William Moore*, Dr. Chandler, Dr. Pursell

Global plastic production in 2015 reached 355 million tons, and gold nanoclusters could be useful in removing alkyne impurities from the olefin feedstocks. We have designed a novel synthesis process, where we produce the gold nanoparticles in a large batch. With this, we can deposit nanoparticles from the same batch on multiple supports, and thus have a group of catalysts with different supports but the same gold nanoparticles. We then remove the ligands in-situ in flowing H2/N2 at 300C. These catalysts were used to study the selective hydrogenation 1-octyne, initially comparing catalysts using plots of conversion vs. temperature. We found essentially negligible support effects: conversion and selectivity for each support was within experimental error of each other support. Selectivity to 1-octene was excellent, generally hovering around 95%. This indicates the reaction occurs on the gold nanoparticle, and not the support. We also prepared a series of Ni-Au bimetallic catalysts with the colloidal synthesis, varying the amount of Au in the nanoparticle. The bimetallic catalysts were far more active than the monometallic materials, but largely maintained the selectivity associated with the Au catalysts. These materials were further characterized with infrared spectroscopy of adsorbed CO to examine the surface sites on the particles.

Funding Source: National Science Foundation
Structure-Activity Studies of Multivalency in DNA Recognition

Timothy Wheatley*, Adam Urbach

The development of reversible high-affinity synthetic complexes has been a significant challenge in supramolecular chemistry. This presentation will discuss the use of repeat DNA as a multivalent receptor for oligomeric minor-groove-binding polyamide ligands. We aim to characterize the contributions of each repeating unit to the thermodynamics of complex formation via a comparative analysis of a series that varies in the number of repeat units. This analysis requires highly pure materials, a quantitative approach to the determination of sample concentration, and the direct measurement of binding thermodynamics. The details of our approach and current progress will be presented.

Funding Source: Welch Foundation, National Science Foundation, Trinity University
Establishing the Role of Rieske Protein Reduction Potential in the Formation of Reactive Oxygen Species in Complex III

Victoria Henderson*, Laura Hunsicker-Wang

The factors that modulate the reduction potential of complex III’s catalytic Rieske metalloprotein subunit (RP) have been the subject of much study. During the bifurcated Q-cycle, RP transports one electron from quinol to cytochrome c1. Quinol’s other electron is passed from heme bL to heme bH, which reduces a quinone bound at the Qi site. If the Q-cycle is disrupted, electrons may interact with molecular oxygen to produce reactive oxygen species (ROS). For example, if RP’s reduction potential is too low, it may never accept quinol’s electron or do so inefficiently. The latter scenario may shift Q-cycle equilibria against RP movement towards cytochrome c1, instead favoring RP electron release and interaction with molecular oxygen to produce superoxide. Thus, we propose that a mismatch in reduction potential between RP and quinol may serve as a possible source of ROS generated from complex III. Understanding the sources of ROS in the electron transport chain may lead to better treatments for diseases that arise from high levels of ROS.

We are investigating this hypothesis by (1) measuring the reduction potential of isolated truncated Saccharomyces cerevisiae (yeast) RP grown in Escherichia coli (E. coli) cells (truncScRieske) and (2) measuring the amount of ROS produced by intact yeast complex III grown in yeast cells (ScComplexIII). In the absence of readily available cloning vectors for either of these purposes, we have conducted several cloning experiments. Primers for two variants of the yeast RP gene (RIP1) were designed: isolated RIP1 tagged with six histidines (H6-RIP1) for truncScRieske expression and RIP1 left as part of a larger yeast complex III gene fragment (C3RP) for ScComplexIII expression. H6-RIP1 and C3RP were amplified by polymerase chain reaction (PCR), restricted, and ligated into restricted segments of pET30 and pRS316, respectively. After sequencing the DNA products, truncScRieske and ScComplexIII will be expressed, isolated, and characterized.

Funding Sources: The San Antonio Area Foundation, 2017 Murchison Summer Research Fellowship, 2017 ASBMB Undergraduate Research Award
Exploring the Tail Region and Stability of Protein Dib1

Grace Lee*, Emma Mask*, and Corina Maeder

Dib1 is a protein that has been shown to be essential to the survival of eukaryotic cells. It is thought to play an important role in the assembly of the spliceosome on the pre-mRNA transcript. In addition to its role in splicing, it has also been shown to be a protease that cleaves its own tail region. The purpose of the project presented here is to find the ideal conditions for the protease activity and characterize the cleavage mechanism, as well as to learn about how mutations in the tail region impact splicing and the health of cells. This project requires the building of mutagenic plasmids in order to express Dib1 mutant proteins, both in yeast to conduct growth assays and in bacteria in order to purify the protein. Purified wild type and mutant protein will be used in autocleavage assays as well as analyzed for stability using circular dichroism spectroscopy.

Funding Sources: The Welch Foundation and National Institutes of Health
Lipid Composition of Astrocyte Secretions: Change as a Function of Age

Cynthia Alvarez*, Amanda Nguyen, Dr. James L. Roberts

Astrocytes are a major type of glial cell that are responsible for the general upkeep of surrounding neurons. They secrete apolipoproteins, which bind lipids that are involved in the basic function of a neuron and serve as a protection against oxidative stress mediated neurodegenerative diseases. Some of the most notable astrocyte secreted apolipoproteins include apoE and apoA1, which when mutated, are associated with neurodegenerative illnesses such as Alzheimer’s disease. Astrocytes also secrete lipids that are vital to the structure and upkeep of surrounding neurons. We hypothesize that there is a reduction in quantity or quality of these secretions and this difference may influence the older astrocytes’ protective effects on neurons against oxidative stress that leads to neurodegeneration. We aimed to analyze the secretions from 4 month and 28 month astrocytes to identify the lipids and apolipoproteins present. The cells were placed in serum free growth medium and media was collected after 48 hours. Media purification was accomplished by precipitation with Dextran Sulfate (Cell Biolabs) to separate and concentrate the low-density lipoproteins/very low-density lipoproteins (LDLs/VLDLs) from the high-density lipoproteins (HDLs). Cleanascite (Biotech Support Group), a lipid binding resin, was used in a different form of media purification that yielded total lipid content. Lipid samples were then further purified using chloroform and methanol to prepare for thin layer chromatography and mass spectrometry in order to identify and quantify lipid content. Western Blots will also be done to identify and quantify the amount of apolipoproteins present in the secretome of the cells. It is anticipated that there will be a difference in the overall lipid composition of secretions between the younger and older cells.

Funding Source: Ronald E. McNair Post-Baccalaureate Achievement Program
Cowles Professorship
Purification and analysis of WS5995 angucyclinones from *Streptomyces acidiscabies*

Ryan Pu*, Frank Healy

Streptomyces are morphologically complex bacteria that produce different classes of secondary metabolites with a broad spectrum of biological activities, including anticancer, antibacterial and other drugs. It is of interest to understand the assembly of these compounds to aid in the improvement of existing drugs or in the design and synthesis of novel drugs. *Streptomyces acidiscabies* produces the antimicrobial WS5995 aromatic type II polyketide angucyclinones. These compounds undergo an uncommon oxidative ring cleavage reaction during assembly.

Analysis of the organism’s genome reveals a variety of secondary metabolite biosynthetic gene clusters, including one predicted to encode enzymes for type II aromatic polyketide production. We are interested in characterizing the components of this pathway and its products and intermediates. WS5995B and WS5995C were recovered from *S. acidiscabies* culture filtrates using solid and liquid phase extraction. Extracts and purified compounds were analyzed using thin layer chromatography (TLC), high pressure liquid chromatography (HPLC) and proton NMR spectroscopic techniques. Mutants were also constructed to carry defective alleles of genes involved in late assembly steps of the predicted WS5995 pathway. We discovered that cultures frequently lost the ability to produce WS5995B and WS5995C. Loss of the production phenotype occurred in the wild type parent culture used for the construction of ketoacyl synthase mutants. This was confirmed through comparative analysis of parent and mutant extracts. Additionally we observed that while all non-producer variants shared the loss of the polyketide production phenotype, they differed in other aspects, such as growth morphology in liquid culture.

While the basis for these phenotypic instabilities is unknown, genetic instability has been reported in other *Streptomyces* spp., and was found to result from large scale chromosomal alterations such as rearrangements and deletions. The WS5995 polyketides, and possibly metabolites made by pathways encoded by other gene clusters in the genome, are dispensable for growth under laboratory conditions and may reside in unstable genomic regions, since the phenotype is lost at high frequencies. The maintenance of large secondary metabolite biosynthetic gene clusters throughout the genome of *S. acidiscabies* supports the idea that pressures are exerted on the organism in its natural environment that select for their retention. It is possible that the WS5995 polyketides may play an important role as antimicrobial compounds in nutrient-poor soil environments.

Funding Source: Murchison Research Fellowship
ZO-1 Plays a Role in the Stability of Tight Junction and Cytoskeleton of Epithelial Cells

Addison R. White*; Gabby G. Mudekunye*; Jonathan M. King

Zonula Occludens (ZO) -1 is a cytoplasmic scaffolding protein that plays a role in tight junction barrier function in epithelial cells. ZO-1 belongs to a family of ZO proteins, which also include ZO-2 and ZO-3. ZO-1 and ZO-2 contain an actin-binding region (ABR) which is thought to help tether the tight junction to the cytoskeleton. ARHGEF11 is a Rho GTPase that has been shown to interact with both the actin cytoskeleton and ZO-1.

Our goal is to elucidate the function of the ZO-1-ZU5 domain by examining the interaction between ARHGEF11, ZO-1 and the cytoskeleton. We employed a series of electrophysiology experiments, confocal microscopy studies, and functional assays to examine these relationships. We used the model epithelium, Madin-Darby canine kidney (MDCK) cells with endogenous and knockdown levels of ZO-1.

MDCK cells were transfected with mCherry-ARHGEF11 to visualize its location within the cells. Latrunculin A (LatA) treatment causes actin cytoskeleton disruption and it is hypothesized that ZO-1 will protect from Lat A exposure. Actin levels were measured in MDCK cells following LatA exposure. Actin levels were lower in ZO-1 knockdown cells and were resistant to LatA treatment whereas actin level significantly decreased at the tight junction following treatment on wild type MDCK cells. ARHGEF11 expression in MDCK-ZO-1 knockdown cells was global with some accumulation at the junction or perijunctional actomyosin ring.

Electrophysiology studies indicate that ZO-1 knockdown cells have lower transepithelial resistance than the wild type. Indicating that ZO-1 assists in the barrier function of the tight junction.

Funding Source: San Antonio Medical Foundation
Synthesis and Evaluation of ROS-Activatable Proteostasis Regulators

Breanna Brietske*, Jonathan Palmer*, Christina Cooley

The cell’s ability to mount a stress response, such as the Unfolded Protein Response (UPR), under conditions of high stress is imperative to the cell’s survival. A specific arm of the UPR, the transcriptional ATF6 arm, has been shown to be instrumental to damage control and cell survival through ischemia and reperfusion during a heart attack or stroke. The induction of the ATF6 pathway thus serves as a potential therapeutic pretreatment for myocardial and cerebral infarction. Recently, a small-molecule activator, AA 147, was discovered in a screening study to specifically activate the ATF6 arm of the UPR. However, constant activation of the UPR leads to apoptosis.

Ischemia and reperfusion are associated with extremely high levels of reactive oxygen species (ROS) that can damage organelles and lead to cell death. Localized delivery of ATF6 activators to areas of high concentrations of ROS would decrease off target effects and provide localized therapy.

We propose a prodrug of AA147 that attaches a ROS-cleavable substituent onto AA 147 that only releases to free drug in the presence of high concentrations of ROS. This approach negates the problems of continuous UPR activation while scavenging excess ROS, leading to less damage and higher rates of survivability through ischemia and reperfusion. We will discuss the synthesis of AA 147 and prodrugs, release studies, and cellular experiments.

Funding Source: Murchison Undergraduate Research Fellowship, Welch Foundation