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# Hope College Abstracts: 15th Annual Celebration of Undergraduate Research and Creative Performance

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2015  
2016

# ABSTRACTS

15TH ANNUAL CELEBRATION OF  
UNDERGRADUATE  
RESEARCH AND  
CREATIVE  
PERFORMANCE



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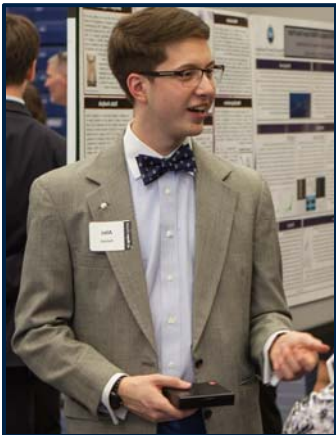
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# WELCOME



As one of the many reasons to celebrate during the year that marks Hope's 150th anniversary, more than 400 students presented nearly 275 posters in the 15th annual Celebration of Undergraduate Research and Creative Performance. The event showcases Hope College's longstanding conviction that students learn more effectively by doing. Each of the research posters at the Celebration, as well as the abstracts from those projects in this collection, represent the work of students and faculty collaborating on an original work of scholarship within the past year.



Over the years, opportunities for research have expanded from independent studies and summer research programs, to capstone courses and more recently, to research embedded in introductory and intermediate courses. Hope is proud of the many years the Phelps Scholars program has provided learning communities for first-year students that include research projects with global implications, as well as the seven years the Mellon Scholars program has provided cross-disciplinary research experiences. This academic year marks the beginning of the Day1 programs, which have significantly expanded opportunities for first-year students in the natural and applied sciences to take on real-world problems through research beginning on their first day of college.



In the *Hope for the World: 2025* strategic plan, student-faculty collaborative research and artistic scholarship are both affirmed and strengthened. Faculty and students are encouraged to work together on these types of scholarly and creative projects that link intellectual skills and habits developed through the liberal arts with vocational aspirations. Through the varied research opportunities across campus, we believe students will find meaningful connections between their education and their future plans, helping them to succeed in college and beyond.



The abstracts in this book are an important record of the many collaborative projects that students and faculty pursued together. Many students report that these projects that challenge them to extend their thinking, creativity and skills beyond their coursework, are some of the most transformative experiences of their academic programs. Similarly, students report that conversations with their faculty mentors throughout the research process have stretched and encouraged them to carefully consider their majors, career aspirations and post-graduate plans within the richer context of their vocational callings.

To learn more about research experiences at Hope College, visit the website: [hope.edu/research](http://hope.edu/research).

*From top to bottom, Cindy Alexander, Eric Nelson, Miriam Roth and Aaron O'Meara*



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## COVER AND HEADER ART

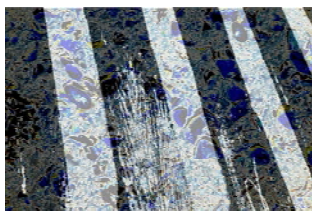


Image by **Madison Schaefer**, '19. This photograph is a combination of two pictures: the blue photograph is a collection of sea shells on a shore and the black and white photograph is a wooden fence. This abstract photograph is meant to reflect the complex layers that God invites us to discover in his creation.

# ARTS & HUMANITIES

## DANCE/ENGLISH

### This Earthly Realm is Fraught: Eall is Earfoðlich

#### **Anna Goodling**

Mentors: Professor Steven  
Iannacone and Dr. Curtis  
Gruenler  
Departments of Dance and  
English

The Old English poem “The Wanderer” tells the story of a lonely poet who clings to the hope of Heaven to sustain himself. However, due to the language it is written in, this great work is unreadable in its original form for those who have not studied Old English. This research project provides an alternate, visual translation of the Old English text, in order to gain a wider audience for the poem. Also, this research strives to stimulate curiosity and interest in a genre of literature which is often passed off as unintelligible by those who have never studied it. This project stands as an attempt to bring the areas of Academia and the Arts into dialogue, and to demonstrate that these two areas can affect and aid one another. Academia and the Arts seem to have little to no connection in the eyes of scholars and artists today—a troubling rift. This research brings up questions about the relationship between scholarship and artistic creation: How do the poem’s words and meaning inform movement choices? What is the best way to teach dancers to unite their understanding of the written text and the danced vocabulary? Can artistic, choreographic work add to the conversation of academic scholarship on the “Wanderer” poem? Ultimately, this research endeavors to integrate dance and literature as both academic and creative subjects of study. It strives to contribute through dance to the conversation about Anglo-Saxon literary scholarship and to demonstrate the legitimacy and complexity of the study of medieval literature to an audience more familiar with the proscenium stage than the mead hall.

### “Peace and Quiet and Good Tilled Earth:” Mimesis in Tolkien’s Shire

#### **Anna Goodling**

Mentor: Dr. Curtis Gruenler  
Department of English

*The work was supported by ae  
Jacob E. Nyenhuis  
Student/Faculty Collaborative  
Summer 2015 Research Grant at  
Hope College*

Twentieth century author J. R. R. Tolkien permanently impacted the world of fantasy with his work about Middle-earth. Countless aspects of his legendarium have been examined through various lenses of literary theory and criticism; however, few scholars have explored the relationship between Tolkien’s works and literary theorist René Girard’s concepts of mimetic desire and scapegoating, leaving this relatively untraversed field ripe for study. Girard’s mimetic theory offers insight into Tolkien’s understanding and portrayal of power by providing a method of interpreting his use of objects of power to demonstrate the corruptive nature of such items and the rivalry they incite. In addition to this, however, Tolkien’s work extends Girard’s theories by offering examples of a positive branch of mimetic desire which Girard does not himself elaborate on. The lives of Tolkien’s hobbits illustrate a unique, living example of this positive desire, and demonstrate a firm resistance to the negative desire fostered by objects such as the One Ring. Girard’s theories supply a new way of understanding Tolkien’s hobbits as less susceptible to the power of objects of negative mimesis due to their living in an environment of positive desire, rather than to some inherent magic or feature of character that hobbits may possess. Similarly, Tolkien’s Shire illustrates Girard’s concept of positive desire, and offers a tangible example of a society that thrives on this receptive, rather than acquisitive, mimesis. This research examines Girard’s theories, applying his ideas of mimesis to Tolkien’s Shire and expanding upon them by seeking out examples of hobbit life that illustrate the positive desire that is so vital to the health of the hobbit community.



# ENGLISH/HISTORY

## Dreadful Old Maids: Jane Austen and the Unmarried Women of Regency England

**Anna Yacullo**

Mentor: Dr. Anne Heath  
Andrew W. Mellon Scholars  
Program and Departments of  
English and History

*This project was supported by  
the ACM-GLCA Newberry  
Program.*

Through her novels, Jane Austen discussed the social situation of the world in which she lived. Her novels place tremendous importance on marriage and marrying well. They illustrate how essential marriage was to the life of a woman in Regency England and how devastating it could be to remain unmarried. Austen's novels include spinster characters, but it is her heroines, all of whom for a time must consider a future as a spinster, who can best illustrate the challenges facing unmarried women in Regency England. When Austen's female characters Miss Bates, Emma Woodhouse, Jane Fairfax, Charlotte Lucas, Elizabeth Bennet, and Anne Elliot are examined within the historical context of actual unmarried women in Regency England, they expose some of the challenges and insecurities women faced regarding marriage. They demonstrate the ridicule faced by unmarried women, how spinsters had no well-defined place in society, and how, for many women, any marriage was better than no marriage. Through her characters like Elizabeth Bennet and Anne Elliot, Jane Austen argues for the capability and intelligence of women independent from men, and through Miss Bates, Austen argues for a bit of understanding for "Dreadful Old Maids" such as herself. Austen's plots highlight the importance and practicality of marriage, the consequences of remaining unmarried, and the dependence of women on men, but her female characters, especially those considering the spinster life, show that her women are more than their marital status, and being an old maid wasn't necessarily all that dreadful.

## "For the Boys Over There": The 1918 United War Work Campaign

**Ian Bussan, Miriam Roth,  
Samuel Stout, and Jonathan  
Tilden**

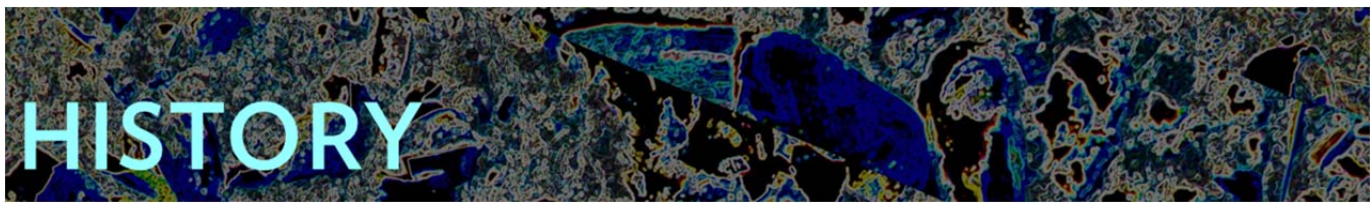
Mentor: Dr. Jeanne Petit  
Andrew W. Mellon Scholars  
Program and Department of  
History

*This project was supported by  
The Andrew W. Mellon  
Foundation Scholars Program in  
the Arts and Humanities at  
Hope College.*

This project, the culmination of a summer of historical research at Hope College and the Library of Congress, is an online exhibit on the United War Work Campaign (UWWC), an American fundraising effort for World War I. Headed by the government's Commission on Training Camp Activities, the campaign involved a confederacy of seven civilian groups wishing to aid the federal government in its war efforts, mainly by providing morally sound recreational services both in training camps and overseas. Sometimes called "The Seven Sisters," the organizations included the Jewish Welfare Board, the YMCA, and the National Catholic War Council. Five of the seven were of various religious affiliations. While the name "United War Work Campaign" implied unity, this was not always the case for the Campaign nor for the public it aimed to reach. The Seven Sisters often came to a head over questions of politics, religion, and more, and Americans at the time were divided by class, race, language, gender, politics, and religion. The groups of the UWWC, while ironically not completely united themselves, nevertheless aimed to present their coalition as a single united front against immoral recreation, and the campaign's leaders hoped that their wartime reform would carry on past the armistice, drawing the diverse population of the country into a new, more unified American society. As we near the centennial of America's involvement in the war, this website aims to offer a historical exhibit accessible to today's American public, and to address the historical and ongoing question of what it means to be American.



*Jon Tilden, Sam Stout, Ian Bussan and  
Miriam Roth examine United War  
Work Campaign posters in the Prints  
and Photograph Division at the  
Library of Congress.*



### The First Inoculation Debate: A Quantitative Text Analysis of the Boston Smallpox Epidemic of 1721

**Elizabeth Ensink**

Mentor: Dr. Jonathan Hagood  
Andrew W. Mellon Scholars Program and Department of History

*This research was supported by The Andrew W. Mellon Foundation Scholars Program in the Arts and Humanities at Hope College.*

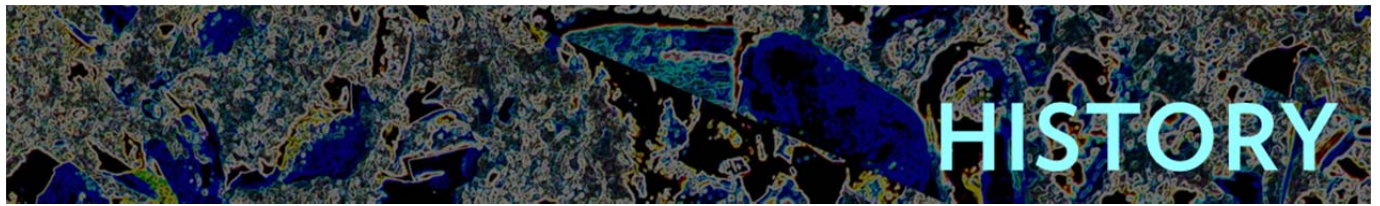
Despite scientific research supporting the use of vaccination to protect against disease, some individuals choose not to vaccinate their children for religious or political reasons. Vaccination is a topic of heated debate today, but this debate actually started in early eighteenth-century America when a Puritan minister promoted the practice during an outbreak of smallpox in Boston. By the end of the 1721 epidemic, inoculation (a primitive form of vaccination) saved almost 300 people, but it also ignited fierce protests. Many Puritan colonists viewed inoculation as distrust in God or were afraid of the spread of disease, and the meddling of ministers in the affairs of “learned men” outraged physicians. This debate provides a case study for analyzing the influence of religious beliefs on public views of inoculation before the development of modern medicine. The study examines a set of digitized documents from the debate using an online tool called Voyant to quantify the word frequencies of religious and secular language used by both supporters and opponents of inoculation. The resulting graphs visually reveal patterns in the language of ministers and physicians and suggest an interwoven relationship between religion and science during this time period. In addition, the study compares this quantitative analysis to a traditional close reading of the texts to suggest limitations of a quantitative analysis and refine conclusions on the relationship between religion and science during the debate. Future research can further develop this text analysis method and potentially apply it to study texts from more contemporary vaccination debates.

### Myth Against the World: Bardo-Druidism and Welsh National Identity, 1792-1900

**Rebecca Fox**

Mentor: Dr. Marc Baer  
Department of History

Today, two major symbols of Welsh national identity are the National Eisteddfod and its bardo-druidic congress, the Gorsedd of the Bards of the Isle of Britain. The Eisteddfod is a competitive literary and musical festival which has its roots in the Middle Ages. The Gorsedd, on the other hand—with its mystical rituals, costumes, symbols, and sayings—is more suggestive of an even earlier time, when the ancient Welsh were led by a priesthood of druids and followed a pagan religion of great poetic beauty. At least, this is what the nineteenth-century Welsh believed on the authority of the great antiquarian, bard, and cultural hero, Iolo Morganwg. In reality, though, this was the “bardic name” of Edward Williams (1747-1826), a skilled literary forger who fabricated an ancient Welsh society that fit the moral and aesthetic values of Romantic-Era Britain. In the 1850s, new interest in Iolo Morganwg arose and a disciple of his, John Williams “Ab Ithel” (1811-1862), organized the first Grand Eisteddfod since the medieval period complete with a Gorsedd. This massive event was the first of many, and, eventually, the National Eisteddfod and the Gorsedd became national institutions in Wales. This project investigates the development of the Eisteddfod and Gorsedd and examines the changing motivations for Welsh identification with these institutions throughout the nineteenth century. As this study explores the shifting relationship between English national identity and Welsh, a hypothesis arises as to why the Gorsedd has survived its unmasking as a fake and remains a national symbol of Welsh pride and identity to this day.



### The Road to Genocide: Reasons for the Herero Rebellion in German South-West Africa

**Natalie Fulk**

Mentor: Dr. Lauren Janes  
Department of History

In 1884, the Germans took control of an area of Africa that they called German South-West Africa, and which is now the country of Namibia. The native Herero people were thus forced to live under German rule and suffered many injustices. The Germans took advantage of the Herero by stealing land and cattle from them and trading unfairly. The Germans also thought that they were physically and mentally superior to the Herero because of their race, and they vocalized this view often. Because of this racism, the Herero suffered injustices such as beatings, sexual violence, and murder. In addition, the Herero suffered inequities within the German legal system. Therefore, the Herero rebelled against the Germans in January of 1904, and afterward the Germans issued an extermination order that essentially said to kill any Herero on sight. After this, about 80% of the Herero were killed by German tactics, and the Herero basically ceased to exist as a cultural society. This genocide of the Herero is considered the first modern genocide of the twentieth century. Most work on this topic focuses on German actions during the genocide. My research draws from first-hand accounts made by Herero people in a 1918 investigation into the genocide, known as the “Blue Book,” and German statements from the time to explain the reasons why the Herero people rebelled in the first place: German economic exploitations, racial ideologies, and racist treatment in and out of the legal system.

### *Braveheart*: The Role of Films in Historical Storytelling

**Colin Kelly and Joseph  
Williams**

Mentor: Dr. Marc Baer  
Department of History

Movies have become a quick, easy source of information but often fail to accurately represent history. This project examines the historical accuracy of the 1995 film *Braveheart* in its depictions of 13<sup>th</sup>-century Scotland and the Scottish War for Independence. This has been done through comparison of multiple historians’ analyses of the film. Upon comparing the body of work, it becomes clear that *Braveheart* was full of inaccuracies that render the film almost useless as a historical source. Through showing that *Braveheart* contains many false representations, this research highlights the importance for the need of research outside of Hollywood films.

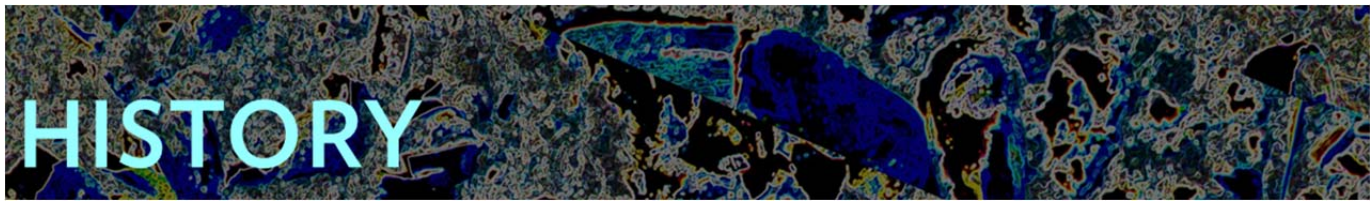
### Division and Fall: Modernity, Confessionalism, and the Church Struggle in the Third Reich

**Matthew Meyerhuber**

Mentor: Dr. Gloria Tseng  
Department of History

Germany, with its rich Protestant heritage, has a special place in the history of modern Christianity. As the birthplace of the Reformation, Germany was the spot of much debate, turmoil, and violence surrounding the beginning and spread of Protestantism. It was also where some of the most important developments in Christian history took place, and it was home to a thriving, advanced culture where faith, the humanities, art, and the sciences all flourished. All of this changed when Germany experienced a political collapse after the disastrous First World War. Hitler’s ascent to power and the rise of the Nazi regime wreaked catastrophe on Germany’s historic culture, with all of its intellectual and moral achievements. As Nazi ideology began to invade the evangelical Protestant churches, many Christian theologians and pastors put up a fierce resistance. What resulted became known as the *Kirchenkampf*, or “church struggle.” Despite their efforts, the leaders of the evangelical Protestant factions in Germany were unable to prevent the Nazis from co-opting nearly an entire society for their murderous aims. This inability was the result of infighting motivated by differing worldviews among rival Protestant bodies.

This paper analyzes the religious and cultural conditions that prevented the Protestant groups in Germany from cooperating against the Nazis. It does this by examining the various groups’ historic attitudes toward confessions (official



statements of faith) and toward modernity. Its findings were that as adherence to confessions strengthened, acceptance of modernity weakened. Differences in confessionalism arose from different concepts of the purpose of confessions, and differing ideas of God's relationship with the Church. Questions of faith identity, rather than questions of individual doctrinal points, dominated Protestant debates in Germany about a proper theological response to the Nazi regime.

### History of the Syrian Civil War

**Colin O'Connor**

Mentor: Dr. Janis Gibbs  
Department of History

The Syrian Civil War is not simply a war between the oppressive Assad regime and the disenfranchised Syrian people. It is a war being fought between competing factions with different ideas about the future of Syria. Syrians have shifted back and forth between seeing themselves as citizens of a nation state and as members of a regional Pan-Arabic community. Their situation is further complicated by the diversity of the population, which includes Sunnis, Shias, Alawites, Kurds, Druze, Christians, and Jews whose opinions are as diverse as the population. The former and current Assad regimes have embodied the nationalist position, while providing a privileged position for their Alawite community. The Syrian Civil War began with resistance to the Assad regime but has fragmented into a war between groups fighting for different political, religious, and social visions of Syria's future.

### Letter Writing, Morale, and Marriage: The Unique Letter Writing Role of Women During World War II and a Commentary on Marriage

**Alexandra Piper**

Mentor: Dr. Jeanne Petit  
Department of History

When we consider the role of women during World War II, we often think of the image of Rosie the Riveter. Yet women found many ways to support the war, including boosting morale to the men overseas as letter writers. During World War II, handbooks and advertisements suggested specific guidelines to women for how to write cheerful, morale-boosting letters, but women did not always follow these guidelines and instead wrote raw and emotional letters. I compare the advice presented to women for letter writing and the reality of the situation using a variety of primary sources including handbooks and advertisements from the time as well as letters from women on the home front. The tensions that arose between the suggested guidelines and the actual letters illuminate a changing dynamic in marriage during the time. Women began to see their marriages as equal and companionate, and the uncertainty of wartime produced a "now or never" aspect to their unions. These letters illustrate the difficulties of life on the home front and underscore the power of love and resilience of women during World War II.

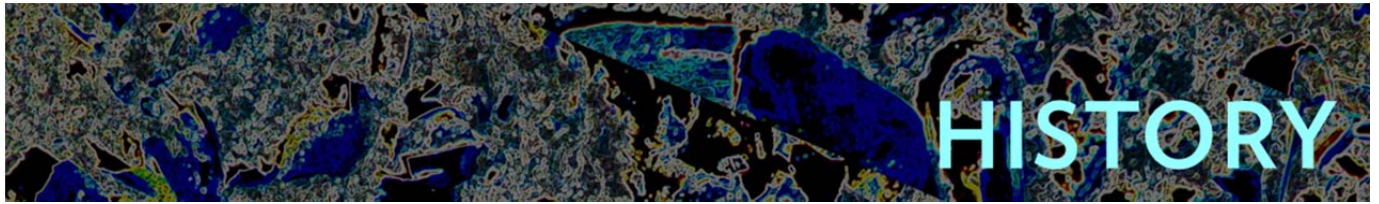
### In the Key of Britain: The Making of British Music, 1900-1930

**Colin Rensch**

Mentor: Dr. Marc Baer  
Department of History

Prior to 1900, the evolution of British music had proceeded at a relatively constant pace. Though sheet music was purchased by a large segment of the population and music hall attendance was on the rise, music was the least discussed British art form. In my paper, I discuss the music of British society between 1900 and 1930, and examine the factors that were so pivotal to the music's development. The emergence of American music and the experience of World War I expedited the process of evolution in British music because they diverted the normal flow of music that had existed up until that point. The imminence of new technology, like the gramophone and radio, allowed the resultant music to reach a mass audience.

*This research was supported by the Andrew W. Mellon Foundation Scholars Program in the Arts and Humanities at Hope College.*



## Holland Vietnam Veteran Stories

### **Cullen Smith**

Mentor: Dr. Marc Baer  
Department of History and  
Andrew W. Mellon Scholars  
Program

*This research was supported by  
the Andrew W. Mellon  
Foundation Scholars Program in  
the Arts and Humanities at  
Hope College.*

The Vietnam War stands as one of the most transformative conflicts in American history, yet one of the most under-researched. An initial search in Hope College's Theil Archives in Holland, Michigan, revealed very little available archival materials on how the war impacted one of West Michigan's largest coastal cities. Furthermore, a collective silence surrounds many of Holland's Vietnam veterans; their stories are largely unavailable to members of the Holland community. This project sought to address this silence through the production of three short audio-visual slideshows on YouTube. Although it is still in its initial stages, this project will be a stepping stone for future exploration of the stories of local Vietnam veterans. Through future investigation, this project may be able to weave together shared experiences between other veterans to present an accurate depiction of the collective experience of Holland's Vietnam veteran community. At its core, however, the project provides the Holland community with a digital platform to examine and discuss a story about one man, one town, and their intersection with the Vietnam War.

## The Incurribility of the Conquered: A Historiography Regarding the Failure of the Protestant Reformation in Early Modern Ireland

### **Cullen Smith**

Mentor: Dr. Janis Gibbs  
Department of History

Throughout the centuries following the Protestant Reformation in Ireland, historians have sought to develop a general consensus regarding the impact of the Protestant Reformation upon Irish history. Though much of the nineteenth and early twentieth centuries, a gradually emerging notion among early modern Irish historians addressed the Irish Reformation as a failure. My research focuses on the historiography of the Protestant Reformation in Ireland during the last quarter of the twentieth century, when analysis of the Protestant failure in Ireland was reformulated by Dr. Brendan Bradshaw and debate reinvigorated by his critic Dr. Nicolas Canny, both challenging the degree to which the Protestant Reformation in Ireland failed. These two scholars represented polar opposite spheres of thought on the matter: Bradshaw asserting that the Reformation was a complete failure due to inconsistent application of ecclesiastical punishment and internal educational reform during Elizabeth's reign in the mid- to late-sixteenth century, and Canny maintaining that the Reformation's failure could not have been conclusive until the emergence of the "Second Reformation" in the early nineteenth century. Subsequent debate amongst scholars such as Karl S. Bottigheimer and Alan Ford reconsidered Bradshaw's points, mostly agreeing with his conclusions while attempting to synthesize the two schools of thought. By the twenty-first century, modern interpretations from scholars like Samantha Meigs shifted back towards narrow contextual explanations and broad socio-cultural interactions, making historical synthesis of past views wholly apparent. By examining the breadth of these views, this research on the historiography of the Protestant Reformation in Ireland attempts to explain how the Protestant Reformation in Ireland came to be regarded as a failure, and how the conquered Irish remained "incurrable" to its effects.

# HISTORY

## Noble Knight or Menacing Pirate? Sir Francis Drake and His Controversial Reputation

**Allison Utting**

Mentor: Dr. Janis Gibbs  
Department of History

To compete with Spain's flourishing fortune in an empire stretching across the globe, nations in Europe, most notably England, turned to employing skilled naval men in legal piracy. These jealous leaders recruited skilled seaman to captain armed ships and attack enemy merchant shipping. The warm waters of the Caribbean off the coast of the New World teemed with treasure and the potential to make ordinary men into legends. This was the case of Sir Francis Drake, one of the most famous privateers to have sailed the seven seas. During the last half of the sixteenth century, Sir Francis Drake plundered numerous Spanish port towns, pillaged countless ships, and became the first man to circumnavigate the globe and return alive. Described as daring, greedy, patriotic, savage, and heroic, Drake has perplexed contemporaries and historians alike as to the true nature of his character and his motives. Over the last 419 years, Drake's historical image has continued to evolve and undergo revision. This project sought to explore the man behind the myth and to reanalyze the character and existence of a bygone figure as the progression of time can lead to historical misinterpretation. An analysis of primary sources led to the conclusion that Sir Francis Drake earned an unwarranted portrayal as a devilish pirate due to his audacious personality and the nature of his exploits as a privateer. However, his reputation as the heroic knight of English legend was limited by his self-seeking motives and vengeful behavior.



*Ian Bussan, Sam Stout, Miriam Roth and Jon Tilden in the Great Hall of the Library of Congress.*

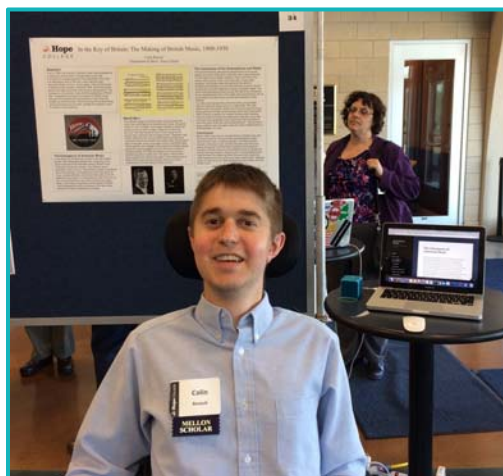
# JOINT ARCHIVES

## Representations of Hope College: An Examination of the Orations of the Class of 1866

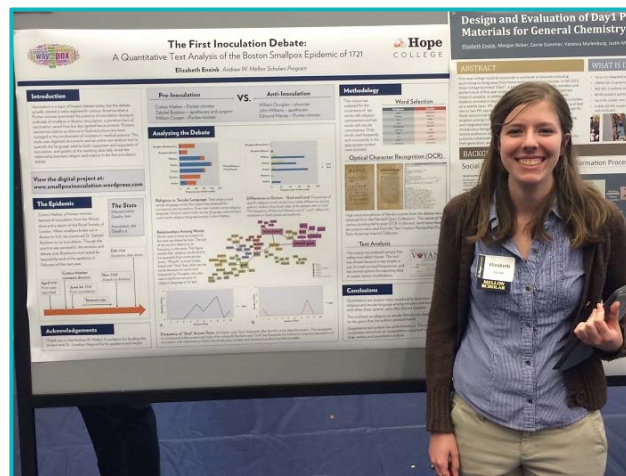
**Natalie Fulk**

Mentor: Geoffrey Reynolds  
Joint Archives of Holland

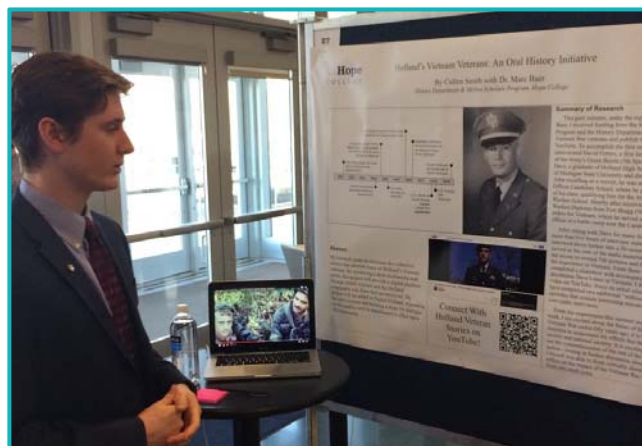
As the first graduating class of Hope College, the class of 1866 set the precedence for what it meant to be a student of Hope College. In the First Commencement, which took place on July 17, 1866, each of the eight graduating men gave a speech on a variety of topics ranging from hope to liberty to the progression of the life of man. However, even with such different topics, one can see recurring values and themes throughout all of the pieces. The first and most prevalent theme is that of Christianity and the coming of the kingdom of God on Earth. The next is the importance of education and enlightenment in individual advancement and the advancement of mankind as a whole. Finally, there is an impression of national pride, for both the Netherlands and the United States, seeing as almost all of these men were Dutch immigrants or descended from Dutch immigrants. These themes can be seen as a representation of Hope College itself, as a college in the United States rich with Dutch heritage and focused on education and Christian values.



Colin Rensch, Mellon Scholar, with his history project at the Celebration, 2016.



Elizabeth Ensink, Mellon Scholar, with her history project at the Celebration, 2016.



Cullen Smith, Mellon Scholar, with his history project at the Celebration, 2016.

# MODERN & CLASSICAL LANGUAGES

## A Crisis that Spans the Atlantic: A Comparative Study of the Housing Crisis in American and French Cities

**Madeline Brochu**

Mentor: Dr. Pauline Remy  
Department of Modern and Classical Languages

For immigrants entering into France with nothing but a dream for a better life, housing options that are less expensive are the only true option. Unfortunately, in recent years France has faced a grave housing crisis that leaves this migrant population stranded and penniless. With the number of immigrants growing and the number of available housing options shrinking, *les bidonvilles*, or slums, are appearing across the country, posing an even larger problem for the quality of life for these people. The history and development of these *bidonvilles* is comparable to the same history of ghettos in inner cities across the United States. Ghettos, rooted in a history of inequality, poverty and racism, pose a similar problem for the quality of life of America's minority populations. This research project investigates the shared histories and impacts of this housing crisis that spans across the Atlantic and finishes with a literary exploration of that crisis in *Le Gone de Chaâba* by Azouz Begag and *A Raisin in the Sun* by Lorraine Hansberry.

## Liberty, Equality, Sisterhood: The Role of Women in the French Revolution

**Julia Fulton**

Mentor: Dr. Brigitte Hamon-Porter  
Department of Modern and Classical Languages

It is fitting that a woman, Marianne, is the symbol of France. The French Revolution shaped France into what it is today, and there would not have been a revolution without the help of women. In my research, I analyze the actions of women during the French Revolution, including their participation in the signing of petitions, demonstrations in the streets, and the violent riots of 1789. I give examples of influential women of the movement, and I explain how women were used as symbols of revolutionary ideals. Although women played an essential role in the French Revolution of 1789, their condition barely improved during the post-revolutionary period. It is ironic that despite all the contributions of women and despite the fact that they represented the face of the revolution, they were not respected as authors of their own fate, nor even as legitimate citizens of the republic. My research concludes by analyzing the reasons why women did not earn significant gains despite all their contributions during the revolution.

## An Unrecognized Inspiration: An Analysis of the Influence of Édouard Manet

**Shannon Gill**

Mentor: Dr. Brigitte Hamon-Porter  
Department of Modern and Classical Languages

Although nineteenth century painter Édouard Manet was a well-recognized painter of his era, he has become less of a household name over time. Nonetheless, he was an innovative artist who left an undeniable impact on the world of art. His influential career started with the practice of Realism and, after tiring of this style, he soon began to break societal expectations by depicting uncommon subjects and practicing a less accepted approach to painting. His revolutionary ideas introduced the art movement of Impressionism and impacted celebrated artists such as Claude Monet and Pierre-Auguste Renoir. While the familiarity of his name has decreased with time, his groundbreaking style of painting and use of colors continued to impact art movements well into the twentieth century. This research examines how Édouard Manet inspired the Impressionist movement and changed the world of art thereafter.



# MODERN & CLASSICAL LANGUAGES

## Analysis of the Portrayal of Dietrich Bonhoeffer

**Emma Hardy, Thomas Jenkins, and Madison Mertz**  
Mentor: Dr. Lee Forester  
Department of Modern and Classical Languages

Dietrich Bonhoeffer's writings have impacted Christian theologians to this day, resulting in numerous biographies and assessments of his works. One biography, *Bonhoeffer: Pastor, Martyr, Prophet, Spy: A Righteous Gentile vs. The Third Reich*, written by Eric Metaxas, brought Bonhoeffer to the New York Times best-seller list and was praised by evangelicals. Despite Metaxas' extensive research, some scholars question his portrayal of Bonhoeffer as violent against Hitler and the Third Reich, while dismissing the influence of pacifism on Bonhoeffer's thinking. Although Bonhoeffer supported the plot to kill Hitler, he is regarded among many scholars as a pacifist, rather than a combatant preacher. This project will attempt to assess the possible inaccuracy of Metaxas's portrayal of the pacifistic characteristics of Bonhoeffer. Bonhoeffer's writings will be assessed in the original German in order to correctly analyze Bonhoeffer's nuanced approach to pacifism. The findings will then be compared to Metaxas's interpretation of Bonhoeffer, aiming at a better understanding of Bonhoeffer's ideals in regard to the Third Reich and Hitler. The extent of Bonhoeffer's pacifism, indicated by his earlier writing, will be analyzed and compared to his alleged encouragement of violence.

## In Search of the Virgin Mary: Saint Mary in the Construction of National Identities in Latin America

**Jordan Hill**  
Mentor: Dr. María Claudia André  
Department of Modern and Classical Languages

The image of the Virgin Mary is ubiquitous in Latin America. She is one of the most important religious symbols for Latin American Catholics and is an extremely accessible object of devotion. All countries in this region, including the majority of cities and towns, claim a particular advocacy of the Virgin as their local Patron Lady, each of which has a unique narrative of apparition and miracles that is inseparable from the history of her people. The origin story and iconography of each patroness is deeply revealing of the religious, political, and cultural identity of those who venerate her.

The many faces of the Virgin Mary are deeply woven into the story of Latin America, and any study of the formation of its peoples will be incomplete without knowledge of one of its most familiar figures. From her arrival with the Europeans to her subsequent transformation to her continued relevance today, Saint Mary has been a powerful symbol of cultural and religious pride and identity.

## Spanish Linguistics in the Medical Field: Interpretation

**Jayne Kessel**  
Mentor: Dr. Daniel Woolsey  
Department of Modern and Classical Languages

The current study explores Spanish linguistics in the medical field and the crucial role of the medical interpreter in patient-doctor communication. Given that it is estimated that Latinos will make up 30% of the population in the United States by 2050, bridging the linguistic gap in the medical field is an urgent need not only due to language barriers but also sociocultural differences. The role of an interpreter extends far beyond simply translating words; he or she must also recognize a situation as bicultural and not simply bilingual. Difficulties arise with access and quality of interpretation in hospital settings, where there is already a lack of time for patient-doctor interaction. Studies have found that the use of a professional interpreter can result in increased patient satisfaction, use of services, comprehension, cooperation, and general state of health. However, there remain areas that still need to be addressed, including providing patients with the means to accurately inform their doctors about all of their symptoms and training healthcare professionals to be more culturally competent. With both current findings and future recommendations in mind, the role of an interpreter must shift from being a conduit of information to being an advocate of the patient and his or her needs. This will result in access to better medical care for all.

# MODERN & CLASSICAL LANGUAGES

## *Portuñol: Portuguese-Spanish Contact in Uruguay*

**Elizabeth Perkins**

Mentor: Dr. Daniel Woolsey  
Department of Modern &  
Classical Languages

In the same way that our daily encounters with one another influence us over time, languages in contact contribute to the ever-changing languages that reflect us as people. The border between southern Brazil and northern Uruguay demonstrates this idea through widespread bilingualism and the combination of Portuguese and Spanish, commonly referred to as *Portuñol*. History, geography, economic motives, and social and national identity affect the use and perception of *Portuñol* in both countries. Linguistically, despite the fact that Portuguese and Spanish share many lexical and syntactic similarities, the phonological differences are notable. It is debated as to whether these two languages in contact create a new language, or merely a Hispanicized dialect of Portuguese. The history, shared border, and linguistic similarities have contributed to a present and controversial *Portuñol* in southern Brazil and northern Uruguay.

## *A Modern Medea: Fitting into a Digital Age and the Methodology Behind Writing a Play*

**Claire Trivax**

Mentors: Dr. Patrice Rankine  
and Dr. Choonghee Han  
Andrew W. Mellon Scholars  
Program, Department of  
Modern and Classical  
Languages and Department of  
Communication

In an era where getting the news on Twitter or Facebook is commonplace, and connecting with people is easier than riding a bicycle, it is hard to imagine how a play that is thousands of years old still has a place in mainstream society. Euripides' *Medea* is a play that has survived in popular culture since its inception in 431 B.C.E., but the question remains if it can survive in the eyes of millennials and command the same attention it always has. My solution was to give the play a social media facelift by replacing the Greek chorus with fully-fledged social media accounts for all characters that interact with the audience in real time before, after, and during performances. I will argue how this keeps an ancient play relevant and expands on the theory of environmental theatre by Richard Schechner. Also, I will be arguing that including social media, to the extent that I do, creates a new type of immersive theatre. The lesser degree of active involvement that this take on immersive theatre requires, allows for broader audiences to engage, interpret and digest the material while keeping the integrity of the theatrical theory. In keeping with the long-standing mythic tradition of adding to and changing narratives, I will also demonstrate how my decision to change a few key plot points is in line with this tradition and pays homage to how Euripides wrote his version of the myth. Finally, I will discuss my methodology in writing my adaptation and how it leads to the innovations I made.

*This project was supported by  
The Andrew W. Mellon  
Foundation Scholars Program in  
the Arts and Humanities at  
Hope College.*

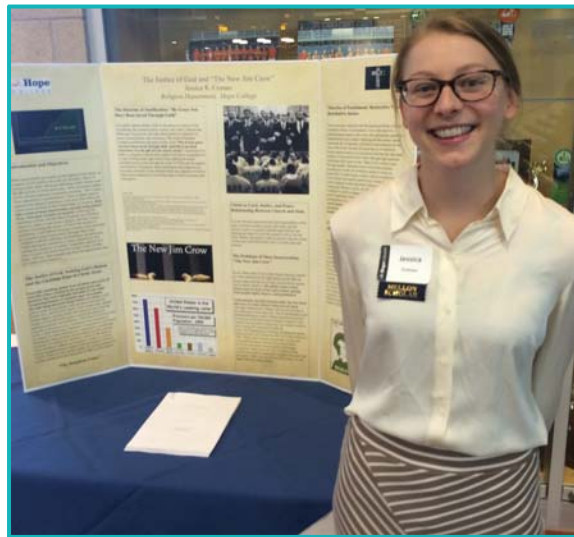
# MUSIC/RELIGION

## The *Ballets Russes* in Grand Rapids, February 1917

**Claire Dickson, Hilary Hunsberger, and Matthew Costello**

Mentor: Dr. Julia Randel  
Department of Music

In 1909, Serge Diaghilev created a sensation in Paris with the company that became known as the *Ballets Russes*. Over the next 20 years he collaborated with the greatest dancers, choreographers, composers, and artists of the day (including Nijinsky, Stravinsky, Bakst, Picasso, Coco Chanel, Prokofiev, Debussy, Ravel, Balanchine, and others) to create modernist ballets that stretched the limits of the genre and sought to combine the arts into one spectacular whole. To escape the dangers of World War I, the company toured the United States, visiting more than forty American cities, including Grand Rapids, Michigan. The focus of this project is their performance in Grand Rapids on February 13, 1917, and what it might have meant for the people who saw it. How did it connect with current events (the war, women's suffrage, Prohibition)? What was the artistic scene like in the city at that time? What was the role of local women's organizations in promoting the arts in the community? We attempt to answer these and other questions through our archival research in the Grand Rapids Public Library.



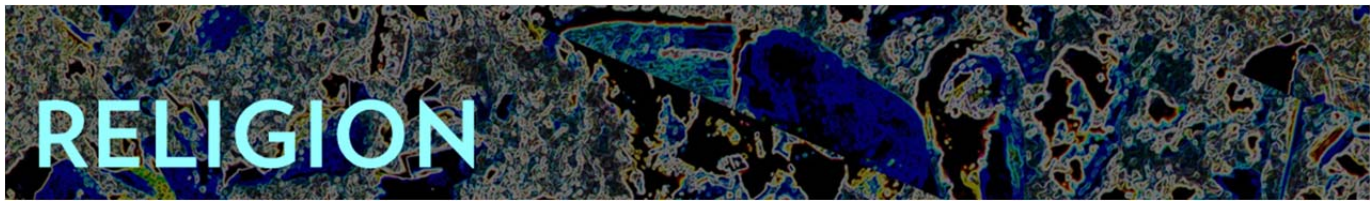
Jessica Cronau, Mellon Scholar, with her religion project at the Celebration, 2016.

## Flood Narratives and Catastrophic Lessons: the Cultural Reminders of Apocalyptic Mythology

**Joshua Briggs**

Mentor: Dr. Barry Bandstra  
Andrew W. Mellon Scholars Program and Department of Religion

Flood narratives are a recurring aspect of the cultural record, particularly within religious and mythological traditions. Considering these occurrences, this research project endeavors to explore the similarities and differences among the varying narratives—specifically drawing upon excerpts from The Bible, Ovid's *Metamorphoses*, and the Sumero-Babylonian *Gilgamesh Epic*. This composition explores common themes among these written accounts with the intent of revealing the symbolic structures buried within the narratives' characters and environs. After concluding an analysis of the metaphors and symbolisms which shape these mythologies, this essay finally investigates more recent explorations regarding "ark mania" with the intent of discovering an underlying theme that motivates human obsession with divine destruction. Summarily, the project concludes with an argument explaining the multi-millennia fascination with flood mythology.



## The Justice of God and "The New Jim Crow"

**Jessica Cronau**

Mentor: Dr. Mark Husbands  
Andrew W. Mellon Scholars  
Program and Department of  
Religion

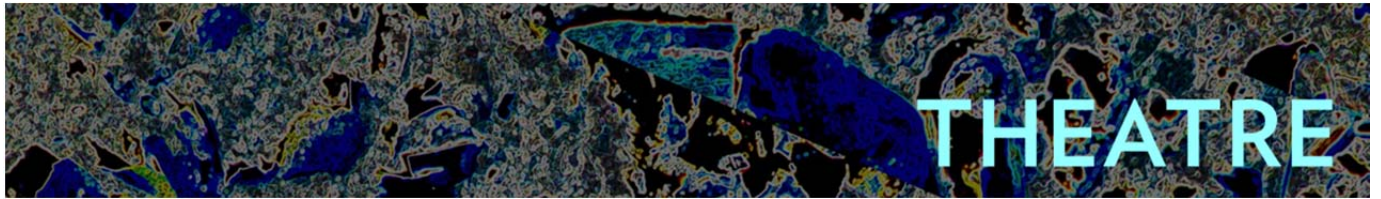
Plato and Aristotle saw justice as the highest of all virtues. In a nation of 320 million, the scale and dramatic effects of violent crime, theft, and trafficking in sex or drugs render elusive the pursuit of virtue and justice. When prominent leaders of the African American community proclaim "We've gone from plantations to penitentiaries," there is ample cause to question the annual expenditure of \$74 billion for correctional facilities in the United States of America. Does this system of mass incarceration bring justice? If so, what kind of justice is enacted? Following the teachings of Jesus and the minor prophets, the Christian church is called to seek justice, forgive, and show mercy (cf. Micah 6:8). Far from limiting the justice of God to the domain of retribution, a fully-orbed biblical theology of justice presses Christians to seek the restoration of peace, reconciliation, and shalom, thus calling into question our nation's misguided appetite for a form of justice divorced from the Gospel virtues of faith, hope, and love. Given the work of Karl Barth and Nicholas Wolterstorff, the distinct contribution of this research lies in providing a theologically robust engagement with Michelle Alexander's *The New Jim Crow: Mass Incarceration in the Age of Colorblindness*. The research methodology utilizes close readings of primary and secondary sources, theological and historical documents alongside biblical material. The primary goal of this research is to offer the Church a public theology of justice calling all who identify with Christ to respond to mass incarceration in prayer and solidarity with the suffering, reconciliation, and advocacy.

## The Authorship of John and the Identity of the Beloved Disciple

**Nathan Longfield**

Mentor: Dr. Wayne Brouwer  
Department of Religion

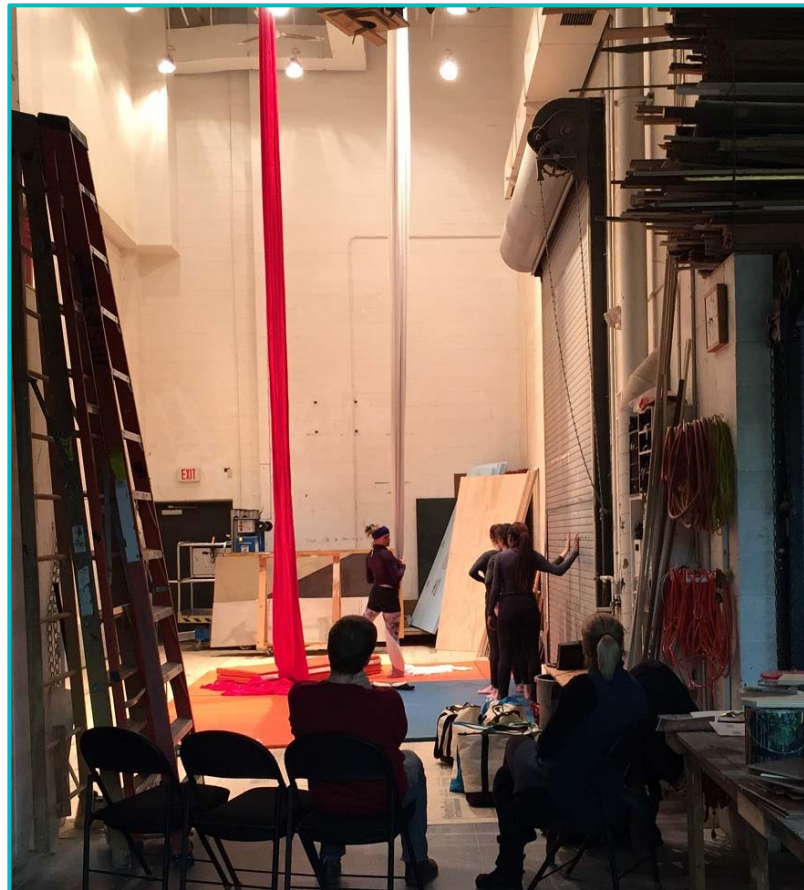
The Gospel of John, the fourth gospel in the New Testament, is one of the most popular books of scripture containing a powerful introduction as well as many oft-quoted verses. However, since the early 19th century the authorship of the Gospel of John has been challenged by a number of scholars as they have proposed alternative authors against the traditional ascription of the Gospel to John the Son of Zebedee. Beginning with David Friedrich Strauss in 1835, an increasing number of scholars have shifted to believing that other sources are responsible for producing the fourth gospel. Raymond Brown suggests that the gospel arose out of a community of early Christian believers, a Johannine Community. Richard Bauckham claims that a different John, John the Elder, is the author of the fourth Gospel. Lastly, Ben Witherington III proposes that Lazarus is the author and the Beloved Disciple. The fourth position examined, and argued for, is the traditional understanding that John the Apostle, the Son of Zebedee, is both the author of the Gospel and the Beloved Disciple. Within all four of these arguments, both the internal arguments of scripture and the external arguments from writers and accounts in the 1st and 2nd centuries were considered, though greater weight was often given to the gospel and other passages of scripture that provide clues towards the identity of the author of the gospel and, consequently, the Beloved Disciple.



## Stage Managing *The Tempest*

**Nathan Gingrich**  
Mentor: Reagan Chesnut  
Department of Theatre

The project will show the process of stage managing *The Tempest* from start to finish, and the effort required to stage manage a full production. Stage management is the organization and coordination of actors, production staff, designers for the set, lights, sound, and costumes, among others, and crew members to successfully create a theatre production. This involves running meetings between the various designers, recording information, such as useful notes for the designers not in attendance as well as blocking notes for the actors, at rehearsals, and running the show once it opens. This is referred to as “calling the show”, which involves giving cues for light transitions and sound effects to the operators of the light and sound boards, and may also include cues for projections or set movement. Notes and the script with cues marked are held in a large prompt book which represents the culmination of the stage manager’s work.



*Nathan Gingrich, stage manager (left) and Daina Robins, director (right) during an aerial silks rehearsal for The Tempest.*

# INTERDISCIPLINARY

## Oxytocin Receptor Gene Variation and Forgiveness: A Study of Traits and States

**Audrey Black, Trechaun Gonzales, Robert Henry, Marina Milad, Morgan Miller, Samantha Moffat Elizabeth Perkins, Madeleine Ryan, and Chloe Werkema**

Mentors: Dr. Charlotte Witvliet, Dr. Gerald Griffin, and Dr. Lindsey Root Luna  
Departments of Psychology and Biology

*This research was supported by a 2015 grant from the Frost Research Center.*

Oxytocin is a neuropeptide associated with social bonding and empathy for others. In the context of interpersonal offenses, level of empathy for one's offender is a significant predictor of granting forgiveness. This study assesses whether empathy and forgiveness-related responses vary based on genetic variations in the oxytocin receptor gene. One single nucleotide polymorphism (SNP) is believed to be a factor in individual differences in the expression of empathy and other affiliative behaviors. Those with one or two copies of adenine (A) in intron 3 of the OXTR gene may have less dispositional empathy and greater stress reactivity than those homozygous for guanine (G). Our study uses a mixed design to test traits and states in 100 males and 100 females. First, we will determine the proportion of GG, AA, and AG participants. Second, using a between subjects natural groups design, we will compare GGs to A carriers for the traits of empathy, forgiveness, and the tendency to ruminate or use positive reappraisal coping styles. Third, we will test whether GG and A carriers differ in their responses to offense cognition conditions within participants. Participants each identify an unresolved interpersonal offense committed against them by someone they know. In the repeated measures design, participants are instructed to ruminate about the offense and to complete two different positive reappraisal conditions in counterbalanced orders: compassion-focused and benefit-focused reappraisal. Compassion-focused reappraisal emphasizes the humanity of the offender and how that person needed to change, whereas benefit-focused reappraisal prioritizes how the participant may have grown through facing the offense. We test whether these two natural groups (AA/AG vs. GG) differ in their response to the repeated measures conditions of positive reappraisals (versus offense rumination) for the dependent variables of state empathy, benevolence, and forgiveness, as well as unforgiveness responses of revenge and avoidance.



*Faculty mentors Charlotte Witvliet and Gerald Griffin with students Robert Henry, Fallon Richie and Elizabeth Perkins.*



### The Polar Front: A Historical Narrative Derived from the Oral History of the American North Russian Expeditionary Forces

**Jonathan Bading, Cassidy Bernhardt, Carolyn Ellis, and Alejandra Gómez Limon**

Mentors: Dr. Curtis Gruenler and Professor Alex Galarza  
Andrew W. Mellon Scholars Program and Department of English

In the summer of 1918, with the Armistice of World War I rapidly approaching, President Woodrow Wilson sent the American North Russia Expeditionary Force (ANREF), colloquially known as the Polar Bears, to Northern Russia in order to secure allied munitions from the Bolshevik Army and reclaim the Russian front for Allied forces. Out of the 5,500 men sent to Arkhangelsk, Russia, 75% percent were from Michigan. In 1978, a group of Hope College students interviewed fifteen members of the ANREF who hailed from West Michigan, inquiring about their experiences. Thirty-eight years later, the interviews, diaries, and other primary sources gathered from the veterans by the students have been converted into a digital timeline, one which narrates these soldiers' journey through the frozen North. Through both audio-visual and graphic media, the timeline also illuminates the thoughts and sentiments of the soldiers, particularly regarding their trials and tribulations throughout the campaign. After being marooned, starved, and neglected by the U.S. military for almost a year, the men's opinions of their country varied. This project revisits the role of small town America in the nation's first major international conflict.

### The Face of Hope: How Perceived Minorities and Other Topics Have Shaped the Experience and Contributions of Hope Students

**Ellee Banaszak, Grace Hulderman, Anna Jones, and Gianna Ramirez**

Mentors: Dr. Curtis Gruenler and Professor Alex Galarza  
Andrew W. Mellon Scholars Program and Department of English

Throughout the history of higher education, institutions have struggled with multiculturalism. Although there is a myriad of mission statements which proclaim their hope to entice and accommodate minority students, the struggle has remained in need of a solution. In recent years there has been research about the experiences of minority groups in higher education; this research highlights how minority students balance different cultures, how their identities affect their academic contributions, and how they see themselves in a pool of differing students. However, there has been a gap in research at small, private religious institutions. Although Hope College claims to be committed to increasing the diversity among its student body, it tends to draw students of similar backgrounds. While this propensity for the familiar is not a problem in and of itself, the homogeneity that sometimes forms in such groups can develop an echo-chamber that is less able to recognize voices that differ from the established "norm." With our research we hope to fill this gap, by discussing and analyzing recorded student interviews in a series of podcasts that will highlight issues common among minority students. In exploring the commonalities among minority students at Hope, we will be able to offer not only a window into their experiences, but also a useful tool for institutions in the quest to create an education that encourages and celebrates all students. We assert that in order to accommodate this minority population and to accomplish diversity, the students and faculty of Hope College must create a wider platform for minority groups and make an effort to integrate their culture and experiences into the campus.

# MELLON SCHOLARS



*Grace Hulderman, Gianna Ramirez, and Anna Jones, Mellon Scholars, at the Celebration, 2016.*

## Dancing through Hope's History

### **Raven Bouvier, Rachel Kennedy, and Nia Stringfellow**

Mentors: Dr. Curtis Gruenler and Professor Alex Galarza  
Andrew W. Mellon Scholars Program and Department of English

Dance is the art of capturing emotion by creating movement that pulls an audience in, makes them think, and makes them feel. Yet, the art form is often misunderstood, especially within a traditional Dutch, old-fashioned, church community such as Holland, Michigan, the home of Hope College. The college's dance department is unique in that the student is nurtured technically, academically, and spiritually. However, the relationship between Hope College's dance department and its religious values as a reformed-tradition college is complex. When dance was first taught in the late 1960s, Hope's administration could not bring themselves to pay someone a salary for teaching dance classes. Thus, for two years Maxine Debruyne, the founder of Hope's dance department, was paid in paintings. With time, attitudes changed and the program was allowed to grow. Today, Hope's dance department is an integral part of the campus community. This project explores the manifestation and transformation of dance in the Hope College community in relation to the values of the Reformed Church of America by examining the department both then and now.

## The State of the Arts in Holland: the Roles of Art and Identity in Community

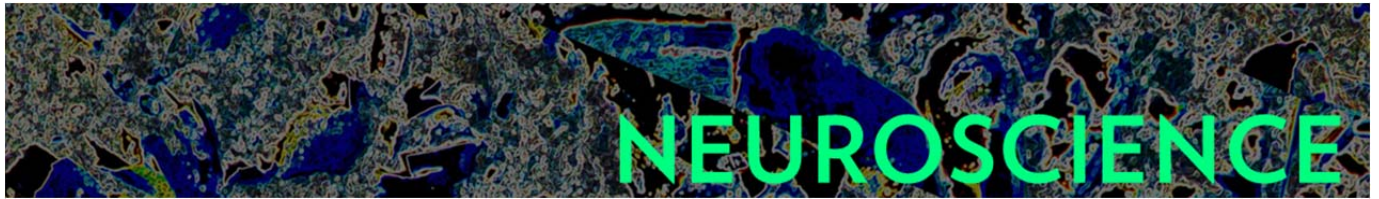
### **Ellen Messner and Hannah Pikaart**

Mentors: Dr. Curtis Gruenler and Professor Alex Galarza  
Andrew W. Mellon Scholars Program and Department of English

Identity is something that we all possess. Forming an identity allows us to both relate to and distinguish ourselves from others. Ultimately, an identity is what unites a community. But by creating identities, we naturally build boundaries. In contrast, art seeks to push or break them. While identity can change to accommodate new ideas, to what extent can identity change without losing itself in the process? Likewise, art can exist within the boundaries of identity, but at what point is the ability of expression repressed? How can we find middle ground?

Hope College has created an identity that sets itself apart from other institutions. One of Hope College's most defining characteristics is its Christian faith, which can be traced back to the college's origins. Hope College has also cultivated a strong arts community. By observing the departments of music, theater, and art, we will observe the relationship between the identity of Hope College and its arts community. Is Hope College a place where identity and art are at odds? Or perhaps it is the middle ground where identity and art can coexist and thrive.





### Does Lithium Diminish Manic/Depressive Behaviors in Rats Associated with HCA Exposure?

**Rebekah Bierema, Sarah Carrara, Brianna Cherry, Ethan Goodman, Amy Hoag, Allison Kleppinger, Kathleen Muloma, Jada Royer, and Lucas Wiles**

Mentor: Dr. Leah Chase  
Neuroscience Program and  
Departments of Biology and  
Chemistry

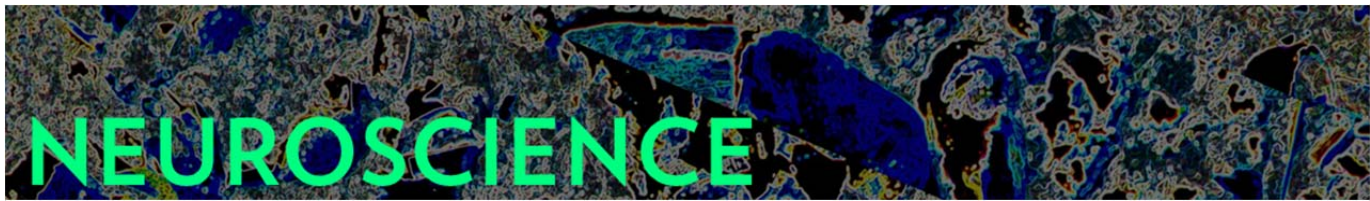
The development of novel treatments for Bipolar Disorder has been hampered by the lack of a good animal model for the disease. The purpose of this study was to establish predictive validity for a novel animal model for bipolar disorder. Previous work in Dr. Chase's lab has demonstrated that early exposure to the glutamatergic agonist, homocysteic acid (HCA), leads to a phenotype which is consistent with a mixed manic/depressive state as is often observed with bipolar disorder. Specifically, we observed that HCA-treated rats displayed increased risk-taking behavior, reduced social behavior, novelty-induced hyperlocomotion, anhedonia, and increased motivational behavior compared to control rats. Now we wish to determine if lithium, a common treatment for bipolar disorder, will lead to a reduction in depressive and manic behaviors associated with HCA. Therefore, we injected 23 rats daily with the endogenous, glutamatergic agonist homocysteic acid (HCA) from postnatal days 3-21. Another group of 23 rats received injection of saline. Six weeks later, the saccharine preference test, elevated plus maze, social interaction test, rotarod test, forced swim test and Morris Water Maze were conducted to assess anhedonia, risk taking behavior, social interaction, motor coordination, depressive behaviors, motivation and risk-taking behaviors. The rats were then treated with lithium for the remainder of the experiment and assessed in the same behavioral tests described previously to observe whether lithium was effective in reducing the behaviors associated with HCA exposure. If lithium is found to reduce manic and depressive behaviors in HCA-treated rats, this would suggest that the HCA model could potentially be used to identify novel pharmacological agents that would better treat the disorder.

### Effects of Light and Ambient Temperature in a Diurnal Rodent, the Nile Grass Rat

**Garrett Fogo, Alyssa Goodwin, Ohanes Khacherian, and Brandi Ledbetter**

Mentor: Dr. Andrew Gall  
Neuroscience Program and  
Department of Psychology

Changes in environmental conditions often result in changes in the display of circadian rhythmicity and locomotor activity levels of mammals. In previous experiments, day active (diurnal) grass rats (*Arvicanthis niloticus*) have been shown to switch to a night active (nocturnal) pattern of activity after the introduction of a running wheel. However, it is not yet known the mechanism by which animals switch from being diurnal to nocturnal. Here, we used grass rats to examine activity levels following manipulations of varying ambient temperatures and lighting intensities. Animals were singly housed with running wheels and data were collected in 12:12 light-dark (LD) conditions. First, we examined how a warmer ambient temperature during the day (25 degrees Celsius) and a cooler night (21 degrees Celsius) would affect wheel running activity. We found that 100% of grass rats in this condition were diurnal. The ambient temperature was then raised to a warmer condition (constant 32 degrees Celsius). Diurnality was still expressed by 100% of the subjects following the temperature increase, yet overall wheel running activity significantly decreased ( $p < .05$ ). Next, we plan to adjust the ambient temperature to a colder condition. We predict that grass rats will maintain diurnal patterns of activity in cold conditions, but will exhibit higher overall wheel running activity. Finally, we plan to adjust the room temperature back to a baseline temperature of 25 degrees Celsius, and dim the intensity of light in the environment. Altogether, we predict that changes in ambient temperatures will affect overall activity levels while maintaining diurnality, whereas changes in lighting intensity will affect the display of diurnal activity patterns. Our results will allow us to predict how lighting and temperature maintain diurnality, which is important in light of the growing evidence that humans that become night-active have significant health consequences.



## Grateful Remembering, Present Awareness, and Hopeful Anticipation: An Assessment of Worrying and Mental Health in College Students

**Allison Kleppinger, Fallon Richie, Manna Shintani, Christian Otteman, Lucas Wiles, Hillary Smith, Mara Bottomley, Austin Elluru, Hailey Fairchild, Ethan Goodman, Morgan Herzog, Amy Hoag, Madison Mertz, Maxwell Schuiteman, and Alexander Swain**

Mentor: Dr. Lindsey Root Luna  
Neuroscience Program and  
Department of Psychology

Gratitude, mindfulness, and hope are three constructs that, along with individual associations with unique dimensions of time, have been empirically linked with positive outcomes (Vøllestad, Nielsen, & Nielsen, 2012; Rash, Matsuba, & Prkachin, 2011; Carr, 2004). The purpose of this study is to assess how brief experimental inductions of gratitude, mindfulness, and hope impact the psychological experience of worry and whether individual difference variables moderate the effects. In this incomplete repeated measures design experiment, undergraduate students ( $N = 89$ ) complete individual difference measures. Next, they spend time two minutes imagining a current worry. Participants then write down three grateful thoughts, three things they could be mindful of, and three hopes for the future, followed by two-minute mental imagery inductions (counterbalanced order across participants). Between each condition, participants complete state questionnaires and rate their worry and mood. To test our hypothesis that engaging in positive mental imagery will attenuate worry, we will perform a within-subjects ANOVA comparing means for the self-report ratings after each imagery trial. We predict that each imagery induction will significantly decrease the psychological effects of worry and increase positive emotion and flourishing. We anticipate that gratitude will have the largest impact in reducing worry and increasing hope and flourishing. Finally, we hypothesize that individual difference variables, specifically trait emotion regulation, anxiety, and flourishing, will moderate these effects. Our findings will indicate how individual differences in trait hope, gratitude, mindfulness, worry, and flourishing are associated with participants' responsiveness to the three interventions to cope with worry. We will also be able to describe worry's relationship with anxiety and depression following brief interventions. Our findings will also suggest relative effectiveness of the three worry-coping strategies which we hope will provide novel insight into the treatment of worry in a clinical setting.

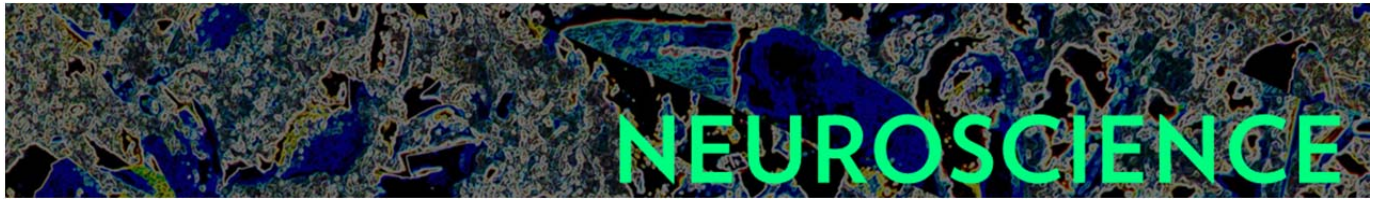
## The Physiology of Positivity: Implications of Mindfulness, Hope, and Gratitude in Alleviating Worry

**Allison Kleppinger, Hailey Fairchild, Amy Hoag, Maxwell Schuiteman, Alexander Swain, Fallon Richie, Mara Bottomley, Ethan Goodman, Morgan Herzog, Madison Mertz, Manna Shintani, Hillary Smith, Lucas Wiles, Austin Elluru, and Christian Otteman**

Mentor: Dr. Lindsey Root Luna  
Neuroscience Program and  
Department of Psychology

People experience worry in a variety of intensities throughout daily life. Although a moderate amount of worry is associated with improved performance in certain activities, studies have shown that long-term worry, such as generalized anxiety disorder, leads to decreased quality of life and has a negative impact on human flourishing (Porensky, Dew, & Karp, 2009). Worries may be expressed over past, present, or future events. Previous research supports the induction of time-oriented, positive constructs as treatments for worry (Cheng, Tsui, & Lam, 2015; Delgado, Guerra, Perakakis, Vera, Paso & Vila, 2010; Sears & Kraus, 2009). Therefore, we are investigating gratitude, mindfulness, and hope as three coping strategies used to attenuate the physiological symptoms of worry.

Subjects ( $N=91$ ) participated in mental imagery exercises with short inductions of worry, followed by immediate worry ratings. Then, a coping strategy is introduced, briefly implemented, and worry is rated once more. Physiology (heart rate, cardiac impedance, heart rate variability, blood pressure, skin conductance as well as trapezius and facial electromyography) is monitored during both worry and coping intervention (gratitude, mindfulness, and hope). We hypothesize that the brief inductions of gratitude, mindfulness, and hope will mitigate some of the physiological responses to worry. Of these inductions, we expect mindfulness will be most effective in its reduction of the physiological changes resulting from worry. In previous studies, mindfulness was found to be successful in the treatment of worry (Tacon, McComb, Caldera et. al., 2003). The outcomes of this



## The Impact of Worry on College Students

**Madison Mertz, Mara Bottomley, Morgan Herzog, Austin Elluru, Ethan Goodman, Hailey Fairchild, Amy Hoag, Allison Kleppinger, Christian Otteman, Fallon Richie, Maxwell Schuiteman, Manna Shintani, Hillary Smith, Alexander Swain, and Lucas Wiles**

Mentor: Dr. Lindsey Root Luna  
Neuroscience Program and  
Department of Psychology

## Effect of Homocysteic Acid Exposure on NMDA Receptor Expression in Developing Rat Pups

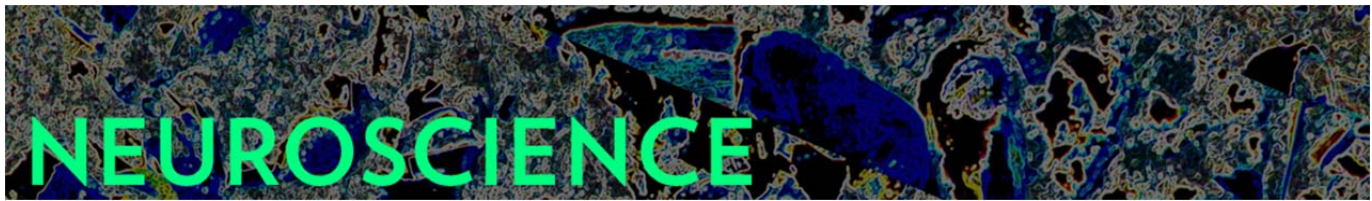
**Stephanie Simko**

Mentor: Dr. Leah Chase  
Neuroscience Program and  
Departments of Biology and  
Chemistry

study will determine the overall effectiveness of coping mechanisms (gratitude, mindfulness, and hope) in managing the physiological consequences of worry. Implications of this study include possible use in clinical settings, personal use in high worriers, and an increase in the general understanding of how worry impacts the various processes essential to normative bodily functions.

College-aged students are at an increased risk for worry compared to older adults (Brose, Scheibe, & Schmiedek, 2013). Worry in college students may not pose an immediate threat to health; however, long-term worry has been linked with reduced physiological flexibility, posing a threat to cardiac health and mortality (Fisher & Newman, 2013). In the current study, we are investigating worry in college students. By determining the domains college students worry about, and how the worry manifests itself, we will be better equipped to assist this population with their worries. Participants (N=89) were recruited from Hope College. The participants completed individual difference measures before the induction to assess trait measures. A two-minute pre-trial baseline preceded a two-minute worry induction. Heart rate variability (HRV), blood pressure, heart rate (HR), skin conductance, cardiac impedance, facial electromyography (EMG), trapezius EMG, and respiration were monitored. After the worry induction, the participants rated their worry. Finally, participants filled out a questionnaire asking about habits and substances that could potentially impact physiology. We expect inducing worry will produce an aroused physiological state. Therefore, we expect a normal worrier to have reduced HRV, higher blood pressure, and increased HR during a worry induction than at baseline, analyzed using a within-subjects ANOVA. Qualitatively, we expect college students to report mostly self-oriented worries. Finally, we anticipate individual difference variables (i.e., trait worry, mindfulness, hope, gratitude) will moderate the impact of the worry induction. Specifically, we expect high-worriers to have lower HF-HRV and higher HR during the worry induction than during the baseline. These results will reveal the nature and mechanisms of worry within college students. This will promote the development of treatments, which could in turn reduce the risk of developing worry-related psychological disorders and negative cardiac consequences.

Homocysteic acid (HCA), a NMDA receptor agonist, is an endogenous compound formed from the oxidation of homocysteine. Since hyperhomocysteinemia is a risk factor for several neuropsychiatric disorders, including bipolar disorder and major depressive disorder (MDD), we sought to test the hypothesis that elevated HCA levels in developing rats may induce alterations in NMDA receptor expression and the development of behaviors associated with MDD and/or bipolar disorder. Previously, postnatal male and female rats were injected daily with either HCA or saline from day P3 to P17. The female, HCA-treated rats displayed increased risk-taking behavior, reduced social behavior, novelty-induced hyperlocomotion, anhedonia, and reduced sensitivity to pain compared to control and male-HCA treated rats. Additionally, an increase in NMDAR2 expression was observed in the cortex and hippocampus of female rats. More recently we expanded the injection period from day P3 to P21. Both male and female rats exhibited decreased social interaction, increased anhedonia, and increased risk-taking behaviors. Also, male HCA-treated rats exhibited an increased motivational behavior in the Morris Water Maze and a reduction in food consumption. We did not observe a significant difference in the NMDAR2 expression in the cortex among the HCA-treated and control rats. We also did not observe a difference in receptor levels



among males and females. There was a trend for female HCA treated rats to have decreased NMDAR2 expression. Currently, we are working to determine if these differences stem from regional differences of NMDA receptors in the cortex. We would like to acknowledge the students in the Introduction to Neuroscience course in the spring of 2015 for their work testing these rats.

### Does H<sub>2</sub>O<sub>2</sub> Regulate the Ubiquitination of System X<sub>c</sub><sup>-</sup>

**Courtney Van Houzen**

Mentor: Dr. Leah Chase  
Neuroscience Program and  
Departments of Biology and  
Chemistry

The cystine/glutamate exchanger, System x<sub>c</sub><sup>-</sup>, plays a critical role in maintaining oxidative balance and regulating extracellular glutamate levels in the brain. Dysregulation of the transporter can be disastrous, leading to excitotoxic cell death or the development of oxidative stress, processes which are the hallmark of most neurodegenerative diseases. Unfortunately, little is known about the factors which acutely regulate System x<sub>c</sub><sup>-</sup> activity. We recently demonstrated that oxidants acutely upregulate System x<sub>c</sub><sup>-</sup> activity by triggering the rapid redistribution of the transporter from intracellular compartments to the cell surface. Our current work suggests that the trafficking of the transporter may be regulated by ubiquitination and that oxidant exposure directly influences the ubiquitination of the transporter. Specifically, we hypothesize that oxidant exposure leads to a reduction in ubiquitination of the transporter, slowing the internalization of the transporter from the plasma membrane. Therefore, we are testing this hypothesis directly by transfecting Cos-7 cells with a myc-tagged xCT (the primary component of the System x<sub>c</sub><sup>-</sup> transporter) and histidine-tagged ubiquitin. These cells are then exposed to oxidants or vehicle. Ubiquitinated proteins are purified on a nickle-column and the presence of xCT is detected by western blot analysis. When completed, this project will allow us to better understand the role that ubiquitination plays in the trafficking of System x<sub>c</sub><sup>-</sup>.



*Biochemistry, neuroscience, geology, and education students at the Celebration, 2016.*



## Take a Look at Snail Fever

**Jason Gombas, Marissa Solorzano, and Anisha Zepeda Moreno**

Mentors: Dr. Kristen Gray and Professor Yolanda Vega  
Phelps Scholars Program

Schistosomiasis is the second most devastating socioeconomic parasitic disease in the world. Snail fever, Schisto, and swimmer's itch are common names for this parasitic disease. Found in bodies of stagnant water, schistosomiasis causes many horrible symptoms, including brain damage, and can cause death if left untreated for a long period of time. This disease is easily curable, but highly contagious. Praziquantel is the drug that cures Schistosomiasis which is readily available for those in first world countries. However, developing countries struggle to get the necessary drug due to the price and availability. Sometimes the drug is not prescribed to those in developing countries because reinfection often occurs within a year. It is important for people in developed countries to seek solutions to this problem as well because this disease affects people regardless of their economic status. This study explores the following steps that can be taken to work to reduce the instances of Schistosomiasis; donations to organizations to make Praziquantel more economically available; build wells in developing countries so that a clean, uncontaminated water supply may exist for the population; educational programs focusing on safe water management such as boiling water to help reduce the occurrences of snail fever.

## Correlation Between a Nation's Human Trafficking Rates and Socioeconomic Status

**Steven Gomez, Katrina Dykstra, and Jacqueline Villarreal**

Mentor: Dr. Llana Chavis Phelps  
Scholars Program

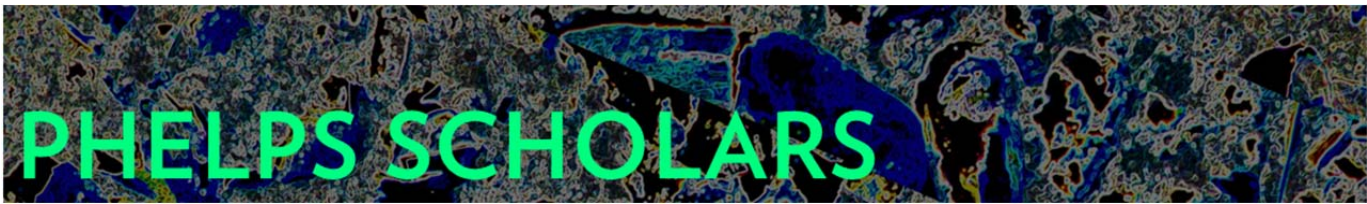
Our data and literature gathered was focused on answering the thesis question, "Does a country's socioeconomic status affect its human trafficking rates?" While literature was rather abundant, raw statistics were scarce. This was due to the illegal nature of human trafficking, which therefore leads to very little official documentation of those caught in it. Despite posing a problem originally, progress was made in gathering reliable data. After collecting and verifying the information and numbers found, the data corresponding to each country was paired against its GDP per capita—the measure of the average income per person in a country. All 12 countries selected at random were represented graphically to show the distinct trend between low GDP per capita and high human trafficking rates. While poverty is not the sole causation of human trafficking, the information gathered showed that it had a strong correlation to high human trafficking rates.

## Interracial Dating

**Jubilee Jackson, Corinne Qualkinbush and Titus Theis**

Mentors: Dr. Llana Chavis and Professor Yolanda Vega  
Phelps Scholars Program

With the increased diversity of societies at this time in the history of the world, more and more people are coming into contact with those of different races. This greater amount of interaction will inevitably lead and has led to interracial dating. The purpose of our research is to determine if interracial dating amongst college students (and the increased relations this may cause between different racial groups) is correlated with more positive racial attitudes amongst those involved. Through various sociological studies on race relations and increased interactions among people of different races, much data has been found to support the hypothesis that increased race relations leads to more positive racial attitudes. This can then be translated to dating. Interracial dating, and the increased interracial interactions this has on those involved, leads to more positive racial attitudes of those involved in the relationship.



### In China and America, How Do Differing Societal Values Regarding Parenting Affect a Child's Development?

**Vania Macias, Yi Qian, and  
Stephen Rivas**

Mentor: Professor Yolanda Vega  
Phelps Scholars Program

This project aims to expose an issue concerned with the hierarchical approach of contrasting authoritative and authoritarian parenting styles, which often recognizes authoritative parenting as superior and authoritarian parenting as inferior. Using American culture as an example that favors authoritative parenting and Chinese culture as an example that favors authoritarian parenting, we have discovered that both styles are effective forms of parenting, and are even favored in their respective cultures due to core beliefs and traditions. Understanding this is key in eliminating the mindset that one form of parenting is universally superior to another.

### Intimate Partner Violence: Cultural Factors and Prevention

**Darien Stimley, Victoria  
Roughley, and Antonio  
Marquez**

Mentors: Dr. Kristen Gray and  
Professor Yolanda Vega  
Phelps Scholars Program

Cultural relativism is defined by the Random House dictionary as “the concept that cultural norms and values derive their meaning within a specific social context.” This is pertinent to understanding the Western view of women’s oppression as a human rights violation and public health concern. In order to thoroughly comprehend the beliefs, customs, and ethics that form an individual’s culture, one must inform themselves of the social context in question. One of the most harmful oppressions forced upon women is the violence inflicted by their intimate partner. Intimate Partner Violence, or IPV, has become culturally acceptable, and is referred to as the “normalization of violence.” Within the countries of Bangladesh and India, the main cultural factors that impact women in intimate relationships include adolescent marriage, the use of contraceptives, and dowries. To understand the severity of the issue, comparisons to Intimate Partner Violence in the United States have been recorded. The process of women gaining full equality has been prevented from progressing due to a lack of knowledge concerning the issue as well as a lack of health care facilities. Cultural relativists would claim that it is not our responsibility to prevent this abuse. However, living in a developed country with numerous resources, we could help provide a strong foundation for developing countries as they begin to address IPV and exploitation. Now is the time to be activists against Intimate Partner Violence.

### A [REDACTED] Dictatorship

**Katarina Zomer, Miche Andre,  
and Trevor Wilson**

Mentor: Professor Amy Otis-  
De Grau  
Phelps Scholars Program

North Korea has had a history of dividing and obscuring itself from the rest of the world, while advocating the creation of weapons and military advancements. The rest of the world has kept an eye trained on the activities of North Korea, measuring their accomplishments and abilities, and at times making them unsure about North Korea’s actions. Over time, as technology has improved, North Korea has begun to control its citizens’ access to media and implementing punishment measures. The control of all media within their country, and the tight hold on media that enters and exits North Korea, has affected other countries and their perception of North Korea. In turn, nations have tried to comprehend their actions and find ways to help the North Korean people while still benefiting themselves.

# WOMEN'S & GENDER STUDIES

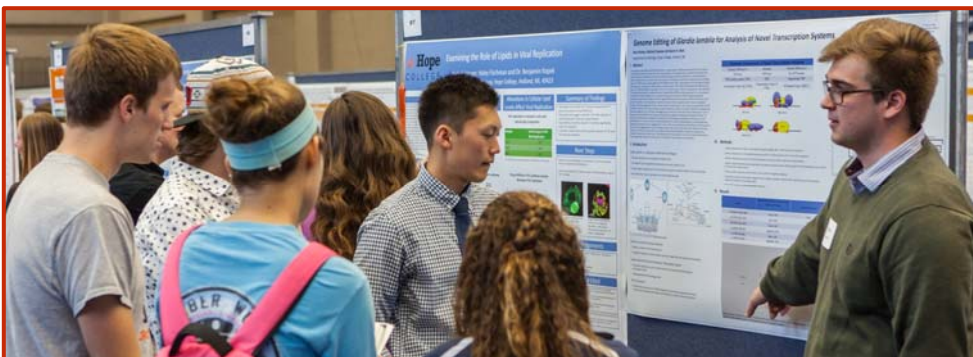
Janelle Monáe; The  
Ultimate Space Maker

**Nina Kay**  
Mentor: Dr. Kendra Parker  
Department of Women's and  
Gender Studies

In 2015 Viola Davis became the first Black woman to ever win an Emmy for best actress in a drama. In her acceptance speech she said, "The only thing that separates women of color from anyone else is opportunity. You cannot win an Emmy for roles that are simply not there" (Davis). R&B singer and record label owner Janelle Monáe is dedicating her career to creating roles for women in all areas of the music industry. Looking through a Black feminist lens I will examine Monáe's life works, whether they be her works as an artist or her works as a businesswoman. It is my argument that through her ability to create space and opportunity for Black women in the music industry, Janelle Monáe is a prime example of modern day Black feminism. Given that so much of Monáe's artistic works fit into the genre of Afrofuturism my findings will be presented not in the form of a paper or a poster, but through a completely modern, interactive website. Presenting my findings in such a manner creates more of an experience for those who view it while giving a nod to the artistic aesthetic Monáe herself employs.



*Phelps Scholars Corinne Qualkinbush, Jubilee Jackson, and Titus Theis, at the Celebration, 2016.*



*Mitch DePree and Ross Nickels, Biology, at the Celebration, 2016.*

# NATURAL & APPLIED SCIENCES

## BIOCHEMISTRY

### Assigning and Testing Function from Structure of Uncharacterized Proteins

**Sarah Bettag, Mark Cunningham, Christopher Da Silva, Christopher Gager, Morgan Glover, Kylie Jacobs, Lauren Kennington, Jacob Knol, Nicole Ladd, Katherine Mader, Mary Margaret Magán, Yubing Mao, Eleanor Marinelli, Lyndsy Miller, Ross Nickels, Sarah Ratliff, Alison Rhodes, Claire Schaar, Meredith Turner**

Mentor: Dr. Michael Pikaart  
Biochemistry and Molecular Biology Program and Department of Chemistry

In 2000, the National Institutes of Health initiated the Protein Structure Initiative as a multi-center structural biology program with “an initial goal to make the three-dimensional, atomic-level structures of most proteins easily obtainable from knowledge of their corresponding DNA sequences.” (NIGMS website). The third and final phase of this program concluded in 2015 with the publication and distribution of more than 5000 previously uncharacterized proteins. The work described here leverages the availability of high-quality structures and pre-cloned expression plasmids to combine forces of undergraduate biochemistry teaching lab courses across a diverse range of participating institutions. This consortium of undergraduate biochemistry faculty and students seeks to identify functional properties of a subset of these uncharacterized proteins, seeking to unify structure-and-function relationships. The current biochemistry laboratory class at Hope College has expressed and purified seven of these proteins, finding that structural information can guide, although not predict entirely, functional predictions regarding substrate specificity.

*This work was supported by the National Science Foundation “Improving Undergraduate STEM Education” program.*

### Development of Novel Plasmids for use in Neuroregeneration Studies in Zebrafish

**Christopher Gager**

Mentor: Dr. Leah Chase  
Biochemistry and Molecular Biology Program and Departments of Biology and Chemistry

Collaborators: Nicole Ladd, Dr. Brent Krueger, Hope College Department of Chemistry and Dr. Aaron Putzke, Whitworth University Department of Biology

System  $x_c^-$  is an amino acid transporter that enables the transfer of intracellular glutamate in exchange for extracellular cystine. This process is involved in reducing oxidative stress within cells. This transporter is commonly found in the central nervous system, most commonly in neuroprotective cells such as astrocytes and glia. Mitigation of oxidative stress is thought to be critical to neuroregeneration of the central nervous system. Neuroregeneration is a trait found in zebrafish and other teleost fishes, and can be observed following neuronal ablation via laser. In order to examine the role system  $x_c^-$  plays in this process, our project aims to generate novel plasmids for use in zebrafish lines, allowing for the fluorescent expression of  $x_c^-$  in the nervous system. The three plasmids we are creating are hb9:hsp:mCHERRY, hb9:hsp:XCT-EGFP, and GFAP:XCT-EGFP. These can be inserted into zebrafish and the lines grown, to enable studies aimed at understanding System  $x_c^-$  and the neuroregeneration process. The hb9:hsp:mCHERRY plasmid will allow motor neurons to specifically be stained red in our zebrafish so that they can be targeted for neuronal ablation. The hb9:hsp:XCT-EGFP will allow for the expression of a green fluorescent-tagged System  $x_c^-$  transporter only in motor neurons so that we can directly observe how System  $x_c^-$  expression and trafficking changes during the neuroregeneration process. Finally, the GFAP:XCT-EGFP will allow for selective expression of a green-fluorescent form of System  $x_c^-$  in glial cells to determine if these cells also contribute to the regeneration process.





## Exploring the Role of xCT in Neuroregeneration through Laser Ablation of Zebrafish Neurons

**Nicole Ladd**

Mentors: Dr. Brent Krueger<sup>1</sup>, Dr. Leah Chase<sup>1,2</sup>, and Dr. Aaron Putzke<sup>3</sup>

<sup>1</sup>Department of Chemistry,

<sup>2</sup>Department of Biology,

<sup>3</sup>Whitworth University  
Department of Biology

System  $x_c^-$  is a heterodimeric amino acid transporter comprised of a light chain unit, xCT, which confers the transport specificity, and a heavy chain unit, 4F2hc. System  $x_c^-$  has been shown to facilitate the exchange of intracellular glutamate for extracellular cystine, which is rapidly reduced within the cell to cysteine, the limiting reagent for glutathione (GSH) production. GSH is an endogenous reducing reagent that is important in mitigating the oxidative stress that, untreated, can trigger cell death. It has been shown that system  $x_c^-$  is strongly expressed in the central nervous system, particularly in activated neuroprotective cells such as astrocytes and glia. It is believed that relief of oxidative stress in the environment of neurons and their protective counterparts is critical in processes such as neuroregeneration. The thrust of the current study is to identify the role that xCT plays in neuroregeneration *in vivo* using femtosecond laser ablation to initiate apoptosis, followed by neuroregeneration. Initial results will be presented including expression patterns of the xCT gene in developing zebrafish and preliminary examples of laser ablation.

*Research funded by the National Science Foundation (NSF RUI #0843564 and NSF RUI #1058981). This research was supported in part by an award to Hope College from the Howard Hughes Medical Institute through the Undergraduate Science Education Program.*

## Does Mutation of a Putative Nedd 4-2 Binding Site Within the C-terminus of xCT Inhibit its Ubiquitination?

**Sehyun Park, Matthew Petrovich, Philip Versluis, Emma Hardy**

Mentor: Dr. Leah Chase  
Biochemistry and Molecular Biology Program and  
Departments of Biology and Chemistry

Glutamatergic synapses require precise chemical control in the surrounding space. System  $x_c^-$  is a membrane antiporter that regulates extracellular glutamate and intracellular cysteine in glial cells, ultimately regulating glutathione production. Glutathione is an endogenous reducing agent for mitigating oxidative stress. Thus, regulation of System  $x_c^-$  is important for regulation of glutamatergic signaling and the oxidative state of the glial cells. Previous studies in Dr. Chase's lab have demonstrated that System  $x_c^-$  is regulated by its trafficking to and from the cell surface in response to oxidative stress. In addition, Dr. Chase and her students have also shown that xCT undergoes a change in ubiquitination state following exposure to hydrogen peroxide. While the specific factors which regulate the trafficking of the transporter are not well understood, we have identified several amino acid motifs in the carboxyl terminus that appear to regulate the trafficking of xCT. Specifically, we observed that mutating residues in a 462PAYYLFI468 motif to alanine led to an increase in cell surface expression of xCT. Studies of an epithelial sodium channel have shown that a similar amino acid motif serves as a binding site for the ubiquitinating enzyme, Nedd 4-2. Since loss of protein ubiquitination is known to increase the cell surface expression of other membrane proteins, we set out to determine if the mutants which increase cell surface expression of xCT also decreased the ubiquitination level of xCT. We used pulldown assays to determine if these mutations inhibited xCT ubiquitination. Specifically, COS-7 cells were transfected with either wild type or mutant xCT and His-ubiquitinated proteins were purified. The presence of ubiquitinated xCT was detected using western blot analysis. Once this study is completed, we will have a better understanding of the role the PAYYLFI motif plays in the regulation of cell surface expression and ubiquitination of xCT.



## Production of Monoclonal Antibodies against VACM-1/Cullin5

**Glen Smith**

Mentors: Dr. Maria Burnatowska-Hledin and Dr. Vicki Isola  
Biochemistry and Molecular Biology Program and Department of Biology

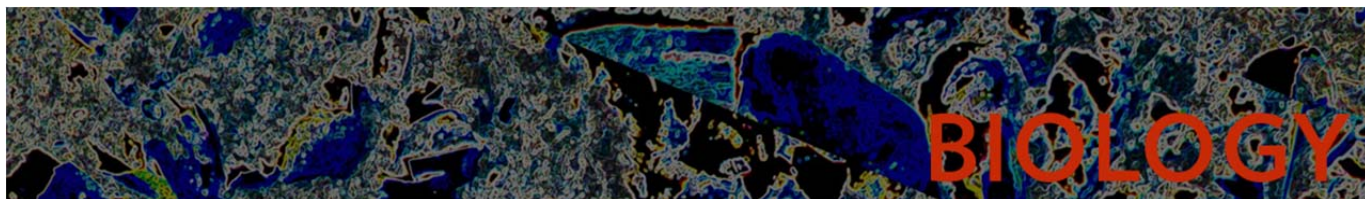
Vasopressin – Activated Calcium Mobilizing receptor 1 (VACM-1) is a 780 amino acid long protein that is part of the E3-Ligase complex responsible for ubiquitin mediated protein degradation. VACM-1 has been shown to have severely decreased expression in cancer cell lines compared to normal cells. Until now it has been difficult to study VACM-1 in the cell using immunochemistry techniques (Western blotting, In-Cell Western, and immunostaining) to investigate cellular processes due to the limited availability of monoclonal antibodies against VACM-1. Whereas polyclonal antibodies can bind to multiple epitopes of a protein, monoclonal antibodies (mAbs) will bind to a specific epitope of a protein. The use of monoclonal antibodies conjugated with therapeutic drugs has become popular in cancer treatment. Monoclonal antibodies can be used to target the antigens that are uniquely expressed in cancer cells to deliver therapeutic drugs to cancer cells specifically or to stimulate the normal immune system pathways to help the body combat the cancer cells naturally. A new mAb against VACM-1 would be useful in providing insight into the role VACM-1 plays in cancer and how it might be used in cancer treatment. Prior to this study cell lineages that produce mAbs to VACM-1 were generated. The media from these cells (which should contain secreted antibody) were purified into fractions using column purification. Fractions from two of the cell lineages (1-10D and 2-F3) were found to contain antibodies. The aim of this study is to screen those fractions for biological activity.

## Identification of Amino Acid Residues in System xc- that are Important in Regulating its Cell Surface Expression

**Mason Yoder, Hailey Fairchild, Brittany Buchholz, and Laura Teal**

Mentor: Dr. Leah Chase  
Biochemistry and Molecular Biology Program and Departments of Biology and Chemistry

System xCT is an antiporter crucial for the production of glutathione by controlling cellular levels of cysteine, the limiting reagent in glutathione synthesis (Kim, et al., 2001). Glutathione is a key component in the antioxidant cascade that exists to protect neurons and glia from oxidative stress (Kim, et al., 2001). Previous research in the Chase laboratory found that membrane levels of xCT increase 2- to 3-fold in response to oxidative stress. Therefore, we sought to determine the events which regulate cell surface expression of xCT. Studies of other membrane proteins have demonstrated that their cell surface expression and trafficking are controlled through the ubiquitination of lysine residues on the membrane-bound protein (Traub and Lukacs, 2007). Therefore, in our study, we induced lysine to arginine mutations on the seven intracellular xCT lysine residues in order to determine whether these residues are ubiquitinated in vivo and whether these residues are involved in xCT trafficking. We performed biotinylation assays and immunocytochemistry on transfected cells to measure the membrane and cellular expressions of mutated xCT proteins. Ubiquitination assays were also performed. Since only lysine and not arginine residues can be ubiquitinated, we hypothesize that the mutation of key lysine residues to arginine will result in increased membrane xCT levels and a reduction in xCT ubiquitination. Furthermore, we hypothesize that this mutation will only affect membrane trafficking and not overall cellular expression of xCT.



## Applying Editorial Processes to Streamline Manuscript Publication

**Elizabeth Brigger**

Mentor: Dr. Maria  
Burnatowska-Hledin  
Department of Biology

Nearly every scholarly journal has a different corresponding set of requirements or formatting expectations required for submissions – this can make it exceedingly difficult to prepare a manuscript in a timely fashion. Similarly, after a publication denies a submitted manuscript, a nearly complete revision is often required in order to resubmit the manuscript to a new publication. After spending months or even years on a project, it can be frustrating to see progress slowed in the pre-publication phase. In order to decrease such potential frustrations and increase the pace at which a publication is prepared, a variety of editing and processing tools were examined and employed. One program found to be useful, Mendeley, was used to simplify the work needed to change referencing style in the manuscripts. Another program, Fiji (an image processing program), was used to simplify the image fluorescence quantitation of cells in preparation for data interpretation. Both programs were relatively easy to learn, free to download, and could be employed in future manuscript preparations to reduce the amount of time spent on style and formatting revisions.

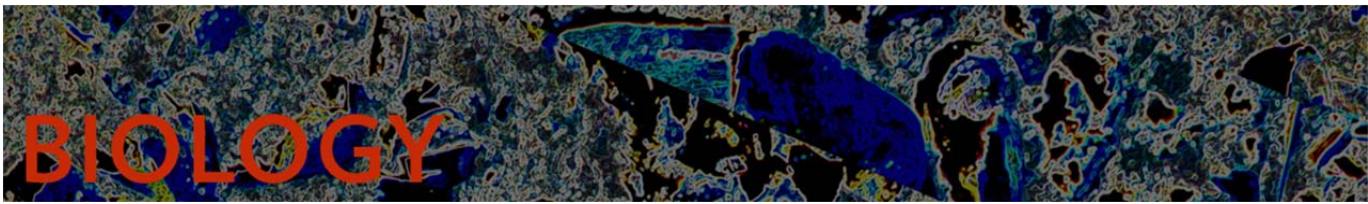
## A Course-Based Research Experience Approach to Examining Host Factors Involved in Viral Replication

**Gracie Curtis, Erin Alenciks,  
Jacob Bordeaux, Brittany  
Buchholz, Jennifer  
Buckingham, Chelsea Chase,  
Jennifer Fuller, Molly Gritt,  
Jessica Guillaume, Jacob  
Iceberg, Daniel Kosiba,  
Francesco Moen, Dimitrie  
Nastasa, Santiago Rios, Clara  
Schriemer, Ryan Skowronek,  
Glen Smith, Connor Smith,  
Julia Stock, Andrew Teahan,  
and Samantha VanderYacht**  
Mentor: Dr. Benjamin Kopek  
Department of Biology

Positive-strand RNA [(+)RNA] viruses are significant threats to human health and include pathogens that are the leading cause of liver cancer and foodborne illnesses in the U.S. Despite the threat (+)RNA viruses pose to human health, few antivirals exist to combat virus infection and replication. As obligate parasites, viruses modulate host functions to create a favorable environment for replication. In turn, host cells modulate their own functions (i.e., immune systems) in a cat-and-mouse game to halt virus replication. Elucidating virus-host interactions may provide novel routes for controlling viruses.

As part of a Course-Based Research Experience, students examined the role of host factors in viral replication using the model (+)RNA virus Flock House virus (FHV). *Drosophila melanogaster* cells are hosts for FHV, allowing us to perform our screens in these cells in culture. Target genes were selected from previous screens performed in yeast or from transcriptomic studies of FHV infected cells. Using a Crispr/Cas9 gene-editing approach, students knocked-out selected genes, and then tested the effect on FHV replication. Our results identified multiple host genes that affected FHV replication. Follow up studies were, and are being, performed to determine the precise role these genes play in (+)RNA virus replication.

*This research was supported by the Howard Hughes Medical Institute through the Undergraduate Science Education Program.*



### Isolation of 18 Novel Mycobacteriophages and Genomic Analyses of Krueger and Phrappuccino

**Allison Darnell, Emily Downs, Riley Draper, Ford Fishman, Cassandra Harders, Julie Isola, Kailee Keiser, Trinity Knight, Allison Lindquist, Sarah Mozdren, Derrick Obiri-Yeboah, Megan Oostindie, Chase Pearce, Daniel Pelyhes, John Peterson, Shannon Smith, Tristan Tobias, Alexandra Vroom, Molly Bogolin, Haley Fischman and Jada Royer**  
Mentors: Dr. Aaron Best and Dr. Joseph Stukey  
Department of Biology

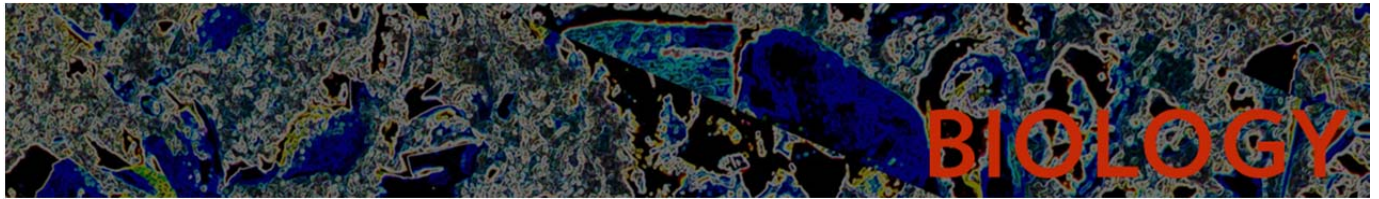
Eighteen new mycobacteriophages were isolated from soil samples collected around the state of Michigan and parts of the United States. All phages were capable of infecting *Mycobacterium smegmatis* and were isolated through either enrichment or direct plating at 25°C. A variety of plaque morphologies were produced based on size, shape, and clarity; both lytic and temperate phages appear represented in this collection. Two mycobacteriophages, Krueger and Phrappuccino, were chosen for complete genome sequencing and comparative genomic analyses. The predominant plaque produced by Krueger at 32°C was circular and 2 mm in diameter. The predominant plaque produced by Phrappuccino at 32°C was 1 mm in diameter, and took 48 hours to appear. Complete genome sequence for Krueger revealed relationships to members of the novel Subcluster K6, while Phrappuccino was not closely related to any known phage and is currently classified as a Singleton. The genome of Krueger is 60.3 Kb, 66.5% GC, and contains 101 genes, including 1 tRNA<sup>(Lys-TTT)</sup> gene; the genome of Phrappuccino is 136.3 Kb, 67.4% GC, and contains 200 genes. While Phrappuccino is a Singleton, there is strong evidence at the morphological (Myoviridae) and genomic levels for a relationship to Cluster C phages. Despite this relationship, Phrappuccino does not carry any tRNA genes. Forty (39.6%) and thirty-six (18%) protein coding genes were assigned functions in Krueger and Phrappuccino, respectively, based on comparative analyses. A detailed analysis of the complete genome sequences and comparison with sequenced mycobacteriophages is the subject of the second semester of this yearlong course and is presented.

*This research was supported by the Howard Hughes Medical Institute SEA\_PHAGES program, and the Day1 Program through a grant from the Herbert H. and Grace A. Dow Foundation.*

### The 1-42 Isoform of Amyloid Beta Reduces Cell Viability of *Salmonella enterica*

**Brandon Ellsworth and Aaron O'Meara**  
Mentor: Dr. Gerald Griffin  
Department of Biology

Alzheimer's disease (AD) is the sixth-leading cause of death in the United States. In fact, one out of every eight Americans aged sixty-five and older will develop the disease. One pathological hallmark associated with AD and other forms of dementia is the over-accumulation of the peptide amyloid beta. While amyloid beta is present at low levels in all humans, its function is a source of great debate. The peptide has been shown to reduce the viability of microbes that have invaded the central nervous system. However, this finding has only been demonstrated once so far. The present work tested the hypothesis that amyloid beta exerts antimicrobial activity against *Salmonella enterica* (*S. enterica*), a leading cause of meningitis. After treating *S. enterica* with a range of concentrations (1pM-100pM) of both major isoforms of amyloid beta (1-40 and 1-42), we measured bacterial cell viability with the alamar blue assay. Our results revealed that the 1-42 isoform, but not the 1-40 isoform of amyloid beta, had an effect on bacterial growth. More specifically, administration of 10pM of amyloid beta (1-42 isoform) reduced cell viability over 20 percent (compared to vehicle control;  $F=32.91$ ,  $p<0.0001$ ). This result extends the finding that amyloid beta has an anti-microbial function. Moreover, our results indicate that the 1-42 isoform, enriched in amyloid beta plaques associated with dementia, has unique properties that allow it to reduce the growth of *S. enterica*. Lastly, our data suggest that the peptide can exert antimicrobial effects at a concentration (10pM) lower than that associated with protein misfolding and the plaque formation associated dementia. While ongoing work is being performed to dissect the mechanisms underlying these findings, our data supports the hypothesis that amyloid beta release *in vivo* is prompted by microbial infection of the central nervous system.



## Host Lipids Associated with Genome Replication in Flock House Virus

**Haley Fischman and Kayla Schipper**

Mentor: Dr. Benjamin Kopek  
Department of Biology

Positive-strand RNA [(+)RNA] viruses are significant human pathogens. A universal feature of (+)RNA viruses is that they replicate their genomes in association with host intracellular membranes. This association may be a target for broad spectrum antivirals against (+)RNA viruses. The (+)RNA virus we used for our studies is Flock House virus (FHV). FHV is a simple (+)RNA virus with a 4.5 kb bipartite genome that replicates in insect cells; *Drosophila melanogaster* cells were used in this study. Previous work by others has shown an involvement of specific lipids, including phosphatidylcholine (PC), in FHV genome replication. To extend this work, we performed genetic knockouts of PC biosynthesis genes using Crispr/Cas9 genome editing. Lipid analysis indicated a reduction in total cellular PC content in these cells. Importantly, qPCR data showed a reduction in FHV RNA replication in cells where PC biosynthesis genes were knocked out. Next, we sought to more specifically examine the role of lipids in FHV genome replication by localizing lipids relative to sites of virus replication. We observed no significant enrichment of phosphatidylethanolamine (PE) or phosphatidylserine (PS) near or at sites of FHV replication. We are currently optimizing studies for imaging PC as well as lipid droplets. These initial studies have provided promising data regarding the role of specific lipids in (+)RNA virus replication.

## Nesting Cavity Preference in *Carnegiea gigantea*

**Jennifer Fuller**

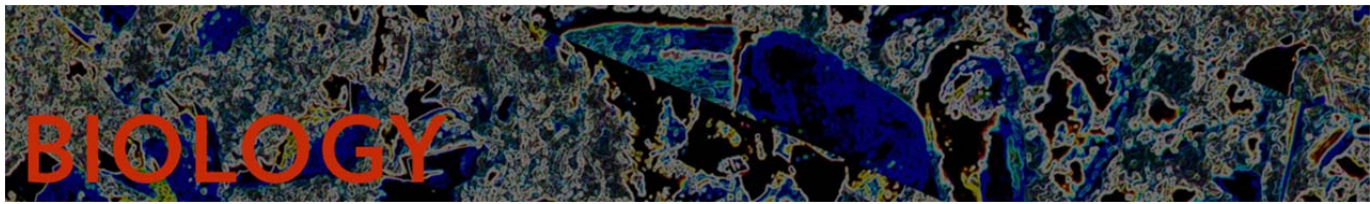
Mentors: Dr. Kathy Winnett-Murray and Dr. K. Greg Murray  
Department of Biology



*Jennifer Fuller, '16 making measurements on Saguaro cacti in the Sonoran Desert during Biology's Arizona May Term 2015.*

Saguaros (*Carnegiea gigantea*) are slow growth, softwood cacti found only within the Sonoran Desert. Because of their pulpy interior and protective spines, they make ideal nesting sites for many bird species. Gila Woodpeckers (*Melanerpes uropygialis*) and Gilded Flickers (*Colaptes chrysoides*) are the only two species that create nesting holes, but several other bird species also inhabit them. I hypothesized that nest height would be higher on taller Saguaros, since at least part of the advantage of nesting in Saguaros lies in avoiding ground-dwelling predators. Assuming that most species nesting in Saguaros rear chicks in the summer months, I hypothesized that nest entrances would face north in order to ensure a cooler nest microclimate. In order to test these hypotheses, I measured elevation, nest height, lowest arm height, total cactus height, number of arms, number of nests, and nest entrance compass direction on 71 Saguaros near Tucson, in southern Arizona. Results indicated that average nest height increased with cactus height, and that nest and cactus height were proportionally related. Sample sizes at different elevations were not large enough to test the correlation between elevation and nest height or direction. There was also no significant preference for nest entrance orientation. Other research suggests that there is a non-random selection of nests at Organ Pipe (north-facing) during summer (rearing) months (Inouye and Huntly et al. 1980). However, a broader study that was not focused on rearing season found that nests were located at random orientations and that birds preferred large saguaros (Kerpez and Smith et al. 1990). Bird preference in nest orientation is likely based on the rearing season and current weather conditions. Both my results and previous studies suggest a preference for higher nest locations in mature saguaros. Therefore, maintaining a population of mature saguaros is critical to nesting bird reproduction in the Sonoran Desert.

*This research was supported by the Hope College and the University of Arizona biology departments.*



## Illustrating Ecology: Artwork for Visualizing Concepts in the General Biology Lab

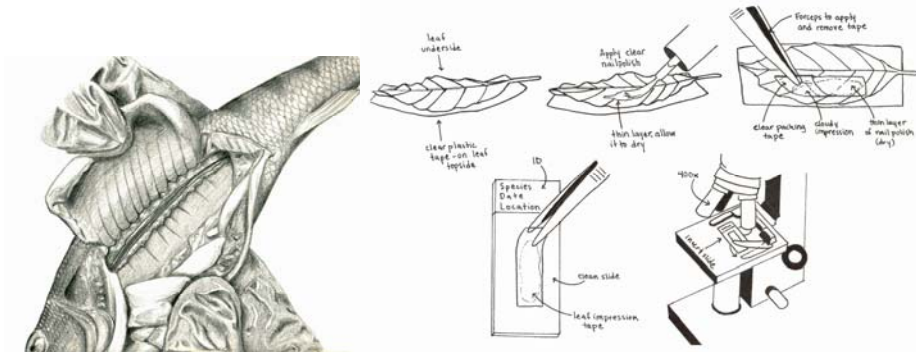
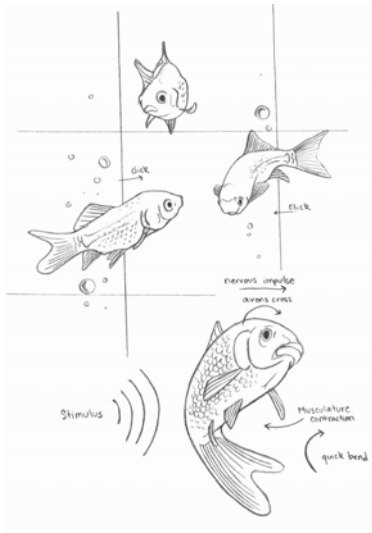
**Jennifer Fuller**

Mentor: Dr. Kathy Winnett-  
Murray

Andrew W. Mellon Scholars and  
Department of Biology

Scientific illustration plays a very important role in science education by providing students, scientists, and the general public with greater scientific understanding through visualization. Illustrations of the natural world have always been and continue to be crucial to society's comprehension of science. Illustrations allow freedom to display concepts and ideas that we cannot fully convey with text. For instance, biological depictions range in scale from 3D models of microbiological structures to large-scale ecosystems. The purpose of this project was to use illustrations to help students visualize biological concepts, prepare them for laboratory procedures, and inspire them to continue in the sciences at Hope College. These illustrations were created for the General Biology Laboratory Handbook (Biology 107) at Hope College. The drawings were created using traditional graphite and ink, and were given a clean finish using Adobe Photoshop®. The illustrations were developed using concepts, descriptions, and directions the handbook provided, and they attempt to convey as many important points or concepts within them in a simple, informative manner. These drawings explain ecological concepts, directions for laboratory procedures, and anatomical features that may be difficult to visualize using only photographs. Some examples include forest succession (ecological concepts), recording and calculating stomatal density (laboratory procedures), and anatomical features in perch and daphnia.

*This project was supported by The Andrew W. Mellon Foundation Scholars Program in the Arts and Humanities at Hope College.*

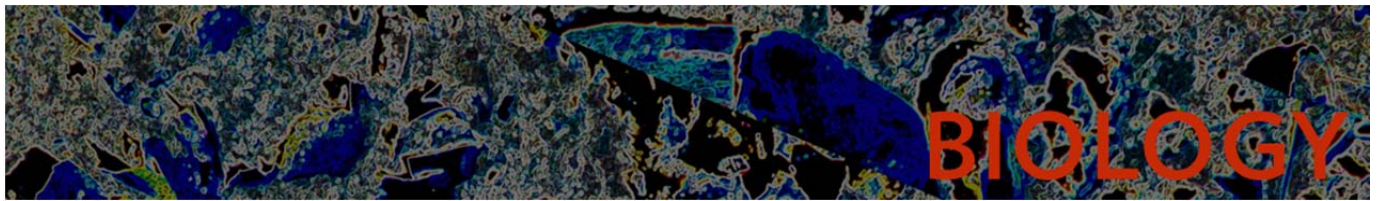


## Effects of Phthalates on Zebrafish Embryonic Development

**Jessica Guillaume and Ryan  
Skowronek**

Mentor: Dr. Tyler Schwend  
Department of Biology

Di(2-ethylhexyl) phthalate (DEHP), benzyl butyl phthalate (BBP), and dibutyl phthalate (DBP), common plasticizers found in many consumer, medical, and building products, are ubiquitous environmental toxicants. Routine exposure to phthalates is unavoidable, posing a significant health threat to humans and animals. Recent epidemiological studies suggest a causal relationship between early-life phthalate exposure and neurobehavioral deficits, thus raising concerns about the potential toxic effects of phthalates during early development. The objective of our research is to utilize the zebrafish embryo as a model system to identify the developmental consequences of phthalate exposure. The aim of our current study is to determine the effects of developmental phthalate exposure on larval teratology at the phenotypic level (hatch-rate, touch response, mortality and structural malformations to the brain, spine, or craniofacial regions). To date, BBP and DBP have proven lethal at high concentrations, while DEHP had no effect on mortality. Exposure to sublethal levels of BBP and DBP resulted in developmental defects, which will be further investigated through craniofacial staining and characterization of structural malfunctions.



### Toward Understanding Keratan Sulfate Biosynthesis in the Chick Embryonic Cornea

**Kimberly Hodgson and  
Katherine Supanich**  
Mentor: Dr. Tyler Schwend  
Department of Biology

The cornea, the most densely innervated tissue on the surface of the body, becomes innervated by sensory trigeminal nerves in a highly coordinated fashion. In the embryonic chicken eye, trigeminal growth cones arrive at the corneal periphery on the fifth day of embryonic development (E5). The nerves then form a ring around the cornea; the cornea does not become permissive to nerve growth until E10. Upon entering the cornea at E10-11, trigeminal axons are restricted to the anterior half of the corneal stroma and defasciculate extensively from the main nerve bundles. The mechanisms behind the precise control of these growth cone guidance cues remain unclear. It is known that extracellular matrix glycosaminoglycans (ECM-GAGs) polymerize in developing eyefronts. The purpose of this study was to determine if keratan sulfate (KS), an ECM-GAG, may provide guidance cues to nerves during cornea innervation. Immunostaining using antineuron-specific- $\beta$ -tubulin and monoclonal antibodies for KS was performed on embryonic chicken eyefronts from E9 to E14 and staining was visualized by fluorescence microscopy.

### Loline Biosynthesis Gene Expression by *Epichloë* Fungi Grown under *In Vivo* and *In Vitro* Conditions

**Sarah Faith Kim**  
Mentor: Dr. Thomas Bultman  
Department of Biology

*This project was supported by  
the National Science Foundation  
under NSF-IOS #1119775.*

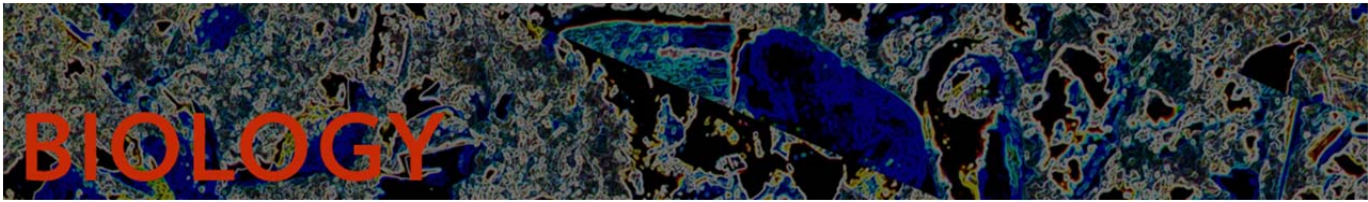
It is known that the fungus, *Epichloë coenophiala*, produces alkaloids, such as lolines, in response to physical damage to its host. I explored presence of the lol-cluster genes (Lol A<sub>1</sub>, A<sub>2</sub>, C<sub>2</sub>, D<sub>2</sub>, E<sub>2</sub>, F<sub>2</sub>, O<sub>2</sub>, T<sub>2</sub>, P<sub>2</sub>, U<sub>2</sub>) in cultured *Epichloë* isolates and the inducibility of lol cluster gene expression within Tall Fescue grass (*Schedonorus arundinaceus*). Isolated cultures of the fungus were procured from Rutgers University and University of Kentucky (UK); additionally, cultures were isolated at Hope College (HC) to be used in the on-site study. RNA was extracted using the Quiagen RNeasy kit following the manufacturer's protocol. Samples were analyzed using qPCR, to test for expression of specific lol-cluster genes, as well as  $\beta$ -tubulin as a control. Previous studies had only looked for the expression of Lol C *in vitro*, and had not shown positive results. Ours is the first study to show expression *in vitro* of lol-cluster genes. Lol A<sub>2</sub>, E<sub>2</sub> and T<sub>2</sub> expressed in samples from HC and UK cultures as well as samples drawn *in vivo* from Tall Fescue grass. Samples from Tall Fescue were collected before it was physically damaged, and then again one week after physical damage. The *in vivo* Tall Fescue grass samples indicated the inducibility of A<sub>2</sub> and O<sub>2</sub> (up regulation) and E<sub>2</sub> and T<sub>2</sub> (down regulation). These indications of inducibility merit further study as lolines can influence preference and performance of herbivores of Tall Fescue.

### Wildlife Use Patterns in a Constructed Wetland

**Courtney Lohman, Katherine  
Pniewski, Alexandria  
Wubben, and Gracie Curtis**  
Mentors: Dr. Kathy Winnett-  
Murray and Dr. K. Greg Murray  
Department of Biology

*This research was supported by  
the Outdoor Discovery Center in  
Holland, MI and by the Hope  
College Biology Department.*

Wildlife land use patterns were monitored from January 2015 through April 2016 at ten sites near the West Michigan Regional Airport before, during, and after conversion of agricultural land to a mitigation wetland by the Outdoor Discovery Center/Macatawa Greenway. Due to concerns about potential collisions between aircraft and wildlife attracted to the restored wetland, point count surveys and trail cameras are being used to track changes in bird and mammal abundance in various habitats around the airport. Based on published studies of hazards to aircraft, animals were grouped into four impact categories: deer, high impact animals, low impact animals, and small mammals. Changes in animal abundance were compared among sites representing open water, the restoration construction site, existing wet meadow, and airport property while correcting for extreme seasonal variation. Sites with open water were found to have higher abundance of animals than either the wetland construction site or the airport property. Overall, there were significant differences in abundance among the different sites for both high impact animals and small mammals, but these differences are generally overwhelmed by seasonal variation. The existing wet



### Elucidating the Anti-Tumor Mechanisms of Naturally Derived Capsaicin

**Nicole Meyer and Samantha Moffat**

Mentor: Dr. Gerald Griffin  
Department of Biology

meadow site showed high variation in abundance of animals in all four impact categories, but generally those abundances were not significantly different from wildlife abundance in the other monitored habitats. Wildlife monitoring is expected to continue for the next two years to enable documentation of post-restoration changes, as well as to establish baseline data on the seasonality of wildlife use at all sites.

Studies have suggested that capsaicin, the compound responsible for the heat sensation when eating chili peppers, possesses anti-cancer effects. More specifically, recent *in vitro* results demonstrate that capsaicin extracted from organically grown *Capsicum chinense* (commonly known as the yellow lantern chili), prompts cell death of neuroblastoma cells. Neuroblastoma is a pediatric cancer. Conventional treatment options require the use of agents that could affect brain and reproductive tract development. To determine the mechanism of action of naturally derived capsaicin on inducing the death of this tumor, we treated neuroblastoma SH-SY5Y cells with naturally derived capsaicin. Next, we utilized Western blotting to determine levels of proteins that regulate apoptosis (caspase-8, caspase-9 and bcl-2) after incubating cells with capsaicin. While our research is ongoing, this work will corroborate and extend previous findings demonstrating the anti-tumor effects of capsaicin extracted from organic peppers and elucidate mechanisms for these effects. The results of this work will highlight how capsaicin may be best used for treating the pediatric cancer neuroblastoma.

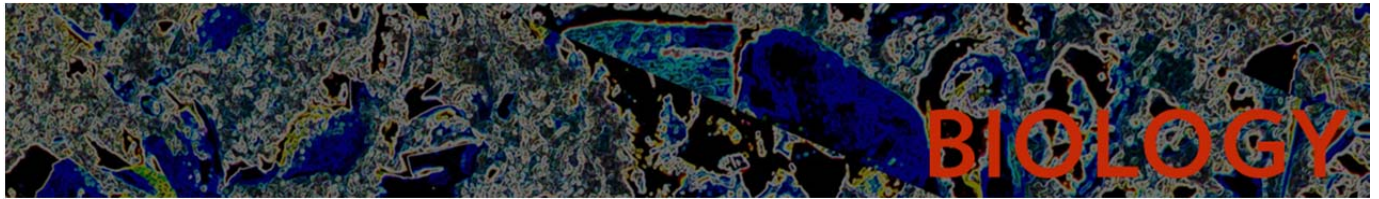
### The Effects of a Junk Food Diet on the Prefrontal Cortex: Behavioral and Protein Analyses

**Kaleigh Mullen, Spencer Morgan, and Zachary Dreyer**

Mentor: Dr. Peter Vollbrecht  
Department of Biology

Obesity is a growing epidemic with over one third of the U.S. adult population being obese. While homeostatic mechanisms play a role in obesity, it is becoming clear that overconsumption is often influenced by areas of the brain involved in reward and executive functions, such as working memory, decision-making and inhibitory control. The prefrontal cortex (PFC) is central to these functions and integrates information from multiple brain areas involved in processing interactions with food. PFC circuitry has been shown to influence self-control mechanisms in response to hedonic feeding, the drive to obtain reward beyond homeostatic need through eating. Impaired functioning of the PFC leads to deficits in executive control, including working memory. We hypothesize that consumption of a “junk-food” diet will disrupt PFC pathways involved in hedonic feeding. To examine the effects of a junk-food diet on the PFC, we utilized Sprague-Dawley rats to perform behavioral and protein analyses. Following a high fat diet, rats underwent working memory tests including spontaneous alternation and the Morris Water Maze. Western blotting was conducted on PFC tissue to examine the protein expression levels of mGluR2/3, CRF-1 receptor, and BDNF. Activation of mGluR2/3 increases the extracellular levels and turnover of dopamine in the PFC, leading to neuroadaptations in reward processing and executive control. CRF-1 receptors play a role in stress response and the regulation of food intake and are found in considerable concentrations in the PFC. Through thermogenic and appetite-reducing mechanisms, the downstream effects of CRF-1 receptors have been shown to contribute to weight and fat loss. BDNF attenuates changes in synaptic plasticity to restore learning and memory impairments induced by a high-fat diet. Protein levels and behavioral analysis of junk-food effects will direct further research in the mechanisms involved in the onset and development of obesity and its effects on PFC function.





## Investigating Mycobacteriophage-Host Protein Interactions

**Andrew Neevel, Gloria Chang, Morgan Cinader, and Adam Krahn**

Mentors: Dr. Joseph Stukey and Dr. Virginia McDonough  
Department of Biology

Mycobacteriophages are viruses that infect bacterial cells of the genus *Mycobacterium*. They possess a multitude of unfamiliar or novel genes – genes encoding protein sequences that do not resemble any previously studied proteins – and thus encode products with functions not readily predicted. We hypothesized that some of those genes encode products that interfere with the normal metabolism of the host cell, possibly through specific phage-host protein-protein interactions, and thus have a role in enabling phage infection. Further, we predicted that those gene products when expressed alone in host cells would still be toxic and impair cell growth. We have investigated unfamiliar genes in two genetically distinct mycobacteriophages, Pumpkin and Vix, and have identified 4 single genes (Pumpkin\_115, Pumpkin\_119, Pumpkin\_142, Vix\_80) and several small genomic regions (Pumpkin gene segment 130-133 and Vix gene segments 65-66, 68-72, 87-88) that are cytotoxic to *M. smegmatis*. We are taking a multi-prong approach to further identify the specific functions associated with these genes and their products and to determine their roles in the infection process: 1) we have identified mutants of *M. smegmatis* that are resistant to the expression of those genes, 2) we are using *E. coli*-expressed phage genes to screen for interacting host proteins, 3) we are collecting microscopy data that could identify phage interruption of normal cellular function, and 4) we are in the process of deleting these genes from the phage genome to determine the effect on infection. 24-hour expression of individual cytotoxic phage genes in *M. smegmatis* resulted in a significant increase in mean host cell length and some subtle effects on cell shape. Ongoing analysis of the mutants has identified a common mechanism of resistance to distinct phage gene expression, while protein-protein interaction studies have not yet identified a potential host target involved in translation.

## Incidence of Infection of *Wolbachia* Bacteria in *Botanophila* Flies

**Lydia Pagel**

Mentor: Dr. Thomas Bultman  
Department of Biology

*This research was supported by the National Science Foundation award NSF-IOS #1119775.*

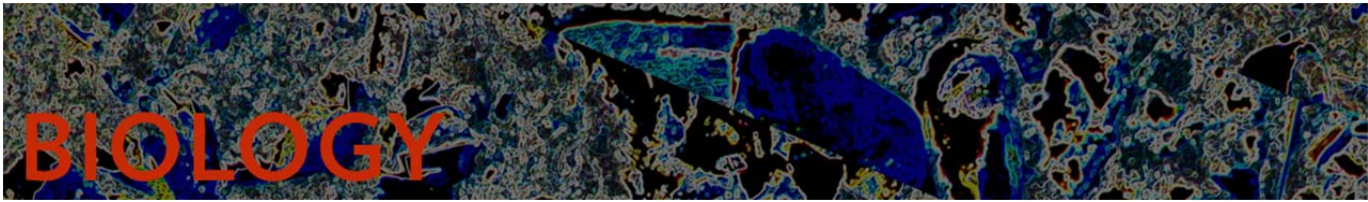
*Botanophila* flies are thought to be pollinating predators of the sexual forms of endophytic fungi in the genus *Epichloë*. When flies visit the fruiting bodies of the fungus, they oviposit on the surface of the stroma, then feed, and defecate along the whole length of the stroma. The spermatia pass through the gut of the fly unharmed and fertilize the next stroma of the opposite mating type that the fly lands on to oviposit, feed, and defecate. In this study, I screened samples of *Botanophila* fly larvae from the USA and Europe for the presence of the sexual parasite, *Wolbachia*, which could lead to dramatic alterations of the sex ratios and fertility rates in fly populations when present. I found a 50% overall infection rate (12 out of 24 samples were infected); however, a majority of these were from one site in the USA (9 out of 12 samples from the USA were infected). Should this infection be prevalent in an area, it may have wide reaching effects on both the fly populations and the *Epichloë* fungus that the flies cross-fertilize, as well as the grass hosts of *Epichloë*.

## Activation of Stress Response Pathways of *C. elegans* by Multiple Types of Stress

**Claire E. Schaar**

Mentor: Dr. Jeremy M. Van Raamsdonk  
Laboratory of Aging and

The mechanism by which organisms age is largely unknown, but many studies suggest that ageing is related to stress. In order to understand the relationship between stress and ageing, we studied the mechanisms by which organisms respond to different stressors. In *C. elegans*, the activation of stress response pathways can be easily observed through the use of fluorescent reporters. Here, we used a series of fluorescent reporter strains to determine which types of stress can activate each different stress response pathway, and to define the optimal stress conditions for maximum activation of each reporter strain. We examined the following stress reporter pathways: the heat shock response/cytoplasmic unfolded



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Institute

*This research was supported by  
the Frederik and Lena Meijer  
Summer Internship Program  
and the Van Andel Research  
Institute.*

### Transcriptional Regulation of *OLE1* expression in *Saccharomyces cerevisiae* is Dependent on Fatty Acid Species

**Clara Schriemer**  
Mentor: Dr. Virginia  
McDonough  
Department of Biology

*This research was supported by  
NSF-REU DBI-0754293.*

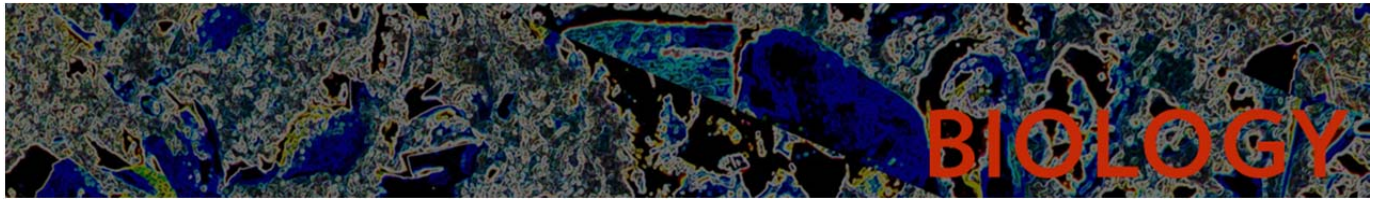
### Testing Antiviral Capabilities of Captopril in *Mus musculus*

**Kristina Skinner and  
Nicholas Rozema**  
Mentor: Dr. Gerald Griffin  
Department of Biology

protein response (*Phsp-16.2::GFP*), mitochondrial unfolded protein response (*Phsp-6::GFP*), endoplasmic reticulum unfolded protein response (*Phsp-4::GFP*), the SKN-1 mediated oxidative stress response (*Pgst-4::GFP*, *Pgcs-1::GFP*), hypoxia response (*Pnhr-57::GFP*), and the DAF-16 mediated stress response (*Pdaf-16::daf-16::GFP*, *Psod-3::GFP*). Each of these fluorescent reporter strains was then exposed to eight different types of stress: heat stress, cold stress, osmotic stress, anoxia, oxidative stress, starvation, endoplasmic reticulum stress, and bacterial pathogenic stress. We found that all of the stress response pathways are activated by multiple types of stress with the exception of the mitoUPR. Similarly, most types of stress activated multiple stress response pathways. These data have subsequently been used to study how the ability to respond to stress changes as organisms age.

The *OLE1* gene in *Saccharomyces cerevisiae* encodes the  $\Delta 9$  desaturase, which inserts a double bond in saturated fatty acids to create unsaturated fatty acids (UFAs). *OLE1* expression is controlled in part through the transcriptional regulators *Mga2p* and *Spt23p* in response to supply of UFAs. We investigated whether the regulation was consistent in response to varied UFA type and concentration. We found that in wild type cells, reporter gene assays show a stronger decrease in expression of *OLE1* when fed 16:1 $\Delta 9$  or 18:2 $\Delta 9$ , 12 as opposed to 18:1 $\Delta 9$  or 17:1 $\Delta 10$ . Concentration of the fed fatty acid also impacted the regulation of *OLE1* with higher levels of each UFA impacting expression to a greater degree. Fatty acid profiles of wild type cells show cells accumulate a higher concentration of 16:1 $\Delta 9$  and 18:2 $\Delta 9$ , 12 than fed 18:1 $\Delta 9$  or 17:1 $\Delta 10$ . This leads to the conclusion that the expression of *OLE1* is dependent both on properties of fed fatty acids and the amount in the cell. While our initial hypothesis was that *OLE1* is regulated in response to membrane fluidity, subsequent work does not support that idea. Conditions that would affect membrane fluidity (besides UFA species and amount), such as growth temperature and saturated or trans fatty acid supplementation do not regulate *OLE1* in the direction predicted by fluidity changes. Recently our lab has isolated a mutant that is deficient in regulation of *OLE1*, called *NRO2* (no regulation of *OLE1*). The signaling mechanism for the *NRO2* protein's action is unknown. Tests using the *OLE1* promoter-reporter gene constructs suggest that *NRO2p* responds more strongly to the fatty acids 16:1 $\Delta 9$  and 18:2 $\Delta 9$ , 12, than 18:1 $\Delta 9$  and 17:1 $\Delta 10$ . Efforts are currently underway to clone and identify *NRO2*.

Existing treatments for Herpes Simplex Virus Type I (HSV-1) have negative effects including nephrotoxicity and increasing rates of drug resistance. The use of Captopril against the Herpes Simplex Virus-1 (HSV-1) provides a possible alternative to other drugs, such as losartan, that produce these negative effects. Captopril is an ACE inhibitor used to treat hypertension or high blood pressure. This project tests the hypothesis that captopril will decrease HSV-1 replication and virulence *in vivo*. Four groups of C57/BL6 female mice were used in this study. Group 1 received a vehicle control with a mock virus. Group 2 received captopril with a mock virus. Group 3 received vehicle control with  $10^6$  plaque-forming units of the F strain of HSV-1. Group 4 received captopril with the HSV-1 virus (same titer and strain as Group 3). Mice were infected with the HSV-1 virus via corneal scarification 24 hours after captopril or vehicle treatment began. Treatment with captopril was administered via drinking water at 1.25mg/mL for a



total of six days. Pathological analysis and viral gene expression level analysis is ongoing. This work builds upon preliminary *in vitro* data demonstrating that captopril protects cells from HSV-1 cytopathic effects. Thus, the goal of this work is promising to validate these *in vitro* results and highlight a novel use for captopril in animals.

### Examining the Effects of Keratan Sulfate on Trigeminal Nerve Growth

**Adam Standiford**

Mentor: Dr. Tyler Schwend  
Department of Biology

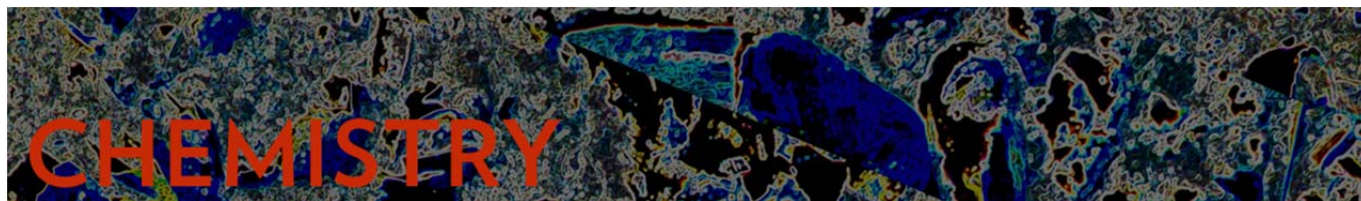
The cornea is the most densely innervated tissue on the surface of the body. Unfortunately, corneal nerve loss is common following corrective surgeries, such as LASIK, and is associated with many corneal diseases. Inexplicably, damaged corneal nerves are slow to repair or fail to do so, resulting in a significant disease burden ranging from dry eye to ocular blindness. Despite their importance in maintaining eye health and vision throughout our lifetime, our understanding of how nerves innervate the developing cornea is fragmentary. Our research aims to identify the molecular factors and underlying mechanisms involved in cornea innervation in hopes of gaining insight into potential therapeutic targets for repairing damaged corneal nerves. Increasing levels of the extracellular sugar molecule keratan sulfate (KS) in the cornea coincides with the time during development that nerves begin to innervate the cornea. This has prompted us to examine whether KS influences cornea innervation. Using *in vitro* methods, we have set out to examine whether corneal KS, derived from bovine eyes, can regulate cellular behaviors of embryonic chick trigeminal ganglion neurons (the source of corneal nerves). Our work will shed insight into the potential regulatory relationship between corneal KS and trigeminal nerves during cornea innervation.

### Endophytic Fungi in *Elymus canadensis* Affects Insect Abundance and Reduces Plant Damage from Sucking Insects

**Carter Wolff and Santiago Rios**

Mentor: Dr. Thomas Bultman  
Department of Biology

Endophytes are microbial species, often bacteria or fungi, which live within a plant asymptotically. Some fungal endophytes have developed a symbiotic relationship with cool-season grasses. It has been suggested that these symbiotic fungi act in a defensive mutualism with their host grasses. Endophytes can produce alkaloids that deter various types of herbivores. We examined the effect these endophytic fungi have on insect abundance, insect herbivory, and plant growth in Canada Wild Rye (*Elymus canadensis*), a native grass of North America. Grasses that were naturally uninfected, naturally infected with *Epichloë canadensis*, and artificially disinfected were studied in outdoor and laboratory trials. Bird-cherry Oat Aphids (*Rhopalosiphum padi*) were used as a bioassay. Our field experiment showed that endophyte infection resulted in a reduction in plant damage due to sucking insects. Our laboratory experiment corroborated this result, showing fewer apterous aphids on grasses with endophyte presence.



## Fast Colorimetric Titration of Boron Tribromide Using *N,N*-Dimethylaniline

**Brianna N. Barbu**

Mentor: Dr. Jason G. Gillmore  
Department of Chemistry

*This work was supported by the National Science Foundation under CAREER Grant CHE-0952768, by the Camille & Henry Dreyfus Foundation, by a Henry Dreyfus Teacher-Scholar award, and by a Schaap Research Fellowship from Hope College.*

A large number of organic transformations are either initiated or catalyzed by boron tribromide ( $\text{BBr}_3$ ), and correct stoichiometric addition to these reactions is often crucial to their success. Few procedures for the quantification of  $\text{BBr}_3$  concentration currently exist, so there is a need to develop additional reliable methodologies. Here we report that *N,N*-dimethylaniline (DMA) has been identified as a colorimetric titrant for accurately determining the concentration of  $\text{BBr}_3$  in solution. Our protocol is fast, direct, and works for a range of  $\text{BBr}_3$  concentrations. An initial Lewis acid-base reaction between the nitrogen and boron centers forms a blue complex. At the equivalence point, additional catalytic  $\text{BBr}_3$  initiates an electrophilic aromatic substitution reaction which results in a loss of the B-N coordination and causes an instantaneous color change from blue to yellow, giving an easy-to-identify endpoint.

## The Effect of Directing Groups on the Rate of Rhodium-Catalyzed Decarbonylation Reactions

**Sarah Bettag, Yubing Mao, and Cameron Pratt**

Mentor: Dr. Jeffrey Johnson  
Department of Chemistry

Carbon-carbon bonds are difficult to activate due to the lack of flexibility of the sigma bonds and steric hindrance which contribute to the stability of the bond. However, the addition of a rhodium catalyst allows for decarbonylation of aryl ketones via carbon-carbon single bond activation. The decarbonylation process is essential to determine the effectiveness of the directing group. Herein, we describe the synthetic pathways for the starting materials, as well as the effects of various nitrogen containing directing groups on the rate of decarbonylation.

*This research was supported by the National Science Foundation and the Schaap Research Fellowship from Hope College and the Smallegan Undergraduate Chemistry Research Fund.*

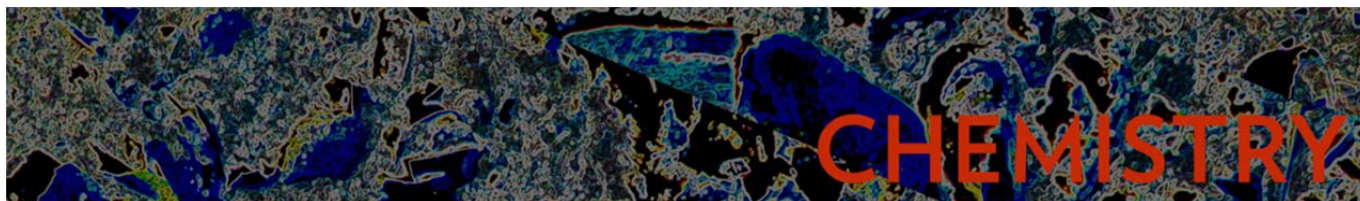
## Parameterizing Fluorescent Protein Chromophores For Molecular Dynamics Simulations

**Dalton Blood and Andreana Rosnik**

Mentor: Dr. Brent Krueger  
Department of Chemistry

*This work is supported by the NSF-MRI under grant No. CHE-1039925 and the NSF-RUI award No. CHE-1058981.*

Fluorescent proteins (FPs) are important to many studies of protein function, and we plan to examine them in the future using molecular dynamics (MD) simulations. Before running MD, fluorescent protein chromophore parameters must be determined that are consistent with the latest version of the Cornell et al. force field (1995, *J. Am. Chem. Soc.*), ffl4SB (Maier et al., 2015, *JTCC.*) along with the generalized AMBER force field (Wang et al., 2004, *J. Comput Chem.*). Parameterization was carried out using quantum mechanical calculations to determine the optimized geometry and electrostatic potential of each chromophore. The restrained electrostatic potential (RESP) charge fitting procedure was used to derive atomic charges. All other parameters (Lennard-Jones, Bond length, Bond Angle, Dihedral Angles) were assigned by analogy to pre-existing force field parameters. Complete MD parameters are presented for the chromophores of six common FPs: EGFP, mCherry, DsRed, EBFP, EYFP, and ECFP.



### Distributed Leadership: Understanding Leadership in Communities of Practice

**Matthew Commet**

Mentor: Dr. Joanne Stewart  
Department of Chemistry

*This research was supported by the  
Hope College Chemistry Department.*

Distributed Leadership (DL) is an emerging model of leadership that focuses on the interactions between leaders in an organization rather than the individual actions of one leader. Contrary to traditional hierarchical leadership models, DL is a collaborative process that engages multiple people with different expertise through trust, respect, and support, to grow the leadership capacity of an organization. We are using a DL framework to study the leadership in an established faculty community of practice: IONiC (Interactive Online Network of Inorganic Chemists). IONiC has been shown to be effective in helping faculty improve their teaching and grow their professional support networks. We believe that studying the leadership in IONiC will provide a needed case study on DL and provide guidance for other communities of practice in higher education. A literature review on distributed leadership was used to develop a survey given to members of the Leadership Council (LC) of IONiC. Preliminary findings from interviews of LC members and analysis of LC interactions on IONiC's website confirm the effectiveness of engaging leaders with different expertise in collaborative decision making and the importance of trust among leaders in a distributed leadership network.

### Elucidating the Mechanism and Expanding the Scope of Organometallic Nucleophiles Utilized in the Nickel- Mediated Decarbonylative Cross-Coupling of Substituted Phthalimides

**Kimberly DeGlopper, Mason Yoder,  
Kyle Lindberg, and Megan  
Kwiatkowski**

Mentor: Dr. Jeffrey Johnson  
Department of Chemistry

A new method for synthesizing *ortho*-substituted benzamides has been developed through the nickel-mediated decarbonylative cross-coupling of substituted phthalimides with diorganozinc reagents. This reaction demonstrates broad substrate scope, including various phthalimides and diorganozinc reagents, with yields up to 96%. However, it requires a stoichiometric equivalent of nickel, which limits its application in synthesis. Efforts to promote catalysis include altering the phthalimide substituent and understanding the mechanism of the reaction using *in situ* IR and NMR. Recent work has also focused on expanding the scope of nucleophiles to include boronic acids, which are safer and more commercially available than diorganozinc reagents.

*This research was funded by the National Science Foundation and Herbert H. and Grace A. Dow Foundation.*

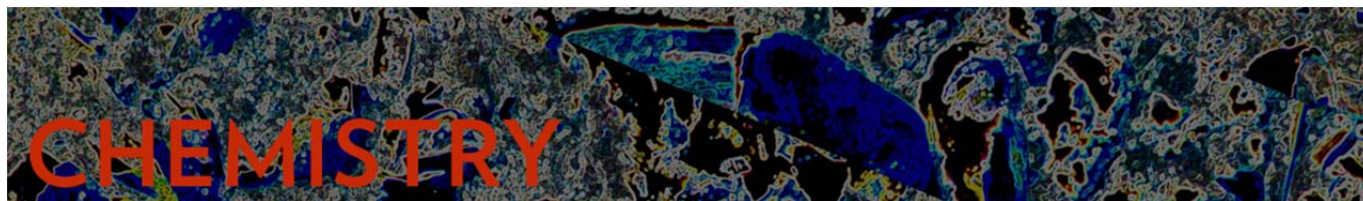
### Monovalent Ion Parameterisation for the Optimal Point Charge (OPC) Water Model

**John Dood**

Mentor: Dr. Brent Krueger  
Department of Chemistry

*This work is supported by the NSF-MRI  
under grant No. CHE-1039925 and the  
NSF-RUI award No. CHE-1058981.*

Molecular dynamics (MD) simulations are used to model the structure and movement of macromolecules. The gold standard for MD is to explicitly include water molecules using one of several standard models. Recently, a new water model, Optimal Point Charge (OPC), has been developed with simulation performance that compares better to experiment than existing models in its class (Izadi, Anandakrishnan, Onufriev, J. Phys. Chem. Lett., 2014, 5, 3863-3871). For this new water model to be useful, Lennard-Jones (LJ) parameters must be developed for at least a few monovalent ions. In this study MD simulations were used to develop these parameters. Results are presented including: extensive convergence testing of Hydration Free Energies ( $\Delta G_{\text{hyd}}$ ), Lattice Constants (LC), and first peak positions of radial distribution functions (RDF's); as well as preliminary LJ parameters for six monovalent ions.



### Incorporation of Boronic Acids in Cross-Coupling Reactions Proceeding through C-C Activation

**Stanna Dorn, Chad Compagner, Joseph Dennis, and Connor McNeely**

Mentor: Dr. Jeffrey Johnson  
Department of Chemistry

Carbon-carbon single bonds can be difficult to activate due to their nonpolar and covalent nature. In recent years, the use of appropriate directing groups and transition metal catalysts has led to the activation and functionalization of carbon-carbon single bonds. Using quinolinyl ketones, our group has demonstrated the successful rhodium-catalyzed exchange of ketone substitution with alkyl and aryl boronic acids. The reaction proceeds in good to excellent yields with a broad range of functionality on both the quinolinyl ketones and the boronic acids.

*This research was supported by the National Science Foundation.*

### Communities of Practice: Improving Chemistry Teaching through Online Collaboration

**Anna Dowd**

Mentor: Dr. Joanne Stewart  
Department of Chemistry

*This research was supported by the National Science Foundation REU program (MPS/CHE 1263097).*

The Interactive Online Network of Inorganic Chemists (IONiC) is an international faculty community of practice whose goal is to improve teaching and learning in chemistry in higher education. One of the group's strategies is to shift the private nature of teaching to a more public one through building supportive relationships and sharing content and practices online. The IONiC community has had a significant impact on its faculty participants. Data from a community survey, interviews with participants, and an analysis of participation rates show that 1) faculty participants change both their teaching content and methods after participating in the community, 2) faculty feel supported by the community and have a desire to "give back" in ways that support IONiC's mission, and 3) faculty are able to "give back" through a changing array of community activities.

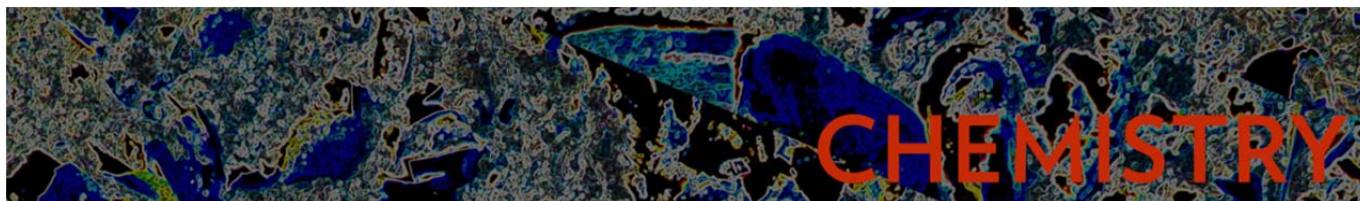
### Design and Evaluation of Day1 Peer Partnership Learning Course Materials for General Chemistry and General Biology

**Elizabeth Ensink and Morgan Ricker**

Mentors: Dr. Justin Shorb, Professor Carrie Dummer, and Professor Vanessa Muilenburg  
Departments of Chemistry and Biology

*This research was supported by the Day1 Program and the Herbert H. and Grace A. Dow Foundation.*

First-year college students encounter a multitude of obstacles ranging from acclimating to living away from home to adapting to a higher level of course rigor. In Fall 2015, Hope College launched "Day1 Research Communities", a program designed to promote retention and performance of first year students in STEM fields through interdisciplinary research projects. In addition to shared residence halls and coursework, students enrolled in Day1 participate in Peer Partnership Learning (PPL) activities on a weekly basis. PPL Leaders attend all lectures for a given section and lead one or two PPL sessions per week for approximately 10 students. The design for these sessions has been built from a literature review of best practices for problem solving in STEM fields, the information processing model of learning, social cognitive theory, and integrated learning of study skills. Worksheets for the first semester of introductory biology and chemistry have been created in partnership with lecture professors in order to train this first generation of PPL Leaders and promote collaborative learning. Goals for their implementation, a template for their generation, and a plan for evaluation will be presented.



### Aggregation of A $\beta$ (12-28) in the Presence of Ru<sub>3</sub>O clusters

**Morgan Glover**

Mentor: Dr. Amanda Eckermann  
Department of Chemistry

Alzheimer's disease (AD) is a neurodegenerative disease that affects more than 5 million Americans, and is currently the 6<sup>th</sup> leading cause of death in the United States. The A $\beta$ (1-42) protein is implicated in memory loss and degeneration of the brain in AD patients. The misfolding of the fragment A $\beta$ (12-28) is often studied to give insight into misfolding of the parent sequence, A $\beta$ (1-42). This fragment contains the hydrophobic KLVFFA section and the His residues, both of which are implicated in aggregation. A growing body of work shows that metal complexes with hydrophobic ligands are able to influence aggregation of A $\beta$ (1-42). We have prepared a library of hydrophobic Ru<sub>3</sub>O(OAc)<sub>6</sub>(L<sub>3</sub>)<sup>+/o</sup> complexes where L = 4-phenylpyridine, pyridine, 4-dimethylaminopyridine, and isoquinoline. We are using label-free assays as well as fluorescent thioflavin T aggregation assays to investigate the effects of these Ru<sub>3</sub>O complexes on aggregation of A $\beta$ (12-28).

### Carbon-Carbon Single Bond Activation Used for Coupling with Michael Acceptors

**Caroline Gregerson, Kathryn Trentadue, and Christian Otteman**

Mentor: Dr. Jeffrey Johnson  
Department of Chemistry

Intramolecular alkene carboacylation has previously been achieved under rhodium catalysis using quinolinyl ketones. Utilizing insight gained from mechanistic studies, new quinolinyl ketone substrates have been prepared and subjected to rhodium catalysis in the presence of an exogenous alkene. This project provides an overview of the development of a new transition metal catalyzed reaction that yields an unexpected product—rather than the anticipated reaction sequence, substrates undergo carbon-carbon bond activation, and Heck-type reactivity is observed via oxidative nucleophilic addition to various Michael acceptors. The reaction proceeds in good to excellent yield with a broad range of functionality on both substrates.

*This research was supported by the John R. Soeter Student/Faculty Research Fund, the National Science Foundation, and the Schaap Research Fellowship from Hope College.*

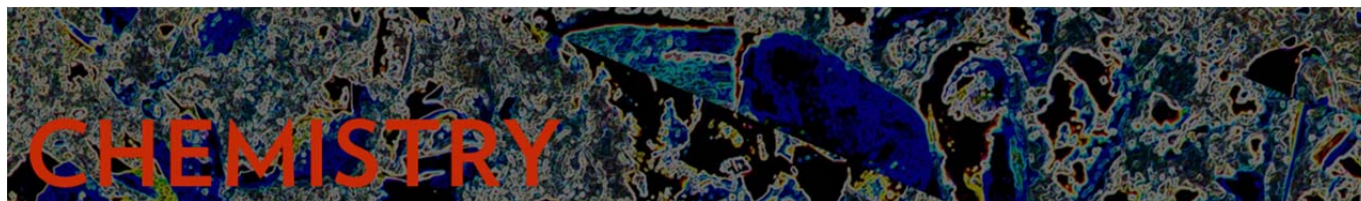
### Application of Ribosomal PCR Probes to Detect Human-Origin *E. coli* Locally and Across the State

**Alexis Guttilla, Kathryn Lee, and Molly Gritt**

Mentor: Dr. Michael Pikaart  
Department of Chemistry

For the past several years, Lake Macatawa has exhibited unusually high levels of *Escherichia coli*, which is a fecal indicator bacterium associated with the presence of other potentially pathogenic microorganisms. This project aims to characterize and identify the sources of *E. coli* in the Lake Macatawa Watershed in order to improve the water quality of Lake Macatawa. Water samples were obtained from 10 different locations throughout the watershed. IDEXX Quanti-trays<sup>®</sup>, mTEC agar plates, and real-time PCR were used to calculate *E. coli* concentrations, and Biolog GN2 MicroPlates<sup>™</sup> were used to characterize isolated strains. Bacterial colonies were isolated from human stool samples in order to investigate human fecal matter as a possible source of contamination in Lake Macatawa. In addition, Hope College is one of several labs that have been testing a new real-time PCR-based method for monitoring water quality at beaches throughout the state of Michigan. Initial data suggest that this method produces variable results due to high levels of inhibition. In the future, increased understanding of the microbial contamination in the Lake Macatawa Watershed and Lake Michigan will lead to cleaner waters for recreational use.

*This research was supported by the Robert J. Motzer '77 Chemistry Undergraduate Research Fund.*



## Preparing for Harvesting Rare Isotopes at FRIB: Production and Separation of Vanadium-48

### Boone Marois

Mentors: Dr. Aranh Pen<sup>1</sup>, Dr. Graham Peaslee<sup>1</sup>, and Dr. Suzanne Lapi<sup>2</sup>

<sup>1</sup>Hope College Department of Chemistry, <sup>2</sup>Washington University School of Medicine, St. Louis

*This research was supported by the United States Department of Energy Office of Science Grant DE-SC0007352.*

The Facility for Rare Isotope Beams (FRIB) will be a new national user facility for nuclear science. FRIB will generate many long-lived radioisotopes, by-products of heavy-ion fragmentation, not currently available or for which no reliable source exists. These isotopes could be synergistically harvested without interference to the primary user. Potential applications of these isotopes include nuclear medicine, stockpile stewardship, and environmental tracers. One radioisotope, <sup>48</sup>V, was selected from a list of priority isotopes with potential to be harvested at FRIB. <sup>48</sup>V ( $t_{1/2}=16$  days) is of interest as a positron emission tomography (PET) isotope and radiotracer. The National Superconducting Cyclotron Laboratory (NSCL) located at Michigan State University was chosen as the experimental site for its ability to best simulate conditions at FRIB for production and collection of <sup>48</sup>V. In preparation for an experiment at the NSCL in the fall of 2016, a successful separation method was developed at the Washington University School of Medicine in St. Louis. Washington University was an ideal location because they have an on-site low-energy cyclotron and the facilities to work with radioisotopes. <sup>48</sup>V was successfully separated from all potential metal contaminants (with the exception of silicon) by Cation-Exchange Chromatography with a conditioned DOWEX 50W-X8 100-200 Mesh resin. More than 90% of the <sup>48</sup>V could be eluted with 10 mL of 0.01 M sulfuric acid containing 1% H<sub>2</sub>O<sub>2</sub>. Silicon also partially elutes in this 10 mL fraction while the rest of the metals can be removed from the column using a stronger acid, such as 6 M HCl. Further research is being done to optimize <sup>48</sup>V separation and to investigate the silicon contamination.

## A Framework for General Chemistry and Biology Laboratory Design and Evaluation

### Sarah Mattioli and Elizabeth Ensink

Mentors: Dr. Justin Shorb and Professor Vanessa Muilenburg  
Departments of Chemistry and Biology

*This research was supported by the Day<sub>1</sub> Program through a grant from the Herbert H. and Grace A. Dow Foundation, and by an award to Hope College from the Howard Hughes Medical Institute through the Undergraduate Science Education Program.*

The Departments of Chemistry and Biology at Hope College have a history of excellence in science education with an emphasis on integration of research experiences into undergraduate education. Hope College has endeavored to include proven new teaching methods such as peer review, real-world contextualization, and inquiry-based experiments into their curriculum as cohesively as possible. Here, a full literature review of recommended learning objectives will be presented, along with a meta-analysis, to generate a useful rubric for evaluating the quality of any General Chemistry or Biology Laboratory curriculum, followed by its application to Hope College's own General Chemistry and General Biology sequence. Highlights of this project include a breakdown of the strengths of our current curricula as well as research-guided avenues for improvements with subsequent iterative evaluation. At the heart of this research is the creation of a framework for both design of new laboratories and evaluation of curricula that can be applied universally to any existing program to aid in the incorporation of effective pedagogies. The transferability of this generic iterative framework for improving laboratory curriculum to other institutions will be discussed.

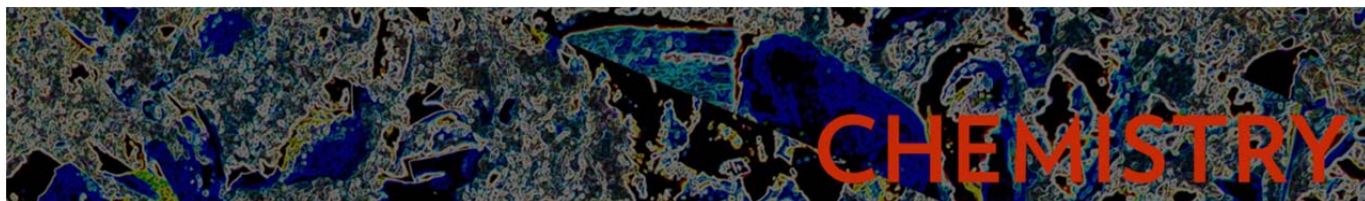
## Antiproliferative Ruthenium Complexes

### Lyndsy Miller

Mentor: Dr. Amanda Eckermann

Due to the severe toxicity of anticancer platinum complexes and acquired drug resistance, research has focused on cymene ruthenium complexes as viable alternatives. Specifically,  $[(\eta^6\text{-}p\text{-cymene})\text{Ru}(\text{ethylene-diamine})\text{Cl}]\text{PF}_6$  (RAED-C) is cytotoxic against primary tumors while  $[(\eta^6\text{-}p\text{-cymene})\text{Ru}(1,3,5\text{-triaz-7-phosphaadamantane})\text{Cl}_2]$  (RAPTA-C) is effective against cancer metastasis, but both exhibit low uptake in cells. Our hypothesis is that





Department of Chemistry  
Collaborators: Luke Wisniewski and  
Dr. Maria Burnatowska-Hledin,  
Biochemistry and Molecular Biology  
Program and Department of Biology

*This research was supported by the  
Thomas L. Riechel Endowed Fund for  
Summer Research in Chemistry.*

### Development of a Novel Transition Frequency Eigenvalue/Principal Component Approach for the Analysis of Eye-Tracking Data

**Kirsten Monson, Yong Chul Yoon,  
Murchtricia Charles, and Chantel  
Ible**

Mentor: Dr. Justin Shorb  
Department of Chemistry

*This research was supported by the  
Donald W. Visser '37 Summer Research  
Fellowship.*

### Creation and Assessment of Day1 Research Communities

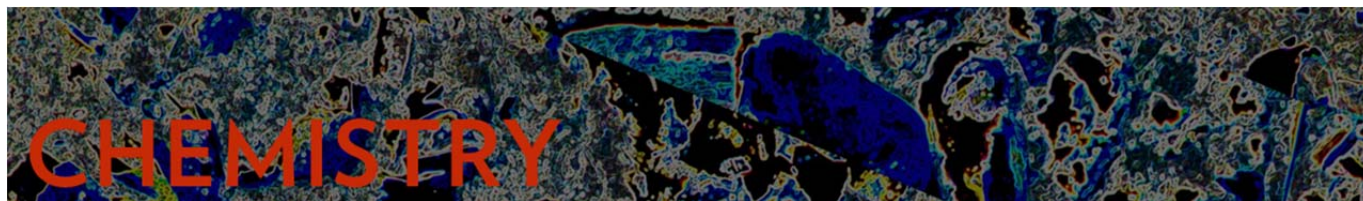
**Emma Ropski**

Mentors: Dr. Justin M. Shorb and Dr.  
Catherine Mader  
Departments of Chemistry and Physics

glucose ligands will improve cellular uptake of cymene ruthenium complexes and therefore cytotoxicity. Reaction of the sodium salt  $\beta$ -D-thiogluco-  
se with  $[\text{cymeneCl}_2\text{Ru}]_2$  dimer forms either a dinuclear, dithiolate bridged complex  
or a dinuclear, trithiolate bridged complex depending on reaction  
conditions. We are working towards building a library of related compounds  
focused on variations to the cymene backbone and placement of the  
thiogluco-  
se. Collaboration with Luke Wisniewski and Dr. Maria  
Burnatowska-Hledin has allowed us to determine some of the properties of  
these compounds *in vitro*.

The advent of digital multimedia resources in education has required careful  
thought as to the best methods for organizing and creating them so as best  
to help students learn complex concepts. This issue is highlighted within the  
field of Chemistry Education reflecting the need to relay concepts that  
cannot be visualized without some level of abstraction and representation.  
Recent work in understanding student engagement with digital tools has led  
to the use of eye-tracking technology to monitor student gaze patterns. Until  
recently, it has been impossible to correlate gaze patterns across more than  
two areas of interest (a paragraph, an equation, and a picture would be three  
areas of interest). Our group's novel transition-frequency principle  
component analysis method allows for more complex coupled gaze patterns  
to be quantified. This method uses eigendecomposition of transition  
frequency matrices to find correlations in viewing patterns. In collaboration  
with our collaborators at GVSU, initial benchmarking and consistency  
testing of the new method will be demonstrated.

Hope College began a new residential STEM learning community in the fall  
of 2015 that centers around shared research-like experiences and intentional  
mentorship across many aspects of the first-year student experience. These  
new Day1 Research Communities (<http://www.hope.edu/day1>) include  
aspects such as shared residence halls, course-based research experiences,  
field experiences, peer mentoring, pre-college trips, and a coupled first-year  
seminar/chemistry-biology lab sequence. In preparation for this dynamic  
program and its first cohort of students, a complete literature review on  
undergraduate STEM programs and supporting theories has been performed  
in order to design a whole-student theoretical framework. This framework  
was used to align predictors for success in college, pre-assessments, and  
post-assessments to evaluate the impact each student experience has on  
their growth as STEM scholars and individuals within the community. Select  
institutional metrics will also be collected to provide summative longitudinal  
data about the program's success. The whole-student theoretical framework  
along with the instruments and tools used to collect benchmark data for this  
inaugural year of the program will be presented along with plans for using  
future data collected for continued improvement of the Day1 Research  
Communities.



## Investigating the Coordination Chemistry of Tetrathiooxalate

**Daniel SantaLucia**

Mentors: Dr. William Polik and Dr. Amanda Eckermann  
Department of Chemistry

*This research was supported by the Chemistry Undergraduate Research Fund.*

Transition metal complexes with bridging ligands containing sulfur and carbon are commonplace in molecular electronics. Tetrathiooxalate ( $C_2S_4^{2-}$ ; *tto*) has redox properties which allow it to store electrons, which could provide useful functionality in molecular circuitry. To date, there are only a handful of molecular complexes with *tto* due to difficulties in synthesizing and utilizing this ligand. Our research investigates *tto* as a bridging ligand and alkylated derivatives of *tto* as terminal ligands. The reaction of *tto* with dichloro(*p*-cymene) ruthenium(II) dimer at low temperature gives insoluble green microcrystals which have been characterized by IR spectroscopy, SEM/EDS, and XRD. We believe that the insolubility may arise from the lability of the *p*-cymene ligands giving rise to polymers of ruthenium metal centers bridged by *tto* ligands. To find a solution to this issue, we have been investigating the trispyrazolylborate (*Tp*) ligand since it is negatively charged and might prove to be less labile. We have made attempts to coordinate the *Tp* ligand to Co(II), and future work will involve trying to bridge two Co(II) centers with *tto*. Alkylation of *tto* with hexyl bromide and benzyl bromide results in a mixture of products. The NMR spectra of the purified products revealed unexpected anisotropies, which were hypothesized to be due to the formation of *cis/trans* conformers. Coordinate scans for dimethyltetrathiooxalate using the Gaussian computational engine do not support this hypothesis. A competing alternative hypothesis is that a hetero Diels-Alder dimerization reaction produces multiple constitutional isomers.

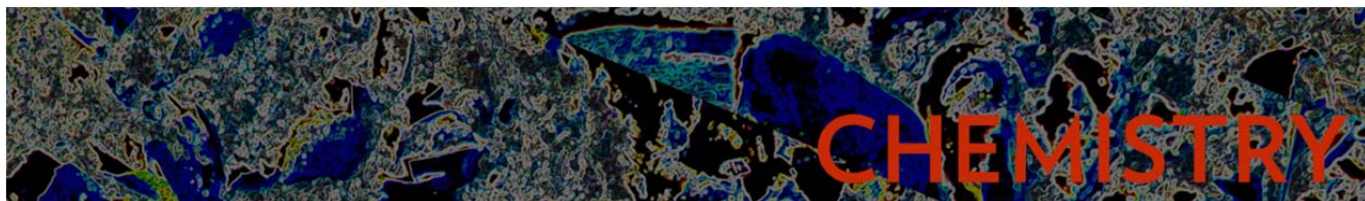
## Reducing the Rare Earth Content in Red- and Green-Emitting Phosphors for Lighting Applications

**Lisa Savagian**

Mentors: Dr. W. Michael Chance<sup>1</sup> and Dr. L. A. Boatner<sup>1</sup>  
Hope College Department of Chemistry, <sup>1</sup>Oak Ridge National Laboratory, Materials Science & Technology Division

*Research supported by the Critical Materials Institute— An Energy Innovation Hub, U.S. Department of Energy.*

Fluorescent lamps remain a relevant, energy-efficient branch of lighting technology. However, commercially available fluorescent bulbs currently rely on phosphor coatings predominately composed of expensive and scarce rare earth elements (REs). These phosphor materials are necessary for converting the mercury vapor emission within the lamp to visible white light. To steer next-generation lighting technologies away from unstable RE markets, extensive efforts have gone towards developing phosphor materials that require reduced or eliminated RE content. This work explored the synthesis and performance optimization of three classes of reduced-RE phosphors. We prepared red-emitting magnesium germanate and magnesium fluorogermanate phosphors by different routes and investigated the effects of synthetic method, constituent precursors, and anion doping on the phase purity, light yield, and photoluminescence of these RE-free materials. We also demonstrate enhanced  $Eu^{3+}$  red emission in yttrium aluminate hosts via  $Sm^{3+}$  co-doping. To develop reduced-RE green-emitting phosphors, zinc pyrophosphates were studied as hosts for low levels of RE dopants. While the material exhibited a quantum efficiency rivaling commercial standards, RE dopants were insoluble in the zinc pyrophosphate crystal lattice. Preliminary results suggest the enhanced performance of the zinc pyrophosphate phosphor may be due to the particle size or crystallinity of monazite precipitates. The results of these studies highlight the challenges associated with the synthesis of inorganic phosphors and showcased unexpected optical properties for further investigation.



*Lisa Savagian at Oak Ridge National Laboratory, and shown “illuminated” by green light from one of her phosphors that is excited by 254 nm UV light.*



### Trifluoromethylation of Dihaloarenes: toward Bis(trifluoromethyl)quinazolinespirohexadienone

**Jessica D. Scott**

Mentor: Dr. Jason G. Gillmore  
Department of Chemistry

*This work was supported by the National Science Foundation under Career Grant CHE-0952768, by the Camille & Henry Dreyfus Foundation by a Henry Dreyfus Teacher-Scholar award, by Hope College through the Chemistry Undergraduate Research Fund, the Stanley Busman Chemistry Summer Research Fund, and a Schaap Research Fellowship.*

### Electrochemical Quartz Crystal Microbalance and Simplex Optimization Study of Ruthenium-Based Films of 5-amino-1,10-Phenanthroline

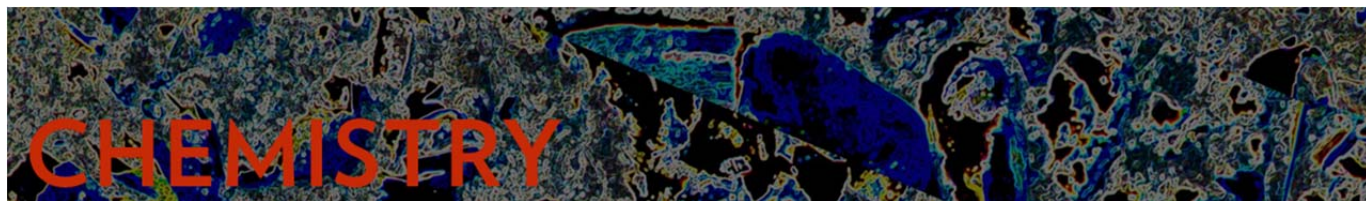
**Maxwell Sievers**

Mentor: Dr. Kenneth Brown  
Department of Chemistry

*This research was supported by the Dr. Bernard J. DeWitt Chemistry Research Fund.*

Our computational studies predict that replacing the methyl groups in our group's first dimethylquinazolinespirohexadienone (dimethylQSHD) photochrome will make for a much more potent photochromic photooxidant. Previous group members have determined that it is not possible to carry out the synthesis with trifluoromethyl groups present from the start, as they completely inhibit a key nitration step, and devised a synthesis of dihaloQSHDs that could be amenable to installing the trifluoromethyl group at a variety of points later in the synthetic route. Model studies have allowed us to optimize trifluoromethylation reaction conditions. The effects of competing reactions and inhibitors were studied through competition experiments. Together these allowed us to identify the most promising targets for trifluoromethylation in the synthesis of the desired bis(trifluoromethyl)QSHD. However, the desired transformation of the actual compounds has not yet been successfully achieved. Issues of solubility, reaction dilution, loss of compound upon workup, and the development of an internal standard for GC/MS and NMR monitoring of the reaction are all reported.

Ruthenium-based polymer films of 5-amino-1,10-phenanthroline, a potential redox mediator, were prepared and characterized on the gold electrode surface of the quartz crystal in the Electrochemical Quartz Crystal Microbalance (EQCM) instrument. The ruthenium compound was dissolved in acetonitrile with tetraethyl ammonium perchlorate (TEAP). The mass change of the electrode during characterization was evaluated, showing that the solvated perchlorate anion is most likely involved in maintaining charge electroneutrality when the film undergoes a change in redox state. The mass polymerized was also studied under different electropolymerization parameters, and it was noted that significantly more mass was immobilized on the first cycle of cyclic voltammetry. The concentration of the ruthenium compound, scan rate, and number of cycles during polymerization via cyclic voltammetry onto a glassy carbon electrode were optimized with simplex optimization.



## Computational Chemistry: From the Phone to the Cloud

**Nathan R. Vance**

Mentor: Dr. William F. Polik  
Department of Chemistry

*This research was supported by the  
Cupery Chemistry Student Research  
Fund.*

Over the last half century, the cost of computing power has dropped by about 10 orders of magnitude. As a result, computational modeling has become a practical tool for chemists to calculate molecular structures, properties, spectra, and reactivity. The Polik group previously developed WebMO, which installs on a linux computer and allows students and researchers to perform state-of-the-art computational chemistry calculations from their web browsers. This past year, we have extended the WebMO project to two additional computing platforms: smartphones and cloud computing. Smartphones, with their touchscreens and high portability, are convenient for building molecules and viewing computed results. Cloud computing promises a low cost server alternative for those who plan to compute intermittently, do not have access to a conventional cluster, or lack technical expertise to maintain a server.

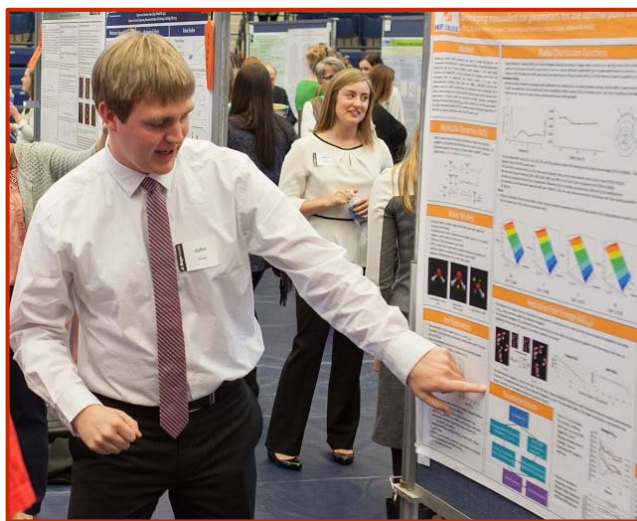
## Coprecipitation and Hydrothermal Synthesis of Doped Hydroxyapatite Nanoparticles

**Anna Washburn and Daniel  
SantaLucia**

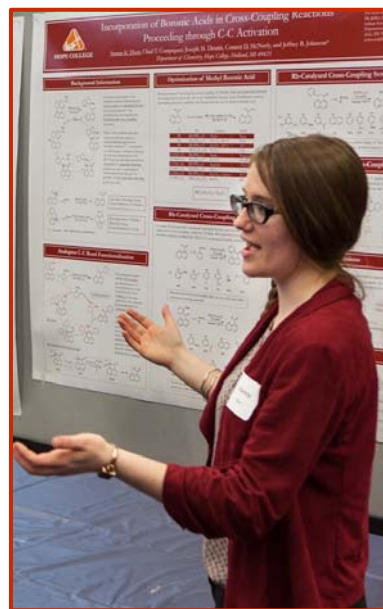
Mentor: Dr. Amanda Eckermann  
Department of Chemistry

*This research was supported by the  
Herbert H. and Grace A. Dow  
Foundation.*

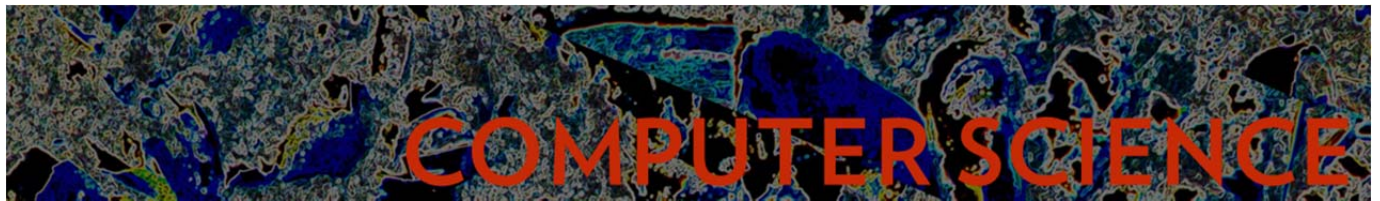
Our goal is to create a nanoparticle scaffold that has multimodal imaging capabilities. We are using hydroxyapatite as the basis of the scaffold due to its stability in biological conditions and lack of toxicity. Following coprecipitation and hydrothermal techniques from the literature, we have synthesized hydroxyapatite nanoparticles doped with europium, gadolinium and terbium. The nanoparticles have been characterized with SEM/ EDS, P-XRD, and DLS. In another approach to make MRI active scaffolds, we are currently working towards modifying the surface of the particles with iron oxide, and building nanoparticles with iron oxide cores. Further, we have modified the surface of these hydroxyapatite nanoparticles using alendronate, a bisphosphonate with the goal of attaching targeting peptides and zirconium ions to the nanoparticles. In collaboration with the Lapi research team at University of Alabama, these particles will be labeled with peptides targeting somatostatin receptors and radioactive  $^{89}\text{Zr}$  for PET/SPECT imaging of tumors.



*John Dood, Chemistry, at the Celebration, 2016.*



*Stanna Dorn, Chemistry, at the Celebration, 2016*



## Graham's Conjecture, Lemke Graphs, and Algorithms

**Cole Watson and Aaron  
Green**

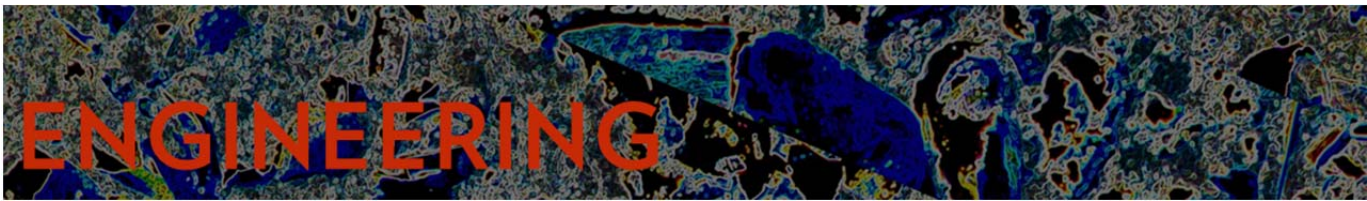
Mentors: Dr. Charles Cusack  
and Dr. Airat Bekmetjev  
Department of Computer  
Science and Department of  
Mathematics

Graph pebbling is a game on a connected graph  $G$  in which pebbles are placed on the vertices of  $G$ . A *pebbling move* consists of removing two pebbles from any vertex and adding one to an adjacent vertex. A configuration of pebbles is *r-solvable* if for a given target vertex  $r$ , there is a sequence of pebbling moves so that at least one pebble can be placed on  $r$ . The *pebbling number* of a graph  $G$  is the smallest integer  $\pi(G)$  such that any configuration that uses  $\pi(G)$  pebbles is *r-solvable* for any  $r \in V(G)$ . A long standing conjecture in graph pebbling is Graham's Conjecture. It states that given any two graphs  $G$  and  $H$ ,  $\pi(G \square H) \leq \pi(G)\pi(H)$ , where  $G \square H$  is the Cartesian product of graphs. A graph  $G$  satisfies the *two-pebbling property* if two pebbles can be placed on any vertex  $v \in V(G)$  given any configuration of  $2\pi(G) - q + 1$  pebbles, where  $q$  is the number of vertices that have at least one pebble. The only known graphs that do not satisfy the two-pebbling property are called Lemke graphs ( $L_k$ ). We will show that Graham's conjecture holds for such families as  $L_k \square K_n$  and several others.

*This research was supported by the Howard Hughes Medical Institute through the Undergraduate Science Education Program.*



*Biology and psychology students at the Celebration, 2016.*



## Surface Stimulation as a Potential Treatment for Phantom Limb Pain

**Brooke Draggoo and Payton Hoff**

Mentor: Dr. Katherine Polasek  
Department of Engineering

*This research was supported in part by an award to Hope College from the Howard Hughes Medical Institute through the Undergraduate Science Education Program.*

Phantom limb pain, a pain or discomfort in the missing limb, is experienced by a majority of amputees. Our work is based on the hypothesis that by eliciting a “real” sensation in the phantom limb, via surface electrical stimulation, pain may be decreased or even eliminated. Previously, we have shown that a variety of sensations can be obtained from stimulation on the surface of the skin. The goal of this study was to quantify the authenticity of the stimulated sensations using the rubber hand illusion.

The median and ulnar nerves were stimulated with the goal of creating a realistic tapping sensation in the subject’s hand. The rubber hand illusion was then used to quantify the authenticity of the stimulated sensation. A total of five rubber hand illusion trials were performed on each subject: three traditional trials done by a human investigator tapping on both the real hand and the rubber hand, and two artificial trials using surface electrical stimulation to evoke a tapping sensation in the real hand while the robot tapped on the rubber hand. Data collected included: questionnaire results, proprioceptive drift, and temperature changes of the arm. The results of these measures were compared to determine if a significant difference was present between the traditional and artificial methods. The trials are still ongoing, but current analysis shows that the traditional method produced a more realistic illusion than the artificial method; however the artificial method produced a better illusion than the control. These results demonstrate the potential for using this combination of surface electrical stimulation and simultaneous visual feedback as a future therapy for phantom limb pain.

## Modeling Surface Electrode Stimulation

**Kathleen Finn and Jessica Gaines**

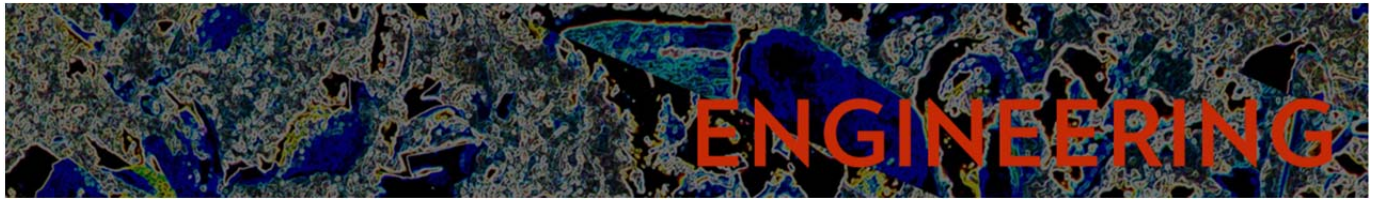
Mentor: Dr. Katharine Polasek  
Department of Engineering

*This research was supported by the Hope College Dean Start-up Fund, the Christine Tempas Engineering Summer Research Fund, the Michigan Space Grant Consortium, and an award to Hope College from the Howard Hughes Medical Institute through the Undergraduate Science Education Program.*

Phantom limb pain is experienced by 50-80% of amputees. We hypothesize that eliciting a “real” sensation in the phantom limb using surface electrode stimulation may reduce or eliminate phantom limb pain. To assist in eventual electrode placement, a computer model is being developed to predict the effect of electrode location, size, and configuration on median nerve activation.

A three-dimensional finite element model of the elbow was created with ANSYS Maxwell, using two illustrated cross sections of the arm swept together. Simulations were performed by applying a voltage across two 17x30 mm electrodes placed over the elbow. The median nerve was modeled with 10 fascicles in three random arrangements and NEURON was used to predict axon firing. A sensitivity analysis was performed to determine the effect of the number of nodes per axon, number of axons per fascicle, and resolution of exported voltages on nerve firing. After investigation of these parameters, the model can predict how many motor axons fire for a given fascicle size, fascicle location, and stimulation value. The next step will be performing a similar analysis with sensory axons.

To adapt the model to account for the difference between the channel properties of motor and sensory axons, a sensory axon model was developed based on a motor axon model by McIntyre, Richardson, and Grill (2002) and information from literature. Parameters were adjusted to reflect the differences in channel properties. A sensitivity analysis was conducted to find the parameters with the largest effect on threshold, and these significant parameters were investigated further. The models are still in progress but presently predict a slightly lower threshold voltage for a sensory axon than a motor axon at a given fiber diameter. This differs from the predictions of the original model but is closer to experimental observations.



## Engineering the Future

**Lindsey Gryniewicz, Sherah Head, Alex Klunder, Anthony Nguyen, and Eric Weeda**

Mentors: Dr. Eric Mann and Professor Susan Ipri Brown  
Departments of Mathematics and Engineering

High school students from primarily high-risk backgrounds attended a week-long engineering academy to introduce them to the complementary relationships among science, mathematics, technology and engineering. A coordinated teacher training and high school student engineering summer experience, the inquiry-based program was built around the Engineering the Future curriculum developed at the Boston Museum of Science's National Center for Technological Literacy. The Hope College Center for Exploratory Learning partnered with the Muskegon Area Intermediate School District/Regional Math and Science Center for a second year to recruit teachers to first attend a three day workshop to discuss the use of engineering design as the foundation for STEM learning and to plan the week long student academy in conjunction with Hope College engineering and education students and faculty. Hope pre-service education students gain valuable interactions with practicing teachers; teachers gain hands-on experience using engineering design in their classrooms; and high school students explore fundamental topics in a real-world context.

*This research was supported by a grant from the Michigan Space Grant Consortium, by an award to Hope College from the Howard Hughes Medical Institute through the Undergraduate Science Education Program, and the Hope College Deans of Natural and Applied Sciences and Social Sciences.*

## Development of a Wireless Sensor Node for Structural Health Monitoring

**Jeffrey Russcher and Courtney Myers**

Mentor: Dr. Courtney Peckens  
Department of Engineering

*This research was supported in part by an award to Hope College from the Howard Hughes Medical Institute through the Undergraduate Science Education Program, as well as Michigan Space Grant Consortium's Undergraduate Fellowship Program.*

The current methods and resources available for monitoring the structural health of bridges are insufficient to meet growing infrastructure demands and ensure overall structural integrity. In recent years, efforts have been made to employ networks of wireless sensors to monitor factors that indicate structural deficiencies. The purpose of this research was to design a low-power and low-cost wireless sensor node capable of monitoring the state of civil infrastructure. Hardware was chosen for the node based on its power consumption and overall ease of use. For the node, ATMEL's ATtiny 861a microcontroller was designed to interface with Texas Instrument's CC2520, as well as an external memory chip and a tri-axis accelerometer. The entire node operates at 1.8V and consumes approximately two to four times less power than previous state-of-the-art sensors. The wireless sensor node was designed to interface with solar power, thus enabling continuous use of the node for extensive periods. Software from the Narada wireless sensor (University of Michigan), the Bio-Inspired wireless sensor (University of Michigan), and Texas Instrument's CC2520 example code was adapted for use on the microcontroller. New code was added to the preexisting software to allow for transmission and reception of wireless packets, consistent with the IEEE 802.15.4 protocol. Additionally, software for collecting and storing data was written. The software was validated in hardware on a newly-developed sensor node and was verified to collect, store, and transmit data. The node was mounted on various static and dynamic systems, and the resulting data was then analyzed and shown to be consistent with the acceleration of the systems.



## Modeling the Behavior of Photomechanical Materials

**Andrew Sicard**

Mentor: Dr. Matthew Smith  
Department of Engineering

*This material is based on work supported by the Hope College Department of Engineering and the Air Force Office of Scientific Research.*

Photomechanical materials experience strains in response to light of certain wavelengths. These remotely triggered, photo-induced strains lead to large-scale deformations, presenting significant opportunities for wireless actuators and light-driven morphing structures. Because of the difficulty in fabricating complex geometries with these materials, a tool for predicting the behavior of these materials without extensive testing would aid in the design of photomechanical devices. The goal of this project was to implement a method for the modeling of photomechanical materials and use it to explore a variety of material geometries. The modeling performed in this research project was done using COMSOL, a finite element analysis program that contains a versatile equation-based modeling feature. By adding equations to COMSOL for the strains generated upon application of light, the behavior of these materials was effectively modeled. Back and forth snap-toggling was simulated for a strip of photomechanical material asymmetrically buckled over a fixed pin and illuminated on one side. In this simulation, a transition between two stable buckling modes was observed. These results show the importance of considering contact conditions when designing with these materials and lay a foundation for designing light-driven actuators in which boundary conditions increase the complexity of motion. The modeling approach for photomechanical materials utilized in this project has already provided valuable design insight and shows great promise as a versatile design tool for future light responsive applications.

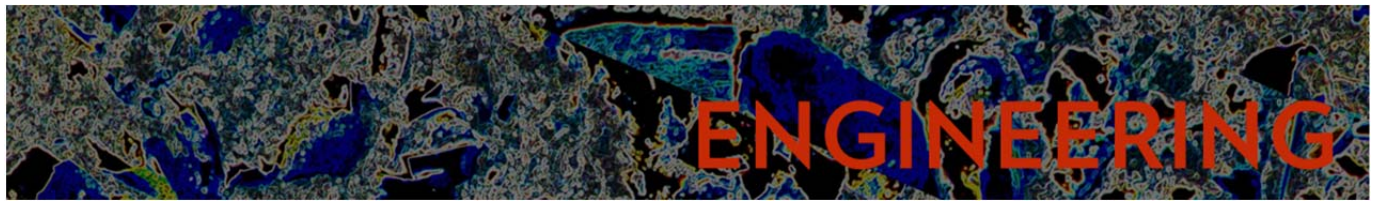
## Synthesis of Possible Near-Infrared Photo Responsive Materials

**Bradley Van Valkenburg**

Mentor: Dr. Matthew Smith  
Department of Engineering

Photo responsive materials are materials that undergo light induced mechanical deformation via photochemical or photothermal effects. These materials have potential for use as wireless actuators or micro-positioners. However, typical light responsive materials can be difficult to synthesize and are often actuated by damaging UV light, which can limit their uses. Benzocyclobutene (BCB) derivatives have shown great potential as flexible units enabling, in some cases, large deformations in response to photo-thermal stimulus. BCB is able to covalently bond with itself to form dibenzocyclooctadiene which can experience conformational changes when heated. In order to explore BCB based materials, we have synthesized an amorphous polymer (PMA-BCB) from meth acrylate and BCB comonomers following standard literature procedures. Based on established literature we have also synthesized liquid crystal-graphene oxide doped, poly(vinyl alcohol) films as more ordered control materials to compare with our PMA-PCB materials. Moving forward, we wish to synthesize 2 or 3 other rod-like molecules with BCB units that can be easily polymerized and made into films which will be tested for mechanical and photomechanical properties.





## Toyota Crash Safety Experience

**Skylar Watson**  
Mentor: Dr. Matthew Smith  
Department of Engineering

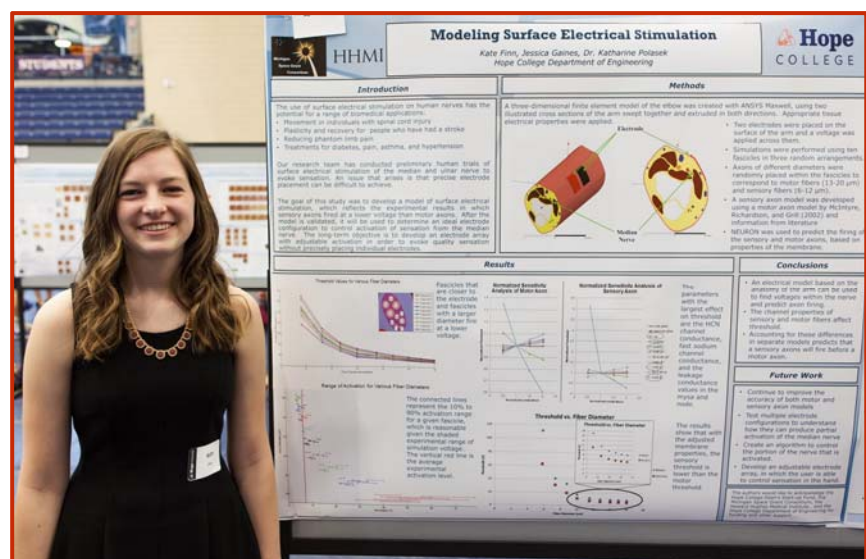
There are many paths that one can follow when graduating with a mechanical engineering degree, my interests and passions have drawn me towards the automotive field. As an intern at Toyota Motor Corporation, I was able to be involved with the testing and crash safety elements of many production vehicles. During this time I assisted crash safety engineers working on the Tundra, Sienna and Sequoia programs. Through this process I gained familiarity with the regulations and ratings systems set forth by the Federal Motor Vehicle Safety Standards (FMVSS), Insurance Institute for Highway Safety (IIHS), National Highway Traffic Safety Administration (NHTSA), and New Car Assessment Program (NCAP). A major focus of my work was to analyze crash safety test results and compare them to predicted component behaviors. Herein I discuss Out Of Position (OOP) injury margin testing, knee air bag reaction surface testing, and analysis of various test modes in preparation for vehicle hand over.

## A Designed Multi-Sensor System for SLAM on Multiple Robots

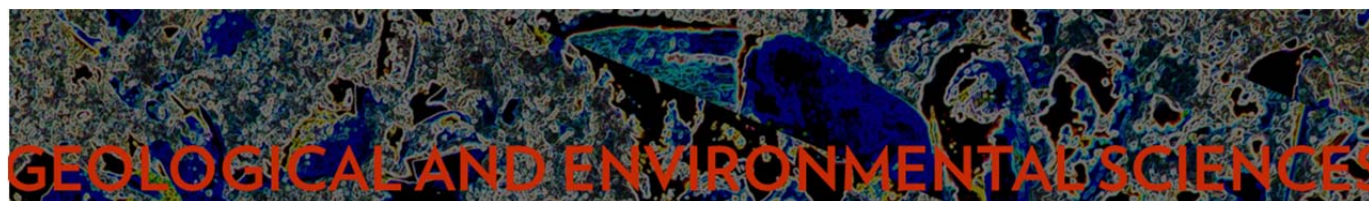
**Xavier Wu**  
Mentor: Dr. Miguel Abrahantes  
Department of Engineering

*This research was supported by the Department of Engineering at Hope College.*

A research group at Hope College is designing a multi-ultrasonic-sensor system for the open source robot Kobuki Turtlebot. The operating system used in this research project, Robot Operating System (ROS), is also an open source project initially released in 2007. This system has higher accuracy, reduced response time and lower cost compared to traditional laser sensors. It consists of 8 HY-SRF05 rangefinders that can work sequentially on an embedded system such as a Raspberry Pi. The communication between the embedded system and the robot is achieved with a Python package designed to communicate locally via Transmission Control Protocol/Internet Protocol (TCP/IP). By making the HY-SRF05 rangefinders work successively, the response time needs to be reduced as much as possible to minimize the errors in the localization process. This structure can also be applied to our multi-agent system, composed of 3 robots of the same model. By implementing this improved design on a multi-agent system, the Simultaneous Localization and Mapping (SLAM) process can be conducted more efficiently and accurately. However, the development of ROS for multi-agent systems is still in a very early stage, which is a challenge for our project.



Kate Finn, Engineering, at the Celebration, 2016.



## Tracing the Sand Dunes: Using a Combination of Panoramic Photography and Dune Pins to Track Changes in Michigan's Sand Dunes Over Time

**Ellee Banaszak and Matthew Selesko**

Mentor: Dr. Brian Bodenbender  
Department of Geological and Environmental Sciences

Sand dunes are an iconic part of Michigan's shoreline. Unfortunately, the sand dunes are disappearing at an alarming rate. This research was part of a continuing project to track changes in sand distribution in the dunes and identify natural and anthropogenic factors affecting the height and shape of the dunes. Through a combination of panoramic photography, GigaPan technology, and "dune pins," we were able to record the movement of sand over an extended period of time. Using measurements collected from two dune sites in Holland and Saugatuck over the course of 8 weeks, we compiled a large and consistent database tracing the amount of sand recorded at each dune pin, which we in turn analyzed for common patterns of sand movement. GigaPan is a mechanical tripod mount and software combination that creates high resolution photos. Accurate measurements of multiple dune pins can be taken from a single panoramic photo. A single panorama is often composed of over 300 photographs that become a highly interactive data collection tool. These high-resolution panoramas allowed us to take digital measurements that were accurate to approximately 0.1 inches without disrupting the delicate dune ecosystem. In addition, the panoramas provide a visual record of the environmental conditions the day measurements were taken. Our research also entailed creating a workshop for high school teachers that educated them on ways to incorporate GigaPan and sand dune research into their curriculum. Through a combination of GigaPan and methodical data gathering this project found that based on the movement of wind across the sand dunes, loss of vegetation was the most significant direct factor on sand dune movement.

*This research was supported by Michigan Space Grant Consortium Pre-College Education and Teacher Training program grants to Brian Bodenbender; the Hope College Biology Department; and the Hope College Department of Geological and Environmental Sciences, including the Nicholas Ver Hey '75 Geology Summer Research Fund.*

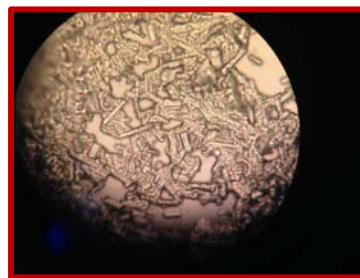
## Investigation of the Aspirin Oily Phase

**Joshua Dykstra**

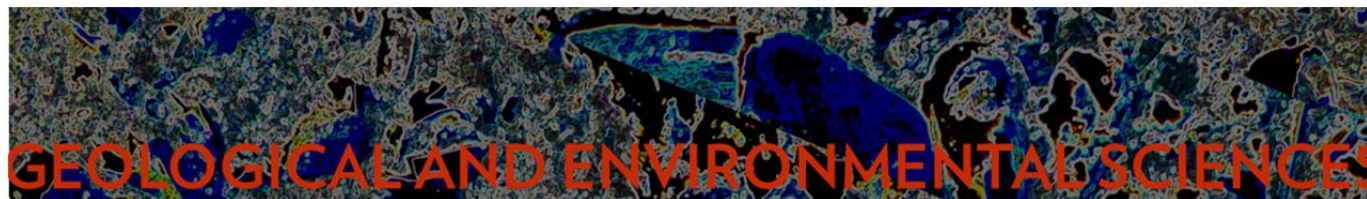
Mentors: Dr. Renata van der Weijden and Dr. Justin Shorb  
Department of Geological and Environmental Sciences and Department of Chemistry

*This research was supported by previous work conducted by Dr. van Rossum and Lotte van Anandel at the University College Roosevelt, Netherlands, and the Holleman Geology/Environmental Science Student Research Fund.*

Aspirin, or acetylsalicylic acid, is one of the most commonly used medications in the world and was first synthesized in 1897. The synthesis of aspirin is quite simple, involving the mixing of salicylic acid, acetic anhydride, and an acid catalyst. This reaction mixture is heated in a hot water bath before being quenched with water, resulting in aspirin forming as a white precipitant. However, occasionally during the synthesis of aspirin, an "oily phase" forms beneath the water layer after quenching. Although aspirin and the components used in its synthesis have been thoroughly studied, there is little to no information on this temporary "oily phase". This research examines the chemical composition of the aspirin oily phase, how it affects the crystallization of aspirin, and whether crystal size and shape could be manipulated from the oily phase to give greater control over the pill manufacturing process. The chemical composition of the oily phase was determined using GC-MS, <sup>1</sup>H-NMR spectroscopy, and 2D-NMR spectroscopy. Crystals precipitated from the oil using various methods were analyzed through XRD, SEM, and light microscopy.



*Ultrasonication of the oily phase results in narrow crystal size distribution. Picture taken with Leica microscope (40x/0.65).*



## Microplastic Beach Pollution

**Sarah Ratliff**

Mentor: Dr. Brian Bodenbender  
Department of Geological and  
Environmental Sciences

*This project was supported by  
Hope College's Nicholas VerHey  
'75 Geology Summer Research  
Fund.*

Microplastic (plastics < 1 mm) pollution is a growing environmental concern. Primary sources of microplastics involve the direct release of microplastics into the environment, such as synthetic fibers released in washing machine effluent, microbeads in cosmetic products, and pre-production pellets that are spilled during transport. Secondary sources involve the breakdown of macroplastics into smaller particles. Microplastics are an environmental problem because they can carry persistent organic pollutants and can easily be mistaken as food and ingested by animals. Here we investigated the presence of microplastics in sediment samples from two Lake Michigan beaches—Oval Beach, Saugatuck, and North Beach, Ferrysburg. Samples (approx. 1.5 L each) were collected at 5 m intervals along a 20 m transect line placed along the beach's storm strandline. Each sample was then fluidized in an elutriation column to separate out the lighter particles, which then underwent a density separation from the remaining sediment using NaI. The supernatant of this density separation was visually inspected using a dissecting microscope to quantify the amount of microplastic particles. While macroplastics were found in all 10 samples, only 9 out of the 10 contained microplastics, with abundances ranging from 0 to 25 particles/L. The average microplastic abundance for Oval Beach was 6 particles/L and the average abundance for North Beach was 14 particles/L. These preliminary results demonstrate that microplastic pollution is present along Lake Michigan beaches. Further research is needed in order to determine the recovery efficiency of the elutriation tower, which will help us better quantify the abundance of plastic at various beach sites.

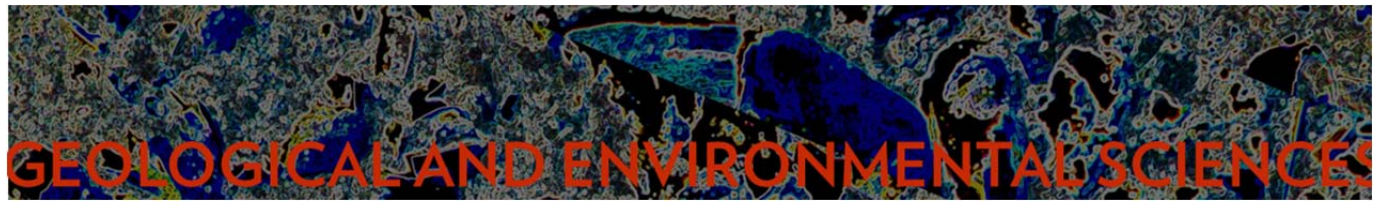
## Investigation of Biochar for Amendment of a Disturbed Urban Soil

**Kenneth Swiftbird, Jennifer Fuller, and Kelsey VanEyl-Godin**

Mentor: Dr. Brian Bodenbender  
Department of Geological &  
Environmental Science

*This work was supported by the  
Hope College Campus  
Sustainability Committee and  
the Hope College Holleman  
Geology/Environmental Science  
Student Research Fund.*

We examined the influence of biochar in amending a disturbed urban entisol that is sandy, quartz rich, and very low in organic matter. We assessed short term (2–3 week) plant growth by comparing dry plant mass among varying treatments of biochar and/or inorganic fertilizer and a control. Biochar has high porosity and specific surface area (Bagreev et al., 2001). Biochar has been reported to increase water holding capacity, improve retention of soil nutrients, and enhance beneficial microorganism growth. We hypothesized that biochar would improve short term growth by enhancing nutrient and water retention in the high drainage, sandy soil. We tested three species in a greenhouse experiment and measured pH and water retention. The sandy soil had a pH of 6.85; commercial biochar had a pH of 6.40. *Vigna radiata* (mung bean) and *Avena sativa* (common oat) were planted in control (original) sandy soil, soil intermixed with 1%, 3%, 7%, 10%, and 20% (by mass) commercial biochar, the same percentages of biochar with full fertilizer, and soil without biochar containing ¼, ½, full, 2x, and 4x recommended fertilizer dosage. All biochar-only treatments for *Vigna radiata* yielded greater above-ground biomass than the control, but fertilizer-only and combined biochar-fertilizer treatments were variable relative to the control. In *Avena sativa* most fertilizer treatments yielded higher biomass than the control whereas biochar treatments were variable. None of these results, however, were significant at a 5% confidence level. *Brassica rapa* was not tested for fertilizer treatment and showed no significant difference from the control among biochar treatments. Data suggested that increasing biochar and increased water retention correlate, but not significantly. In the early stages of plant growth, biochar does not produce significantly different results than fertilizer. This suggests that biochar could potentially serve as a lower input, alternative remediation medium in urban soils.



## What Makes Lake Michigan's Coastal Dunes Migrate? Investigating the Triggers of Dune Mobility in Lake Michigan's Dunes Using a Multi-proxy Study of a Coastal Dune Lake

**Miranda Ulmer, Benjamin Johnson**

Mentors: Professor Suzanne DeVries-Zimmerman<sup>1</sup>, Dr. Edward Hansen<sup>1</sup>, and Dr. Timothy G. Fisher<sup>2</sup>

<sup>1</sup>Department of Geological and Environmental Sciences, Hope College, <sup>2</sup>Department of Environmental Sciences, University of Toledo

Aeolian studies of Lake Michigan's coastal dunes have shown periods of dune mobility and stability in the last 6,000 years. However, the triggering mechanisms for these changes in aeolian activity are not well understood. Small lakes located downwind of dune complexes contain aeolian sand and biological proxies that can provide both dune activity and independent paleoenvironmental data. We undertook a multi-proxy study of a lake-sediment-core collected from Gilligan Lake, located adjacent to a large coastal dune complex in Allegan County, Michigan, to reconstruct these histories. We collected a 7.5-cm-diameter vibracore and subsampled in 1 cm<sup>3</sup> aliquots for percent sand, charcoal abundance, and pollen identification analyses. Sand concentrations vary on two different scales. Intervals of generally high, intermediate, and low sand persist for intervals of ~ 300–600 years with smaller fluctuations occurring at intervals of 20–100 years. A pattern between the sand concentrations and the different charcoal morphologies was noted. The period of overall high sand concentration is correlated with low abundance of charcoal threads and sheets and high abundances of charcoal chunks. This increase could indicate an increase in the amount of fire. The larger scale period of high sand concentrations is correlated with relatively high abundances of charcoal chunks, suggesting that periods of higher dune activity may be correlated with a higher incidence of fire. The larger scale period of low sand concentrations is correlated with relatively low abundances of oak, hickory, birch, and fir pollen and high abundances of maple, beech, pine, and spruce pollen. The pollen record suggests an expansion of the maple-beech climax community during periods of low dune mobility. Shorter scale fluctuations in sand concentrations do not correlate with any of the pollen or charcoal proxies investigated.

*This work was funded by National Geographic Society Grant #9649-15 to Timothy Fisher, University of Toledo, the Holleman Geology/Environmental Science Student Research Fund, the Rex Johnson Student Research Fund, and by an award to Hope College from the Howard Hughes Medical Institute through the Undergraduate Science Education Program.*

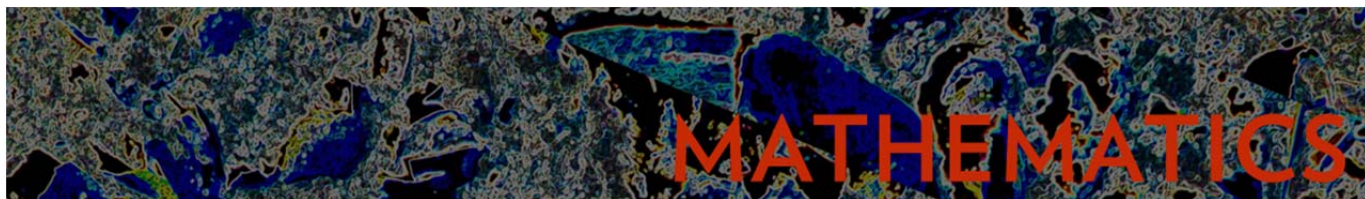
## Trace Elemental Analysis of Copper Inclusions in the Portage Lake Volcanics Series of the Keweenaw Peninsula, MI Using Particle-Induced X-ray Emission Spectroscopy (PIXE)

**Randall Wade**

Mentor: Dr. Graham Peaslee and Dr. Edward Hansen  
Department of Geological and Environmental Sciences

*This research was supported by the Holleman Geology/Environmental Science Student Research Fund.*

The Portage Lake Volcanics is a mid-Proterozoic series made up of over 200 individual subaerial thoeiilitic basaltic flows, which contain extensive amygdaloidal and brecciated flow tops in addition to interflow conglomerates, hosting the secondary copper deposits that make the Keweenaw Peninsula region of Michigan famous. The intent of this study is to explore variations in the trace elemental composition of copper deposits in the area and explore possible geological implications of such variations. Thick sections of conglomerates and basalts containing copper inclusions from the Centennial, Calumet & Hecla, Phoenix, and Allouez mines, among others, were analyzed using particle-induced x-ray emission spectroscopy. PIXE was performed in the Hope College Ion Beam Analysis Laboratory using a 1.7MV Pelletron tandem particle accelerator. The ion beam was focused on copper inclusions and spectra were collected and analyzed using gupix software. Ratios of trace nickel, silver, and arsenic to copper were calculated and compared across different inclusions in a single sample and across samples from different geographic locations, formations, and mine depths. Results show some variation in elemental ratios within samples, and greater variation across samples from different mines, formations, and depths. Elemental compositions are likely subject to a variety of factors influencing local conditions in copper mineralization.



### The Invasion of Sea Lamprey in the Great Lakes

**Chloë Caltrider and Sarah Mozdren**

Mentors: Dr. Paul Pearson and Dr. Yew-Meng Koh  
Department of Mathematics

*This research was supported by the Day1 Program through a grant from the Herbert H. and Grace A. Dow Foundation.*

The sea lamprey is an invasive species that had been introduced to the Great Lakes. The sea lamprey feeds upon the native fish, by attaching itself to the fish with its hinge-less jaw having many rows of teeth, and feeding on the fish's blood. This has had a dramatic effect on the numbers of fish in the Great Lakes, since the sea lamprey has no predators in the Great Lakes areas. This project looks into the numbers of sea lamprey in Lake Michigan, Lake Huron, and Lake Superior from the year 2009 to 2015. Using data from the Great Lakes Fishery Commission and the Michigan Department of Natural Resources, statistical tests of two means, multiple proportions, and multiple means were performed using the Hope College's applet resource. The tests concluded that the northern areas of Lake Michigan and Huron had greater amounts of sea lamprey than the southern areas, that Lake Huron and Lake Michigan had larger amounts of sea lamprey than Lake Superior, and that Lake Huron had a greater number of sea lamprey than Lake Michigan.

### Predicting Transition in Bean Beetle Embryo Development Using Wavelet Transforms and Neural Networks

**Zachary Diener**

Mentor: Dr. Paul Pearson  
Department of Mathematics

As bean beetle embryos develop, time-lapse photographs of their eggs exhibit varying levels of brightness that correspond to different stages of maturation. These time signals can be analyzed to pinpoint when different stages occur. We have developed a method to accurately identify these changes in brightness using a combination of Haar Wavelet analysis and neural networks. We utilized the wavelet analysis to extract key features from the signal and then, using these features, we trained the neural network to pinpoint the transition points in the eggs' development. We have studied these methods at various levels of noise using randomized situations. We are hoping our results support the usefulness of this method to analyze similar signals.

*This project was supported by a Jacob E. Nyenhuis Student/Faculty Collaborative Summer Research Grant.*

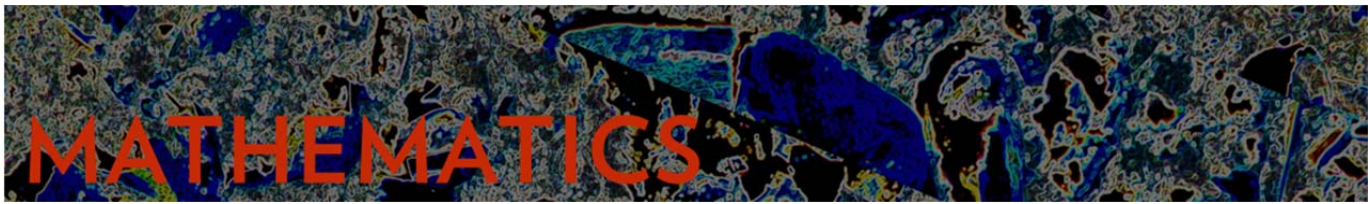
### Biodensities of Lake Michigan Aquatic Life between 2005 and 2010

**Natalie Filipowicz and Allison VanderStoep**

Mentors: Dr. Paul Pearson and Dr. Yew-Meng Koh  
Department of Mathematics

*This research was supported by the Day1 Program through a grant from the Herbert H. and Grace A. Dow Foundation.*

Since the 1980s there has been an increase in the biodensities of zebra and quagga mussels in the Great Lakes. Zebra and quagga mussels mainly feed on phytoplankton. In the natural food web, phytoplankton are zooplankton's main source of food. However, with the introduction of zebra and quagga mussels, zooplankton are now competing with the mussels for food. Our project compares the biodensities of zebra mussels, quagga mussels, and zooplankton between the years of 2005 and 2010 in Lake Michigan. Based off the natural food web, we expect to see an increase in zebra and quagga mussels and a decrease in zooplankton. From the analysis of the data, we concluded that zooplankton and zebra mussel densities had a significant decrease in biodiversity between 2005 and 2010, while quagga mussels had a significant increase in biodiversity. Looking back on our hypothesis, the results of the statistical tests do not match up with what we had predicted. However, we could infer that zebra mussels and quagga mussels together are not significantly impacting the zooplankton population.



### Statistical Analysis of Lake Sturgeon Data to Find Association and Correlation

**Kellen Gove and Zachary Terpstra**

Mentors: Dr. Paul Pearson and Dr. Yew-Meng Koh  
Department of Mathematics

*This research was supported by the Day1 Program through a grant from the Herbert H. and Grace A. Dow Foundation.*

The lake sturgeon is an ancient species of fish native to the Great Lakes Region. They were considered a nuisance fish by fishermen beginning in the 1800s and were treated as such. This led to a rapid decline in the species, which eventually placed them on the U.S. Endangered Species list. Efforts have been made to restore the population and have been showing signs of payoff. In order to better understand what exactly is happening with these fish, data has been collected over a wide range of aspects about lake sturgeon. Using data collected by the Black Lake Streamside Research Facility in 2011, this project's goal was to analyze the data in an effort to find any correlation between two relationships. These relationships were between incubation temperature and adult length and body area, as well as the relationship between yolk sac area and adult length and body area. Using Hope College's Statistical Applets, we performed a statistical test of multiple means, as well as a theory-based test of multiple means. The tests concluded that a higher incubation temperature of sturgeon eggs does not influence body length or body area of an adult sturgeon, and the correlation between yolk sac area, body length, and body area was extremely weak.

### Impact of a Problem-Solving Curriculum on Pre-Service Elementary Teachers' Affect toward Mathematics

**Stephanie Harper**

Mentor: Dr. Eric Mann  
Department of Mathematics

*This research was supported by the Hope College Department of Mathematics.*

Math is often seen as a curse word, and revulsion of math is common and even celebrated at times by the general public. The dislike of math is even more common among pre-service elementary teachers. Research has shown that pre-service elementary teachers tend to have the highest levels of math anxiety among all college students. These college students are going to be teaching and shaping our youngest and most impressionable children in only a few years, so the general level of math anxiety is worrisome. This work-in-progress study investigates the effect of a problem-solving curriculum on pre-service teachers' attitudes toward and beliefs about mathematics. Affect is a multi-faceted construct that encompasses emotions, anxieties, beliefs, and attitudes, among other psychological concepts. This study focused on the attitudes and beliefs aspects of affect. Students taking MATH 205, a math content course for pre-service elementary teachers, were surveyed in September 2015 about their attitudes toward and beliefs about mathematics, along with their prior experiences with mathematics and demographic information. The same survey, minus the questions about the students' experiences with mathematics, was administered to students at the end of MATH 206, the final math content course for pre-service elementary teachers, in February 2016. The curricula of both MATH 205 and MATH 206 were based on problem-solving and discussion and contained very little lecture. Final analysis and results about the effectiveness of these curricula on the attitudes and beliefs of pre-service elementary teachers regarding mathematics are pending.

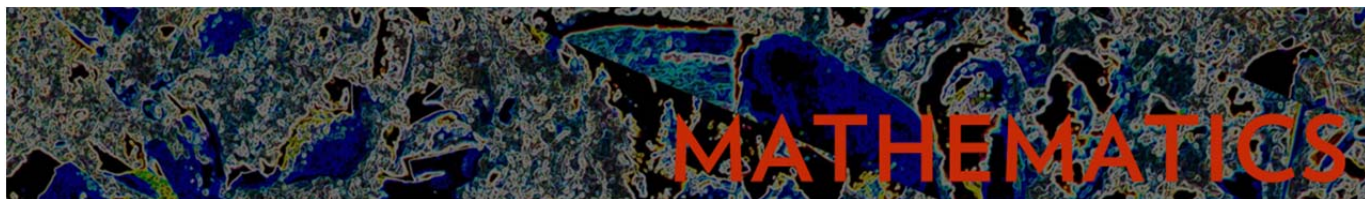
### Estimation Precision in a Quantile Regression Model

**Jiyi Jiang**

Mentor: Dr. Yew Meng Koh  
Department of Mathematics

Quantile regression provides a method for estimating quantiles of a distribution while incorporating covariate information. If distributional assumptions are placed on the distribution of the response variable, an asymptotic variance estimate for the estimators can be obtained. This is done for a variety of distributions and comparisons are made to equivalent simple linear regression models.

*This research supported by the Tanis Math Research Fund.*



## Classifying Handwritten Digits without Seeing Them

**Jiyi Jiang**

Mentor: Dr. Paul Pearson  
Department of Mathematics

Digital images of handwritten digits are high dimensional and vary with writing style. This work presents a method to perform classification on a handwritten digits database, MNIST, and enable visualization in low dimensional space. To address the handwritten digit variation issue, the edges of each digit in an image are first highlighted by gradient feature extraction. Then, the curse of high dimension is broken by t-SNE algorithm, which constructs a certain “lens” so that one can visualize MNIST on two or three coordinates. The “lens” also helps trace from low dimension back to high dimension in which clustering is applied to assigned level sets and form a more explicit visible structure among all data points. The last process is done by Mapper algorithm.

## A Statistical Analysis of River Flow Rate and Turbidity

**Briana Linton and Micaela Wells**

Mentors: Dr. Paul Pearson and  
Dr. Yew Meng Koh  
Department of Mathematics

The scientific community has established a correlation between river flow rate and turbidity, but the vast majority of research thus far has been focused on large rivers and bodies of water. Can the same conclusions be drawn from smaller rivers that may be subject to more local variance, such as weather, animal movement, and plant growth? After analyzing data from three streamlets, we conclude that studies on small, local ecosystems suffer the effects of confounding variables to a greater extent than studies on larger, more stable ecosystems. Because small rivers are subject to more variance than large rivers, no correlations were found between flow rate and turbidity.

*This research was supported by the Dayı Program and the Herbert H. and Grace A. Dow Foundation.*

## Clustering Farms According to Using Data from Categorical Variables

**Catherine Namwezi**

Mentor: Dr. Yew-Meng Koh  
Department of Mathematics

A dataset concerning farms from the Kibaale District of Uganda contains information from various categorical variables. This study looks at using the categorical variable data to group like farms into clusters. This would enable us to determine common features linking farms with higher annual incomes as well as determining factors which may influence food security for households in the Kibaale District.

## Level Curves of a Real Algebraic Function

**Sarah Petersen and Anna Snyder**

Mentor: Dr. Stephanie Edwards  
Department of Mathematics

Let  $h(x) = \sum_{k=0}^n b_k x^k$  and  $f(y) = \sum_{k=0}^m a_k y^k$  be real polynomials where  $n \geq m$  and

$b_n, a_m \neq 0$ . We consider the structure of the real algebraic function

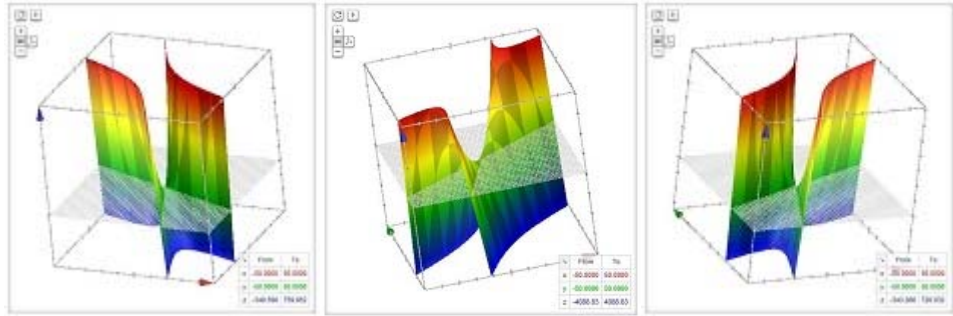
$F(x, y) = \sum_{k=0}^m b_k x^k f^{(k)}(y)$  and the curve  $F(x, y) = 0$ . In 1916, G. Pólya showed

that when  $h$  has only negative real zeros, the real algebraic curve  $F(x, y) = 0$  has  $m$  real intersections with each line of positive slope. In the case where  $f$  is an arbitrary real quadratic polynomial, we extend a characterization of all level curves of the function  $F(x, y)$  with relaxed conditions on the zeros of  $h$ . In higher degrees, we describe the behavior of all curves  $F(x, y) = 0$  when the zeros of  $f$  are kept real and the zeros of  $h$  are limited to being real and of the same sign or equal to zero.

*This research was supported by an award to Hope College from the Howard Hughes Medical Institute through the Undergraduate Science Education Program, and the Hope College Department of Mathematics.*

# MATHEMATICS

*Hyperbolic paraboloids  
(Sarah Petersen and Anna  
Snyder)*



## Pedagogical Content Knowledge: Preservice Teachers Working with Fractions

**Daria Solomon**

Mentor: Dr. Eric Mann  
Departments of Mathematics  
and Education

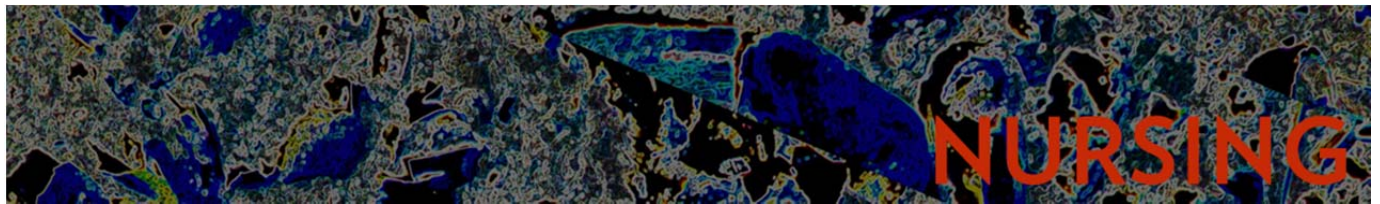
*This research was supported by  
the Hope College Department of  
Mathematics.*

Mathematical content related to fractions can be difficult to understand, both conceptually and procedurally. In order to help elementary students develop a better understanding of fractions, preservice teachers must understand and be prepared to teach content related to fractions. In the Math for Elementary and Middle School Teachers course, an intervention involving pedagogical content knowledge was implemented in order to increase preservice teachers' ability to execute and explain various methods and models of problem solving related to fractions. Preservice teachers were exposed to pedagogical content knowledge through experiences such as analyzing samples of student work, watching videos of elementary students learning material in educational settings, and becoming familiar with a variety of models and explanations that could be used in mathematical problem solving. While these types of activities were integrated throughout the course, this research specifically analyzed the effect of experiences in the fractions unit. In addition to taking a Learning Mathematics for Teaching pretest and posttest developed by the University of Michigan, which covered material related to fractions and other topics, the preservice teachers in the class wrote journal entries on their developing knowledge about fractions. Initially, 57 preservice teachers participated in the course; however, data from some pre and posttests was not used since some individuals dropped or added the course without completing the fractions unit or without taking both tests. Data from 51 preservice teachers is being analyzed, and research is ongoing.



*Matthew Selesko, Sarah Ratliff, and Josua Dykstra, all geology students, at the Celebration, 2016.*





## Learning Needs Assessment: Comparison of Perceived Learning Needs of Registered Nurses Based on Age and Shift Type

**Katherine Bird**

Mentors: Joshua Meringa, MPA, MHA, BSN, RN, BC, ONC<sup>1</sup>, and Vicki Voskuil, PhD<sup>c</sup>, RN, CPNP<sup>2</sup>

<sup>1</sup>Spectrum Health, <sup>2</sup>Hope College Department of Nursing

Studies have examined various learning needs of Registered Nurses (RNs) to improve their continuing education. However, learning needs based on age and shift types have not been closely examined. Shift types tend to be segregated based on age due to more experienced RNs working day shifts. The purpose of this study was to examine differences between self-identified learning needs of Direct-Care RNs in three major categories (Interdisciplinary Team, Professional Issues, and Client Care) and age categories and shift types. Benner's Stages of Clinical Competence theory was used to guide the research. This theory explains that through acquisition and development of skills, RNs pass through five levels of proficiency from novice to expert. An electronic survey sent out to all RNs at a large tertiary care hospital in the Midwest gathered information from 654 Direct-Care RNs. Of this sample, 61% were on day shifts, 6.4% on evening shifts, 28% on night shifts, 0.6% on weekends only, and 4% on rotating shifts. Data were entered into SPSSv.22 and a one-way ANOVA test was conducted. Results indicated no significant effect of shift type on learning needs and a significant effect ( $p < 0.05$ ) of age on learning needs in two categories; Interdisciplinary Team [ $F(6, 647) = 2.723, p = .013$ ] and Client Care [ $F(6, 647) = 4.037, p = .001$ ]. Results from the post hoc analysis using the Bonferroni procedure indicated a significant mean difference (.289,  $p = .029$ ) between 20-29 year olds and 50-59 year olds for the Interdisciplinary Team category and a significant difference for the Client Care category between the 20-29 year olds and two age range categories: 30-39 year olds (.251,  $p = .029$ ) and 40-49 years old (.321,  $p = .011$ ). Using these results, educational programs could be tailored to different age groups. Limitations include the potential for self-report bias and lack of generalizability due to results from RNs at only one hospital system.

## Previous Hospitalization as a Risk Factor for *Clostridium difficile* Infection

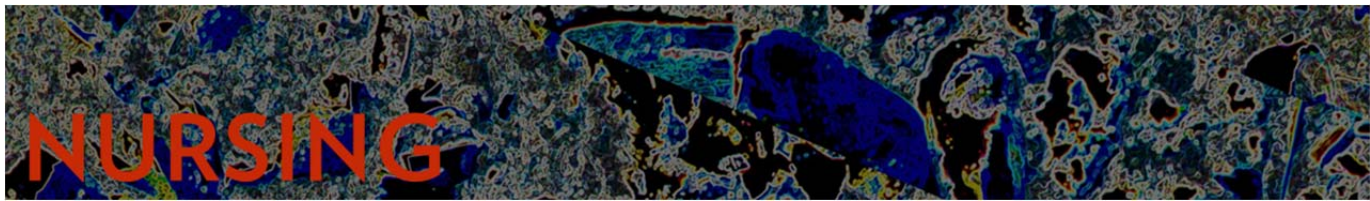
**Laris Davenport**

Mentors: Chau Nguyen, MS,<sup>1</sup> Kerrie Verlee, MPH, CIC<sup>1</sup>, and Donna Garrett, MSN, RN,<sup>2</sup>

<sup>1</sup>Spectrum Health Infection Control & Prevention, <sup>2</sup>Hope College Department of Nursing

*This material is based upon work supported by Spectrum Health Infection Control & Prevention.*

Previous hospitalization is associated with *Clostridium difficile* (*C. diff*) colonization, which can occur without symptoms, but may lead to an infection when immunities are compromised. *Clostridium difficile* Infection (CDI) is expensive to treat and is associated with extended hospitalization. The objective of this study was to determine the percentage of positive healthcare-onset *C. diff* patients with previous hospitalization, and identify the length of time between the patient's last discharge date and current hospitalization. Neuman's Systems Model, the conceptual model for this study, views the patient multi-dimensionally, focusing on preventing and managing stressors and responses to stressors. This study addressed secondary prevention by identifying risk factors for CDI. All inpatients at a tertiary care hospital system with a positive *C. diff* PCR test in the first quarter of 2015 were identified using Compass Pathfinder<sup>®</sup>. Only patients classified with hospital-associated *C. diff* were included, totaling 37 participants. A retrospective chart review collected data from Cerner PowerChart<sup>®</sup>. Data were analyzed using SPSS<sup>®</sup> Version 22. Approximately 70% of patients had a previous discharge. Fifty-four percent were discharged within the last year and 16.2% were discharged over a year ago. Among the 26 with previous discharges, 3 were noted to have a previous positive *C. diff* test. In conclusion, most positive health-care *C. diff* patients had a previous hospitalization. Implications include healthcare provider awareness of previous hospitalization as a risk factor for CDI. Opportunities exist to evaluate prior and current length of stay and the number of hospitalizations to assess the association with CDI.



## Learning Needs Assessment: Comparing Non-Baccalaureate and Baccalaureate Prepared Registered Nurses

**Abby Hodgkinson**

Mentors: Professor Donna Garrett, MSN, RN<sup>1</sup> and Joshua Meringa, MPA, MHA, BSN, RN, BC, ONC<sup>2</sup>

<sup>1</sup>Hope College Department of Nursing and <sup>2</sup>Spectrum Health

*This material is based upon work supported by Spectrum Health.*

## Health Literacy amongst Ethnic Minority and Majority Women in the Acute Care Setting

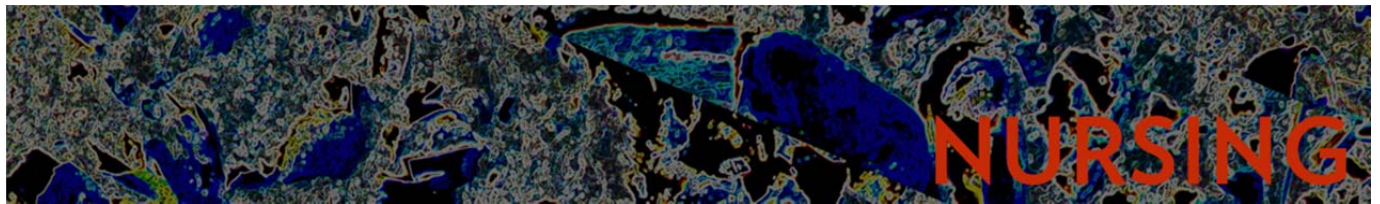
**Anna Holm**

Mentors: Susanne Brooks, MSN, RN, ACCNS-AG<sup>1</sup> and Emilie Dykstra Goris, PhD, RN<sup>2</sup>

<sup>1</sup>Spectrum Health, <sup>2</sup>Hope College Department of Nursing

The Institute of Medicine recommends increasing the proportion of registered nurses in the U.S. with a BSN degree to 80% by 2020. Research studies suggest that higher degrees correlate with shorter lengths of stay and better patient outcomes. However, financial constraints and lack of support create barriers for RNs to return to school. Direct-care RNs hold the same job responsibilities and expectations regardless of the degree of education. The objective of this study was to examine if differences exist between self-identified learning needs of BSN-prepared RNs compared to non-BSN RNs. Benner's Stages of Clinical Competence explain that nurses increase their level of abilities from novice to expert through knowledge. An electronic survey sent to all RNs in a large tertiary care hospital in the Midwest gathered information about learning needs with responses from 821 direct-care nurses for a response rate of 26.2%. Data were entered into SPSSv.22. Results from independent t-tests indicate that BSN (64.93%) and non-BSN (34.94%) RNs did not have significantly different learning needs ( $p > 0.05$ ) in any of the three major categories. Based on these findings, educational programs should not be stratified into BSN and non-BSN RNs in this setting. Further research could identify if specific learning needs exist between education groups. Limitations for this study include lack of generalizability because only one hospital was surveyed and the potential for self-report bias existed.

Health literacy rates have a significant impact on patient health outcomes. Lower health literacy levels are associated with decreased medication adherence, increased hospitalization rates, and greater health disparities. The purpose of this study was to examine how health literacy varies between ethnic minority and majority women of comparable educational levels. Nora Pender's Health Promotion Model served as a foundation for this research since adequate health literacy is an essential component in achieving health promotion outcomes. Pender identifies individual characteristics, including socio-cultural and ethnic factors, as being predictive of health-promoting behaviors. This study applied a prospective and descriptive design, utilizing the Shortened Test of Functional Health Literacy assessment tool to evaluate health literacy levels. The sample of 134 female participants was randomly selected from various acute-care units within a large Midwestern health care system. SPSS was utilized in data analysis to elicit descriptive statistics and a multiple linear regression. No significant difference in health literacy scores existed between ethnic minority and majority women of comparable education levels, which can be concluded based on the p-value greater than 0.05, and a  $R^2$  value equal to 0.015. However, differences did exist in educational levels between minority and majority women: only 15 % of minority women had completed a post-high school education as compared to the 32% completion rate by their majority women counterparts. The small number of female, ethnic minority participants limited the ability to obtain significant results. Additionally, it is likely that patients with lower health literacy were less likely to participate in the study, therefore influencing external validity. Implications include the need for health care professionals to assess a variety of patient factors, including education and ethnicity, when considering a patient's health literacy level. These findings can also provide a foundation for future research that could be conducted on this topic.



### Identified Post-Discharge Nursing Interventions for Mothers and Newborns

**Emma Rae Humphrey**

Mentors: Jeannette Pollatz, RN, MSN, and Barbara Vincensi, PhD, RN, FNP<sup>2</sup>

<sup>1</sup>Spectrum Health Zeeland Community Hospital, <sup>2</sup>Hope College Department of Nursing

Transitions of care for patients discharged from the hospital to their home environment have not been thoroughly studied. Post-discharge telephone calls are a method of maintaining contact with patients during the first 24-72 hour period after discharge, allowing for beneficial transitions of care interventions to occur. The purpose of this study is to investigate themes of post-discharge interventions implemented through a post-discharge telephone call for recently discharged mothers and newborns. Boykin and Schoenhofer's Nursing as Caring Theory supports the research project and emphasizes the importance of nurses making patients feel cared for and known. This can be facilitated through post-discharge phone calls. Data regarding the nature of implemented nursing interventions was gathered through a retrospective chart review of post-discharge call questionnaires. The sample size, eighty-eight patient chart reviews, was selected using G\*Power 3.1.5. and taking into account the Chi-Square test. There is limited generalizability of the findings from this study because all of the data were gathered from a community hospital in West Michigan. In addition, interventions done by nurses were not always clearly identified on the post-discharge call questionnaire. Implications could be that further education for nurses is needed emphasizing the importance of documenting post-discharge interventions. In addition, persistence is needed in calling patients until they are reached because it was found that a number of patients only received a voice message and were never successfully contacted.

### Exon Amplification and Sequencing within the Oxytocin Receptor Gene (OXTR) among Persons with Alzheimer Disease

**Jamie Johnson and Michelle Kerr**

Mentor: Dr. Emilie Dykstra Goris  
Department of Nursing

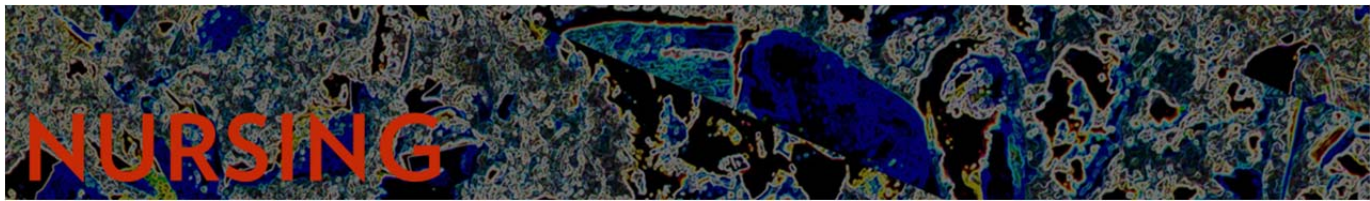
Apathy, defined as a disorder of motivation, is a prevalent neuropsychiatric symptom among persons with Alzheimer Disease (AD). Variations in the Oxytocin Receptor Gene (OXTR), located on chromosome 3, are hypothesized to be candidate modifiers of apathy severity in persons with AD. The aims of this study were to design and successfully utilize primers and polymerase chain reaction (PCR) in order to amplify OXTR single nucleotide polymorphisms (SNPs) and coding regions of exons as a means to examine variations within OXTR that may be associated with apathy. Primer sets were designed to amplify coding regions of exon 3 and 4 within OXTR, using PCR, and were tested with lab control human DNA samples. Sequencing results indicated successful primer design and amplification of sections of exon 3 and 4 coding regions. Chromatograms of the sequencing results were used to obtain genotype data on both exon 3 and exon 4 for each human sample. Findings may contribute to a risk profile for identifying individuals with AD most at risk for apathy based on OXTR genotype.

### Test-Retest Reliability of Postpartum Depression Risk Factors Questionnaire (PDRFQ) and Edinburgh Postnatal Depression Scale (EPDS)

**Christina Mulder**

Mentors: Nancy Robert, RN, CCE, CBC<sup>1</sup>, and Barbara

Studies have suggested that postpartum depression can lead to adverse outcomes. Having a reliable tool to assess for postpartum depression would assist in evidenced-based screening for risk factors and associated symptoms to facilitate timely interventions. Previously, validation of the PDRFQ and EPDS was performed and allowed for the evidence-based use of both tools together in nursing practice. The purpose of this study is to examine test-retest reliability of the PDRFQ+EPDS, a 19-item questionnaire, in order to implement the revised version into routine postpartum nursing care. The nursing theory used to shape this study is Betty Neuman's Systems Model, focusing on stressors and reactions that weaken the lines of defense and resistance, ultimately affecting basic structure. This is a prospective, cross-sectional, descriptive study which is part of a larger longitudinal validation study. Mothers will be enrolled during their



Vincensi, PhD, RN, FNP<sup>2</sup>  
<sup>1</sup>Spectrum Health, <sup>2</sup>Hope  
College Department of Nursing

### Factor Analysis of the Postpartum Depression Risk Factors Questionnaire (PDRFQ) plus the Edinburgh Postnatal Depression Scale (EPDS)

**Kelsey Otter**

Mentors: Barbara Vincensi,  
Ph.D., RN, FNP<sup>1</sup> and Nancy  
Roberts, Nancy Roberts, RN,  
CCE, CBC<sup>2</sup>

<sup>1</sup>Hope College Department of  
Nursing, <sup>2</sup>Spectrum Health

*This research was supported by  
the Hope College Department of  
Nursing.*

### Emergency Department Quality Improvement: Patient Medication Education

**Elizabeth Roskamp**

Mentors: Emilie Dykstra Goris,  
PhD, RN<sup>1</sup> and Marcy Achterhof,  
MSM, BSN, RN, CEN<sup>2</sup>

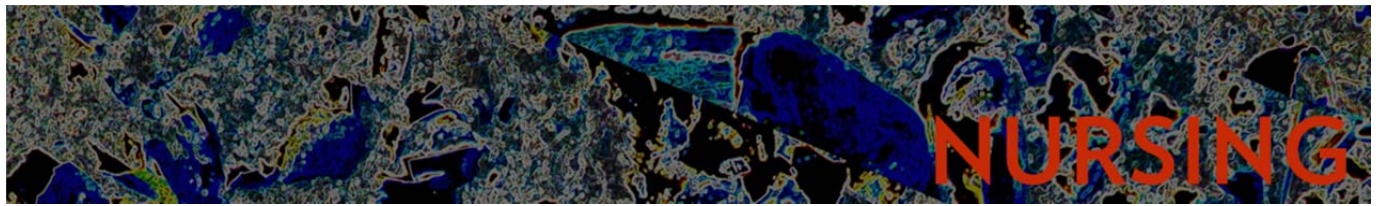
<sup>1</sup>Hope College Department of  
Nursing and <sup>2</sup>Holland Hospital

*This research was supported by  
Holland Hospital and the Hope  
College Department of Nursing.*

postpartum hospital stay and asked to complete a second copy of the PDRFQ+EPDS while inpatient to provide test-retest reliability when compared to the previously completed PDRFQ+EPDS, given as part of routine care. A convenience sample of n=x postpartum mothers will be recruited from a Midwest hospital. SPSS 21 software will be used to analyze data to determine test-retest reliability. Results are pending. Conclusions are pending. Limitations include convenience sampling, limited generalizability, and self-reporting. The primary implication is confirming reliability of the revised PDRFQ+EPDS for implementation into nursing practice.

Postpartum depression (PPD) can have a negative impact on a mother, infant, and family. Developing methods to identify risk factors or the presence of PPD is an important step in helping mothers' receive treatment. The purpose of this study is to run factor analysis on the revised Postpartum Depression Risk Factors Questionnaire (PDRFQ) given alongside the Edinburgh Postnatal Depression Scale (EPDS). This will allow for the comparison of common underlying dimensions. The PDRFQ is a nine-item risk factor screening tool and the EPDS is a 10-item self-assessment tool. The PDRFQ and EPDS will be administered in the hospital within two days after giving birth, and the EPDS again through phone follow-up at 6 weeks, 6 months, 12 months and 18 months postpartum. The nursing theoretical framework used is Sr. Callista Roy's Adaptation Model which speaks to how mothers may have to adapt to the change of caring for an infant. A convenience sample of postpartum women will be used. The setting is a large Midwest hospital with the possibility of a multisite study in the future. This is a longitudinal, descriptive, prospective research study. SPSS21 software will be utilized. The overall results and conclusions of the study are pending. This study will provide nurses with the information of how different factors may relate or interact in the development of PPD, thus helping to better understand and predict PPD in patients. Limitations include limited generalizability, limited diversity, and the possibility of skewed results because of the self-assessment of the EPDS.

Nurses play a key role in patient medication education, which impacts medication adherence and affects patient outcomes. This study examined how Emergency Department (ED) nurses in a small community hospital educated patients about medications in order to identify strengths and areas for improvement using a short questionnaire in conjunction with observation. A convenience sample of 101 registered nurses was recruited from the ED of a small community hospital in the Midwest. Analyses were completed using SPSS statistical software. Faye Abdellah's Theory, the foundation for this study, focuses on providing information to the patient to help meet each patient's needs and increase self-care ability. A data collection tool was created based on a draft version of the Emergency Department Consumer Assessment of Health Care Providers and Systems (ED-CAHPS) survey to assess whether the nurse explained medication purpose and possible side effects and to collect relevant demographic data (age, gender, degree, years of experience). There was a significant relationship between degree preparation and medication side effect explanation by nurses in the Emergency Department ( $\chi^2=3.84, p=0.05$ ). BSN-prepared nurses were more likely to explain medication side effects to each patient. This study concluded that there is room for improvement regarding provision of medication side-effect education to each patient. Limitations included participation/observation bias, limited generalizability, and



small sample size. The ED-CAHPS survey will dictate future reimbursement of the hospital, contribute to the quality improvement of the unit, and potentially identify areas of nursing practice in need of intervention. Future nursing research will need to be done to identify whether or not improvement has occurred based on the changes made as a result of this study.

### Hospital Readmission Risk Prediction Models: A Literature Review

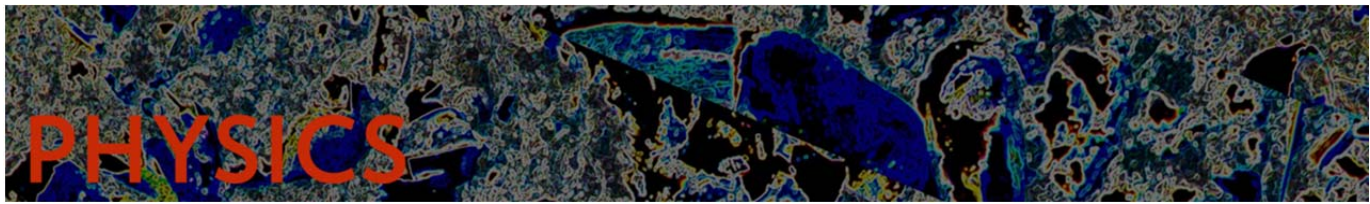
#### **Kathryn Shanklin**

Mentors: Rob Schwartz, MBA, MHA, MS/MIT<sup>1</sup>, Tanya Young, MBA, BSN, RN<sup>1</sup>, and Emilie Dykstra Goris, PhD, RN<sup>2</sup>  
<sup>1</sup>Holland Hospital, <sup>2</sup>Hope College Department of Nursing

Limiting 30-day hospital readmissions, a major cost factor for healthcare organizations, requires identifying high-risk patients so that nursing interventions aimed at reducing readmission may be implemented. The identification of key variables contributing to readmission is essential for the development of effective 30-day readmission risk prediction models. The purpose of this study was to complete a comprehensive literature review to examine existing published readmission risk-prediction models and the unique variables utilized in each model. Orem's Self-Care Deficit Nursing Theory served as a foundation for this research as it demonstrates the importance of identifying self-care deficits so that specialized nursing assistance can be provided where most needed. An extensive review of the literature from September, 2010 through September, 2015 was completed with Cochrane Library, MEDLINE, and CINAHL databases using the keywords readmission prediction model, readmission algorithm, and risk assessment tool. The literature search yielded 16 articles that met the inclusion criteria. The most common variable categories included in the algorithms were demographics, diagnosis, number of admissions, procedures, laboratory values, length of stay, comorbidities, and socioeconomic indicators. Demographics and health literacy were the most promising readmission risk prediction variable categories based on this review. Limitations for this study include the use of published literature when many hospitals use unpublished hospital-specific algorithms. Additionally, specific variables are rarely included in the literature so this study evaluated broad variable categories. A comprehensive understanding of readmission prediction models and variables can direct future nursing research by contributing to the development of increasingly effective models as well as identifying pertinent variables indicating patient readmission risk.

*Psychology and chemistry  
students at the Celebration,  
2016.*





## Production of Unbound Resonance in $^{23}\text{O}$

**Jaelyn Brett**

Mentor: Dr. Paul DeYoung  
Department of Physics

*This material is based on work supported by the Hope College Dean for Natural and Applied Sciences and the Hope College Department of Physics' Dr. Harry and Jeannette Frissel Research Fund.*

The nuclear structure of a state in a given isotope is determined by which nucleons occupy the bound and unbound energy levels. This state determines the energy of decay, which can be calculated from the energy and momentum of the fragment and neutron. From the calculated decay energy, information about an isotope's nuclear structure can be found. At a National Superconducting Cyclotron Laboratory experiment, a 101.3 MeV/u  $^{27}\text{Ne}$  ion beam hit a liquid deuterium target, causing reactions which produced several isotopes. Many of these isotopes decayed, resulting in a charged fragment and one or more neutrons. A superconducting dipole magnet bent the path of the fragments into a series of charged-particle detectors. Neutrons from these decays were measured as they interacted with arrays of scintillating plastic bars. One of the isotopes produced was  $^{22}\text{O}$ , most likely formed in two ways in this experiment. Either  $\alpha$ -stripping of the  $^{27}\text{Ne}$  beam resulted in  $^{23}\text{O}$ , which decayed into  $^{22}\text{O} + n$  or 2-proton stripping of the  $^{27}\text{Ne}$  beam resulted in  $^{25}\text{O}$ , which decayed into  $^{22}\text{O} + 3n$ . The cross-sections and the nature of decay for both of these processes will be determined. In addition, resonances of other unbound nuclear systems may also be included for cross-section production comparisons.

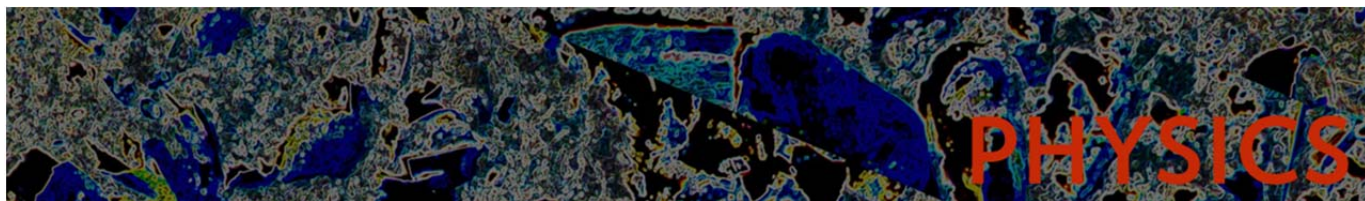
## Spin-Dependent Cyclotron Total Widths in Strong Magnetic Fields

**Sarah Caballero**

Mentor: Dr. Peter Gonthier  
Department of Physics

*This research was supported by the National Science Foundation (Grant No. AST-1009731), the NASA Astrophysics Theory and Fundamental Program (NNX13AO12G / 12-ATP12-0169), the American Physical Society, and the Michigan Space Grant Consortium.*

We are developing compact, analytical expressions of the cyclotron total spin-dependent widths, or lifetimes, of the excited lepton, Landau states. These widths are required in our recent Compton scattering developments for strong-field magnetar magnetospheres. We begin with the analytics for the spin-dependent widths presented in Sina (1996), which has been our source for the development of Compton scattering, and establish equivalency with the differential widths developed by Latal (1986). Both approaches implement correct Sokolov & Ternov wave functions. From here, we make further improvements to develop an integral for the total differential widths with the integration variable only present in the square of the associated Laguerre functions. With the use of several series representations, we obtain an integral in the form previously used in our efforts. The result is an expression that includes Legendre functions of the second kind with an argument  $>1$ , for which we seek an algorithm for efficient evaluation. Exploring two possibilities, recursion relations and hypergeometric functions, we find that the former breaks down for large values of the magnetic field ( $B$ ) and the initial Landau state ( $n$ ) due to the argument being  $>1$ . Taking the hypergeometric approach, we achieved numerical values that agree with Latal (1986) and Sina (1996) results for small  $n$  and  $B$ , but the analytics break down for large  $n$  and  $B$ . This problem encourages the development of asymptotic approaches similar to those developed in the past but for spin-averaged widths. These processes will be applied to future work.



### Characterization of the Pseudocapacitive Nature of Surface Bound Prussian Blue Analogues

**Daniel Clark**

Mentor: Dr. Jennifer Hampton  
Department of Physics

With the increased use of intermittent renewable energy sources, more efficient methods of energy storage must be explored. Electrochemical capacitors provide a larger volumetric charge density than physical capacitors while maintaining fast charge and discharge rates. Prussian Blue analogues (nickel and cobalt hexacyanoferrate) are ideal pseudocapacitors for frequent charge and discharge cycles since the crystalline structure does not physically change during switching, causing less stress on the film. This project examines the charge transfer and diffusion coefficients for nickel and nickel-cobalt thin films modified with potassium hexacyanoferrate. The films were examined using a scanning electron microscope, an atomic force microscope and an electrochemical workstation to determine their composition, topography and pseudocapacitive nature. Preliminary data suggest that nickel-cobalt films have a larger quantity of charge and have a lower diffusion coefficient per charge than nickel films.

*This work is supported by the Hope College Jacob E. Nyenhuis Faculty Development Fund, the Hope College Department of Physics' Guess Research Fund, and the National Science Foundation under NSF-RUI Grant No. DMR-1104725, NSF-MRI Grant No. CHE-0959282, and NSF-MRI Grant No. CHE-1126462.*

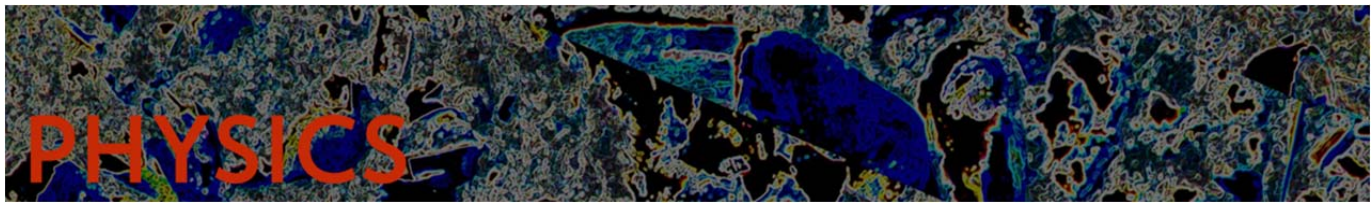
### Development of a Novel Method to Measure Per- and Polyfluoroalkyl Substances in Paper and Textiles

**Margaret Dickinson, Cody Berkobien, Megan Czmer, John Harron, Briana Linton, David Lunderberg, Brandon Miller, Evelyn Ritter, and Shannon Urbanik**

Mentors: Dr. Graham Peaslee and Dr. Paul DeYoung  
Departments of Chemistry and Physics

Per- and polyfluoroalkyl substances (PFASs) are chemical compounds used as powerful, long-lived surfactants in many consumer products. Because of the environmental persistence of PFASs, their ability to bioaccumulate, and their suspected human toxicity, new methods to identify these chemicals in consumer products are needed. Current techniques to measure PFASs involve liquid chromatography-tandem mass spectrometry (LC-MS/MS) which requires significant time and expense per sample for analysis. Particle Induced gamma-ray emission (PIGE) spectroscopy is an established ion beam analysis method that utilizes a beam of accelerated protons to excite  $^{19}\text{F}$  nuclei in a sample. As these nuclei return to their ground state, they emit characteristic gamma rays that can be used to identify and quantify the total fluorine content in a sample. In this study, paper and textile samples were analyzed with LC-MS/MS, paired with the total oxidizable precursor (TOP) assay, and with PIGE. A set of PFAS reference standards were created by depositing known amounts of perfluorooctanoic acid onto filter paper, and these standards were used to determine the fluorine concentration on papers and textiles. In addition, preliminary results suggest that the contact angle of water on paper is roughly associated with the presence of PFAS. A comparison of these results reveals that PIGE is an effective tool to determine the presence or absence of PFASs added to these consumer products.

*This work is made possible by funding from the National Science Foundation (NSF-RUI 1306074), the Department of Energy (DE-SC0007352), and the Hope College Department of Physics' Guess Research Fund.*



## Resonant Compton Physics for Magnetar Astrophysics

**Jesse Ickes, Matthew Eiles, and Matthew Baring**

Mentor: Dr. Peter Gonthier  
Department of Physics

*This work is made possible by the generous support of the National Science Foundation (Grant No. AST-1009731), the NASA Astrophysics Theory and Fundamental Program (NNX13AO12G / 12-ATP12-0169), and the Michigan Space Grant Consortium.*

Various telescopes including RXTE, INTEGRAL, Suzaku, and Fermi have detected steady non-thermal X-ray emission in the 10 - 200 keV band from strongly magnetic neutron stars known as Magnetars. Magnetic inverse Compton scattering is believed to be the leading candidate for the production of this intense X-ray radiation. Scattering at ultra-relativistic energies leads to attractive simplifications in the analytics of the magnetic Compton cross section. We have recently addressed such a case by developing compact analytic expressions using correct spin-dependent widths acquired through the implementation of Sokolov & Ternov basis states, focusing specifically on ground-state-ground-state scattering. Compton scattering in Magnetar magnetospheres can cool electrons down to mildly relativistic energies. Moreover, soft gamma-ray flaring in Magnetars may involve strong Comptonization in expanding clouds of mildly relativistic pairs. Such environs necessitate the development of more general magnetic scattering cross sections, in which the incoming photons acquire substantial incident angles relative to the field in the rest frame of the electron leading to arbitrary Landau excitations of the intermediate and final states. Due to the rapid transitions of the excited-state to the ground-state, the initial electron is still assumed to be in the ground-state. The cross sections treat the plethora of harmonic resonances associated with various cyclotron transitions between Landau states. We present numerical results to show the comparisons to highlight the role of the spin-dependent widths of the resonances. The findings presented here will have applications to various neutron star problems, including computation of Eddington luminosities and polarization mode-switching rates in transient Magnetar fireballs.

## PIXE-NRA Analysis to Determine Metalloprotein Complete Stoichiometry

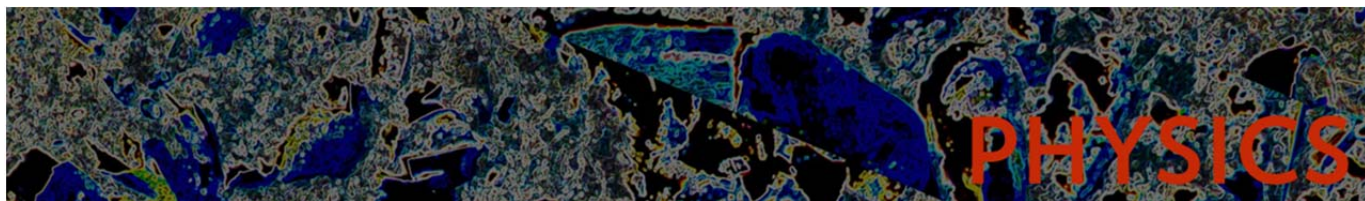
**Elizabeth Lindquist**

Mentors: Dr. Paul DeYoung and Dr. Graham Peaslee  
Department of Physics and Chemistry

While approximately a third of all proteins are metalloproteins, their stoichiometric ratios are still largely unknown. Current elemental analysis procedures are capable of determining which metals are in a protein, but it is difficult to determine how many. To address this, an ion beam analysis method is being developed using Particle-Induced X-ray Emission (PIXE) and Nuclear Reaction Analysis (NRA). PIXE determines the elemental composition of the sample and provides a metal-to-metal ratio. However, this is not the desired ratio of metal per protein. NRA uses Rutherford scattering cross-sections to determine an exact ratio of number of atoms to number of proteins. When PIXE and NRA are used in conjunction, it is possible to accurately determine the desired metal-to-protein stoichiometric ratio. In order to ensure accuracy, this method is being developed on Cyanocobalamin (B<sub>12</sub>) and Cytochrome C which have known stoichiometries. This method will provide us with a standard such that it will be possible to obtain the atomic ratios of additional metalloproteins with confidence. Recent advances include revising sample preparation, refining the substrate, and improving data analysis.

*This work is supported by the National Science Foundation under grant 1306074; and the National Science Foundation Scholarships for Transfer Students in Science, Engineering, and Mathematics 1153600.*





## Development of a Low-Cost, Rapid Screening Method to Measure Per- and Polyfluoroalkyl Substances in Groundwater

**David Lunderberg, Cody Berkobien, Megan Czmer, Margaret Dickinson, John Harron, Briana Linton, Brandon Miller, Evelyn Ritter, and Shannon Urbanik**  
Mentors: Dr. Graham Peaslee and Dr. Paul DeYoung  
Departments of Chemistry and Physics

Because of the environmental persistence of per- and polyfluoroalkyl substances (PFASs), their ability to bioaccumulate, and their suspected human toxicity, new methods to identify these chemicals at trace levels in groundwater are needed. Particle induced gamma-ray emission (PIGE) spectroscopy is an established ion beam analysis technique that has been used to quantitatively measure light elements in diverse target materials. PIGE utilizes a beam of accelerated protons to excite  $^{19}\text{F}$  nuclei on the surface of a target. As these nuclei return to their ground state, they emit characteristic gamma-rays that can be used to quantify the total fluorine concentrations in a sample. An in-air PIGE method has been developed and is shown to be an effective tool to determine the presence or absence of PFASs extracted from groundwater samples. Solutions of perfluorooctanoic acid (PFOA) were extracted onto the surface of a weak anion exchange solid-phase extraction (SPE) column, and the total fluorine measured on this column by PIGE correlates well with the initial PFOA concentrations. Subsequent experiments with actual groundwater samples demonstrate PIGE to be an inexpensive, rapid, and non-destructive method for total fluorine analysis, which can be adapted to detect environmentally relevant PFASs concentrations in groundwater.

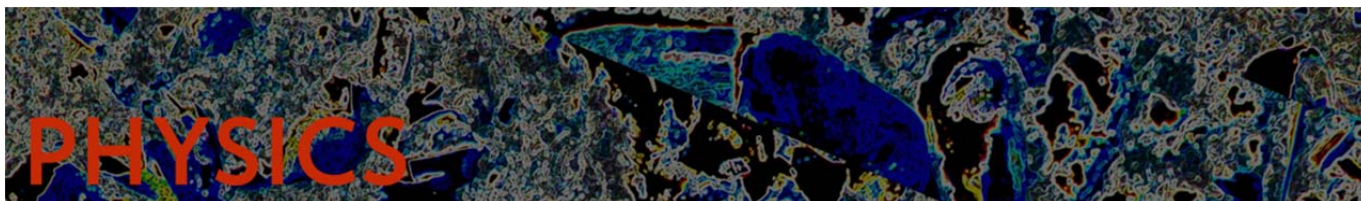
*This work is made possible by funding from the National Science Foundation (NSF-RUI 1306074), the Department of Energy (DE-SC0007352), and the Hope College Department of Physics' Guess Research Fund.*

## Population of $^{13}\text{Be}$ in Nucleon-Exchange Reactions

**Braden Marks**  
Mentor: Dr. Paul DeYoung  
Department of Physics

*This material is based upon work supported by the National Science Foundation under grant No. PHY-1306074.*

Neutron-unbound nuclei are traditionally formed by the removal of one or more nucleons from a fast beam of ions. This method often results in a background, which is difficult to separate from the particle of interest. Nucleon-removal entrance-channels also require the ion beam to be more massive than the particle of interest, which presents the additional challenges of the beam being unstable, difficult to make, and low in intensity. In an effort to avoid these obstacles, the present work was done with a more unorthodox entrance-channel called nucleon-exchange. At the National Superconducting Cyclotron Laboratory (NSCL), a  $71 \text{ MeV/u } ^{13}\text{B}$  beam impinged on a  $47 \text{ mg/cm}^2$  thick target of  $^9\text{Be}$ . As a result numerous reactions occurred, including the population of  $^{13}\text{Be}$  through the nucleon-exchange entrance-channel. The  $^{13}\text{Be}$  nuclei decayed to  $^{12}\text{Be}$  and one neutron in approximately  $10^{-21}$  seconds. The resulting neutrons were detected by either the Modular Neutron Array (MoNA) or the Large multi-Institution Scintillator Array (LISA), while the  $^{12}\text{Be}$  nuclei were directed through an array of charged particle detectors by a 4T superconducting sweeper magnet. The four-momentum vectors of the fragment nucleus and the neutron were calculated to determine the decay energy of  $^{13}\text{Be}$ . Monte-Carlo simulations consistent with results from previous analyses of  $^{13}\text{Be}$  were satisfactorily fit to the decay-energy spectrum. Additionally, the cross-section for the nucleon-exchange entrance-channel was determined to be consistent with the theoretical prediction.



## Exploring the Effect of Electrolyte Composition on the Charge Capacity of Nickel Hexacyanoferrate Thin Films

**Walter Meeker**

Mentor: Dr. Jennifer Hampton  
Department of Physics

*This work is supported by National Science Foundation under NSF-RUI Grant No. DMR-1104725.*

A problem that plagues many existing methods of clean energy production is energy storage; the batteries used are very expensive and require rare elements such as lithium and platinum. It is therefore essential to develop cheaper, more earth-abundant replacements for the materials currently used. Due to the intermediate position they occupy between traditional batteries and capacitors, electrochemical capacitors may play a role in solving this problem. This project studies Nickel Hexacyanoferrate (NiHCF) thin films, a material that could be used as part of an electrochemical capacitor. The NiHCF thin films were electrochemically synthesized and cycled with cyclic voltammetry in various electrolyte solutions. The material's charge capacity and diffusion coefficient in each respective electrolyte solution were calculated from the data collected. An enhanced understanding of the interaction between NiHCF thin films and various electrolytes allows the performance of the NiHCF thin films to be optimized. Once optimized, it becomes possible to understand the role NiHCF thin films will play in future methods of energy storage.

## Bending and Bifurcation of a Superconductor Resonator with Engineered Nonlinearity

**Alec Nelson**

Mentor: Dr. Stephen Remillard  
Department of Physics

*Funding for this project was provided by The Hope College Natural and Applied Sciences Division and Award number DMR-1206149 from the National Science Foundation.*

This experiment is designed to compare the feedback from an altered superconductor resonator with a conventional, unaltered superconductor resonator. Superconducting transmission lines are patterned on a lanthanum aluminium substrate chip with a geometry that resonates within the microwave range. Nonlinearities, distortion of the signals in the superconductor, can be engineered into the transmission line using an ion beam or other artificial source of radiation. The sample in this experiment, thin-film yttrium barium copper oxide: YBCO was sent to a facility in Italy to be engineered with a nonlinearity and then characterized in a low temperature (77 K) cryostat. This means that the power dependence of a traditional resonator will differ greatly from this sample. Two key figures of merit of superconducting resonators are their critical power, where the power input to the resonator is most absorbed, and critical frequency of the sample, the frequency at which the critical power occurs. Both were found to vary with temperature, and at high incident power the frequency response of the resonator begins to experience deformation. The change of the power response as frequency is swept through (bending) and the hysteresis in the curve (bifurcation) form the core disparities between traditional superconducting resonators and those with engineered nonlinearities.

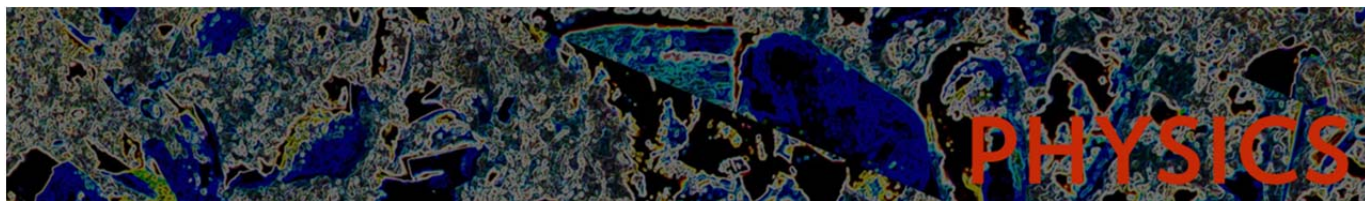
## Dealloying NiCo and NiCoCu Alloy Thin Films Using Linear Sweep Voltammetry

**Benjamin Peecher**

Mentor: Dr. Jennifer Hampton  
Department of Physics

*This research was supported by an award to Hope College from the Howard Hughes Medical*

When electrodeposited into thin films, metals have unique and well-known electrochemical potentials at which they will be removed from the film. Theoretically, these potential differences can be utilized to re-oxidize only certain metals in an alloy, thus altering the film's structure and composition. This dealloying process is understood relatively poorly in the case of nickel-cobalt and nickel-cobalt-copper thin films. Here we discuss these films' response to linear sweep voltammetry as a means of electrochemical dealloying. A three-electrode electrochemical cell was used for both deposition and dealloying. To perform linear sweep voltammetry on a sample, it was immersed in a sodium sulfate solution in the electrochemical cell and a steadily increasing potential was placed between the working and reference electrodes. For each of four different metal ratios, films were dealloyed to various potentials in order to gain insight into the evolution of the film over the course of the linear sweep. Capacitance, topography,



*Institute through the Undergraduate Science Education Program, the Hope College Department of Physics' Dr. Harry and Jeannette Frissel Research Fund, and the National Science Foundation under NSF-RUI Grant No. DMR-1104725 and NSF-MRI Grant No. CHE-0959282.*

### Crystalline Channeling of MeV Ion Beams

#### Jacob Pledger

Mentors: Dr. Stephen Remillard and Dr. Paul DeYoung  
Department of Physics

*This work was funded by a seed grant from the Michigan Space Grant Consortium and by the Hope College Natural and Applied Sciences Division.*

### Differential PIXE Analysis of Multi-layer Auto Paint

#### Christina Sarosiek

Mentors: Dr. Paul DeYoung and Dr. Graham Peaslee  
Departments of Physics and Chemistry

*This effort is based upon work supported by the National Science Foundation under grant No. PHY-1306074.*

and composition were examined for each sample before and after linear sweep voltammetry was performed. For nickel-cobalt films with high percentages of nickel, dealloying resulted in almost no change in composition, but did result in an increased capacitance, with greater increases occurring at higher linear sweep potentials. Dealloying also resulted in the appearance of large (100-1000 nm) pores on the surface of the film. For nickel-cobalt-copper films with high percentages of nickel, copper was almost completely removed from the film at linear sweep potentials greater than 500 mV. Preliminary data suggested that the linear sweep first removes larger copper-rich dendrites from the film's surface before creating numerous nano-pores, resulting in a net increase in area.

Thin film strontium titanate ( $\text{SrTiO}_3$ ) on single crystal MgO substrate, and thin film strontium manganese oxide ( $\text{SrMnO}_3$ ) also on single crystal MgO substrate, are being considered for use in engineered superlattices. Crystal matching of the films to the substrates is indicated by channeling of an ion beam through the lattice. With its ability to resolve depth in a sample, Rutherford backscattering of helium ions is used to determine layer thickness and the depth profile of the elemental composition of a sample. Ion beam channeling occurs when the beam's incident angle is parallel to crystal planes, or rather normal to the surface. Channeling can occur in well-ordered and pure crystals, providing an indication of sample quality. Comparison of the backscattering yields at different incident angles will show a drop in yield as the optimum channeling angle is approached. Channeling is seen with the bulk  $\text{SrTiO}_3$  sample as well as with the thin film samples. Even though an 8% lattice mismatch exists between  $\text{SrMnO}_3$  and MgO, channeling was still evident, although in this case the yield suppression revealed structure around normal incidence.

Differential Particle Induced X-ray Emission (DPIXE) is a technique developed to analyze multi-layered samples in a non-destructive manner. Analysis of auto paint, in particular, is beneficial in legal cases involving automobile crimes. Particle Induced X-ray Emission (PIXE) involves particle beams produced by an ion beam accelerator to analyze the concentration of elements present in one or more layers. As the beam penetrates into the sample, characteristic x rays of various energies are emitted which correspond to different elements in the sample. DPIXE involves varying the beam energy so the beam penetrates to different depths within the sample, emitting x rays only from the layers through which the beam has passed. Quantitative analysis is made easier by first taking measurements of the thickness of each layer. A Scanning Electron Microscope (SEM) with Energy Dispersive Spectroscopy (EDS) capabilities allows us to view a cross-section of paint and measure the thickness of each layer, as well as earn a better understanding of which layers hold the major elements within the sample. A careful combination of the SEM, EDS and DPIXE data is required to obtain accurate concentrations of elements in a sophisticated peak fitting program (GeoPIXE) with calculations of energy loss as the beam penetrates to different depths and reabsorption of x rays as they travel out of the sample towards the detector. This technique has shown to produce reasonable results when analyzing samples containing layers of uniform thickness.

# SOCIAL SCIENCES

## COMMUNICATION

### Predicting Closeness Behaviors: Additional Validation of the Unidimensional Relationship Closeness Scale

**Katrina Greathouse, Brook Hubbel, and Nathan Long**

Mentors: Dr. Jayson Dibble and Dr. Carrie Bredow  
Departments of Communication and Psychology

The Unidimensional Relationship Closeness Scale (URCS; Dibble, Levine, & Park, 2012) was introduced as a self-report measure of relationship closeness. This research seeks to provide additional evidence for the construct validity of the URCS. After completing the URCS and other leading measures of closeness, participants will be randomly assigned to hold a short conversation with a friend or a stranger. If the URCS is measuring relational closeness, then it should predict behavioral outcomes associated with closeness such as physical distance between conversation partners and amount of eye contact. Moreover, we seek to learn whether the URCS will outperform the leading alternative measures. Results will inform better measurement of relationship closeness.

### From Hippies to Hipsters: Changing Expressions of Cultural Citizenship at Music Festivals

**Hope Hancock**

Mentor: Dr. Marissa Doshi  
Andrew W. Mellon Foundation Scholars Program and Department of Communication

Music festivals continue to attract young citizens across the United States. As Ryan Moore suggests in *Sells Like Teen Spirit*, the music of the 1960s was embraced as a way of bringing change to the world. As music continues to change, it represents cultural shifts. Music has been, and will continue to be, a representation of shifting ideologies throughout the decades.

This project compares Woodstock's impact on youth culture with the impact of modern music festivals, like Coachella, on contemporary youth culture. Data analyzed includes news articles, social media, and archival material. Promotional materials will also be examined to see how audiences are targeted differently across the years and what this reveals about the purpose of music festivals. Do youth still engage in music festivals as a form of social protest? Are music festivals a platform for youth to participate in cultural citizenship? Or are modern music festivals merely a large business venture? These questions animate this project to reveal how music continues to be an outlet for today's youth to engage with cultural citizenship. However, music festivals are no longer used as a platform for the kind of cultural citizenship that was prevalent at Woodstock. Instead, they have become a space for youth to engage in commercialized neoliberal forms of citizenship.

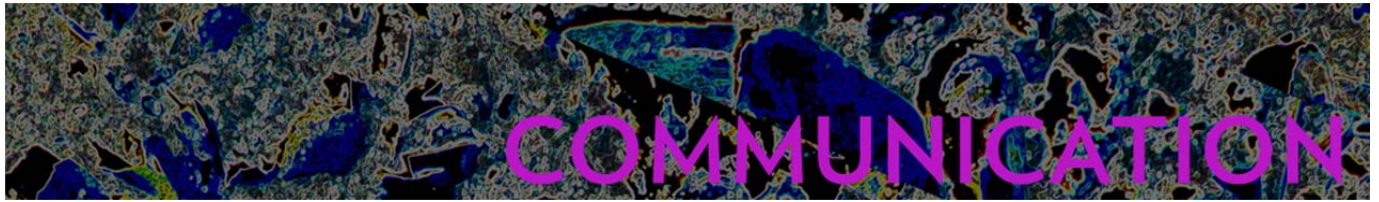
This project will be presented through the use of a fully interactive and immersive digital timeline hosted on a Weebly site. The timeline will include a variety of media, including photographs, music, videos, and oral narratives.

### Exploring Visual Appeal of Women's Health Apps

**Noah Jurik**

Mentor: Dr. Marissa Doshi  
Department of Communication

Women use mobile phones to manage their health (mHealth), highlighting the need for an analysis of the range of apps available to women to manage their health. Recently, researchers have begun questioning behaviors and knowledges prioritized through mHealth design. In addition, the intersections of gender and mHealth in terms of design require further examination. However, what makes iTunes health applications desirable based on visual appeal remains under-explored. This study will analyze the popularity of women's health applications based on the color and images included in the icon. Research question: Which colors and images of a women's health app icon correlate with popularity? For this content analysis of the visual appeal of women's health apps, popularity was



measured by number of reviews and ratings based on iTunes' five-star scale. Popularity was correlated with color and images on the icon. The results of this study provide a methodological framework for designers of women's health apps and improve understanding about which visual appeals are persuasive in digital design.

*This project was funded by the Hope College Department of Communication.*

## Shaped by Flames

**Noah Jurik and Robert Byrne**  
Mentor: Dr. Choonghee Han  
Department of Communication

Hope College occupies about a four block diameter of downtown Holland, MI, but it wasn't always so. We (Noah Jurik & Robert Byrne) began investigating the consolidation of Hope's campus after Van Raalte Hall, a major administration building, burned to the ground in April of 1980. This documentary follows the stories of six people that were on campus at the time, from their experiences of the building, the fire, and the aftermath, to their impressions of how campus life changed as a result. Thanks to the Joint Archives of Holland and Hope College's Former Associate Vice President of Public Relations, Tom Renner, we were able to compile an extensive photographic history of the event.

*This project was supported by the Hope College Department of Communication and the Joint Archives of Holland.*

## Cross-Cultural Photographic Representations of Happiness in USA, Japan, and Honduras in College Students

**Jean Luc Miralda**  
Mentors: Dr. Deirdre Johnston<sup>1</sup>  
and Dr. Rika Hanamitsu<sup>2</sup>  
Department of Communication,  
<sup>1</sup>Hope College, <sup>2</sup>Waseda  
University, Tokyo, Japan

Happiness can be found in little everyday things, actions, and places, or it can be created by people, events, or animals. Although there is a basic definition of happiness, its interpretation and meaning is different among cultures. In this case, my research is to find out what the differences are in three cultures: American, Japanese and Honduran, primarily focused on college students. By a convenient sample, we have recruited 160 US participants in Michigan, Iowa, Ohio, and Illinois, Japanese participants in Tokyo, and Honduran participants in Tegucigalpa and San Pedro Sula. Participants were required to complete a pre- and post-test that employed the Deiner's Flourishing Scale (2009) in which we aimed to measure their perception of self-esteem, social relationships, purpose and optimism. In our post examination we provided the participants with an opportunity to reflect upon the prior 24 hours in which they were required to take 5 photographs throughout the day. Although some of our data is still being translated from Spanish to English, and we are still receiving more participants from Honduras, we are finding very interesting differences like degree to which other people are integrated into their happiness, behaviors in the moments of happiness, and the different contexts in which people realize happiness. All narratives will be coded for emotional complexity according to the Levels of Emotional Awareness Scale (Lane, Quinlan, Schwartz, Walker & Zeinlin, 1990). We will be employing an ANOVA analysis to compare pre- and post-test scales in which we plan to evaluate whether participants' perception of self is significantly impacted by reflecting upon their last 24 hours. This cross-cultural study can provide us with an avenue of understanding the different sources of pleasures found in every culture, as well as how we may construct, experience and express happiness differently.



### Going, Guzzling, Gone? The Effects of Gasoline Prices on Consumer Vehicle Procurement

**Kyle Anderson**

Mentor: Dr. Sarah Estelle  
Department of Economics and  
Business

First enacted by the United States Congress in 1975, Corporate Average Fuel Economy (CAFE) standards were imposed by policymakers on manufacturers to regulate automobile fuel efficiency, with the goal of steadily improving average fuel economy. However, if consumers' vehicle procurement decisions counteract fuel efficiency regulation during periods of low gasoline prices despite CAFE standards, alternative regulation targeting gasoline prices directly may be more effective. I will use monthly, state-level panel data from IHS Automotive during 2010 - 2015 to estimate the effect of gasoline prices on new vehicle registrations in models incorporating state and month fixed effects. Since the data are categorized by vehicle class and method of acquisition (purchased versus leased) with retrospective gasoline prices, I can consider both the magnitude and length of gasoline price changes necessary to impact new registrations of various vehicle classifications, with an emphasis on SUVs (Sport Utility Vehicles). By evaluating different classes of vehicles purchased, as well as the acquisition methods during periods of changing gasoline prices with varying length and intensity, this study will analyze the potential myopia in the consumer vehicle acquisition process.

### Driving Down Teen Employment? Determining the Effect of GDL Programs on Employment Among 16- and 17-year-olds

**Alexander Belica**

Mentor: Dr. Sarah Estelle  
Department of Economics and  
Business

Beginning in the mid-1990s, states implemented more stringent Graduated Driver's License (GDL) restrictions on 16- and 17-year-olds who wish to obtain a driver's license. Data show that the implementation of such restrictions has coincided with a reduced rate of teen licensure. Contemporaneously, the number of high-school-aged students who hold part time jobs has also declined dramatically. While little research on the subject exists, economic studies support that the inability to access private transportation would increase the time cost of employment, consequently, reducing the likelihood that a teen engages in market activity. This paper uses employment data from the Current Population Survey (CPS) to determine if the strengthening of GDL requirements has contributed to a decline in 16- and 17-year-old labor force participation or the number of hours teens work after controlling for a number of other factors. My findings indicate that the harshest GDL restrictions reduce the average number of hours worked.

### Flying Fears Revealed: Effect of September 11, 2001 Terrorist Attacks on Short-Term Domestic Airline Ridership

**Ethan J. Beswick**

Mentor: Dr. Sarah M. Estelle  
Department of Economics and  
Business

Over the course of the last 15 years, the United States has never recorded a lower month of enplaned passengers on domestic flights than September, 2001. This particular month was marked by the terrorist attacks of September 11, 2001, and the total airline ridership count dropped by 26 million passengers—a 47 percent drop—from the previous month (Bureau of Transportation Statistics). With significant media attention on the attacks, the potential dangers of flying were once again revealed, resulting in passengers choosing not to fly as frequently, if at all. This study attempts to quantitatively explain what effect this fear had on ridership immediately following the 9/11 attacks. Using Department of Transportation data, airline ridership is examined in order to determine what percentage of the resulting decrease in ridership can be attributed to passengers' fears of flying and what role mediating factors could have in the decreased number of passengers choosing to fly. Using a difference-in-differences model, the top 30 airports, as measured in terms of enplaned passengers, are compared to smaller airports before and after the 9/11 attacks. The resulting regression shows a significant drop in ridership at the largest airports which is consistent with an additional fear of flying from these more heavily trafficked locations.



## Evaluation of the Gender Pay Gap: The Value of Parental Leave

**Ryan Campbell**

Mentor: Dr. Sarah Estelle  
Department of Economics and Business

On April 8<sup>th</sup>, 2014, President Obama signed two executive orders aimed at closing the wage gap between men and women. These acts emphasize the national dialogue, mostly heated, over the topic of equal pay across genders. This paper aims to shed light on the wage gap the president is referring to in the aforementioned quote. Using data from the 13<sup>th</sup> year of the 1997 cohort of the National Longitudinal Survey of Youth, conducted by the Bureau of Labor Statistics, the difference in coefficients will be studied. By using an empirical method aimed at addressing the issue of bias in maternity/paternity leave provision, the effect that receiving parental leave benefits has on monetary wages will be examined. What will be shown is that the pay gap in pure averages can be pared down piece by piece when factors such as education, industry choice, age, and benefits are controlled for; revealing that the gap in compensation, relative to mediating factors, is indeed smaller than the 22-25 cent over dollar figure that is touted most frequently. The question being: *What effect does paid parental leave have on wages, and how does the gender skewed provision of this benefit affect the gender wage gap?*

## The Effects of Education on Economic Growth

**Kevin Cross**

Mentor: Dr. Sarah Estelle  
Department of Economics and Business

There are strong reasons why education can help promote economic growth that do not always bear out in empirical research. Models, including both the Solow and Romer growth models, attempt to predict economic growth with many considering the effects of investments in human capital. I hypothesize that educational investments in developing countries have a significant positive impact on economic growth, but differ by region. Studying education and economic growth is important for determining why some developing countries are not keeping pace with others and influencing government policy toward education. According to the Global Monitoring Report from the World Bank, several developing counties invest only slightly more than 3 percent of their Gross National Income in education, less than the world average of 5.1 percent. Using data from the World Bank, this research tests the effects of various education indicators on economic growth using regression analysis including country fixed effects.

## The Impact of the Great Recession on Post-Secondary Enrollment in Japan

**Brett Dawsey**

Dr. Sarah Estelle  
Department of Economics and Business

This project seeks to investigate how the Great Recession of 2008 affected the decision of students to enroll in Japanese universities. Prior to 2008, the United States' system of higher education was experiencing major changes which made it difficult to determine the exact impacts of the Great Recession. The college-age student population increased, a greater proportion of students depended on loans to finance their education, and the amount of financial aid per student increased (Long, 2013). However, the Japanese system of higher education immediately prior to the Great Recession faced a fairly stable environment, except for the overall decline of the population. After the onset of the recession, unemployment rose, household income fell, and prices in the real-estate market dropped to around 50 percent above the previous low seen in 2002. Using data from the Statistics Bureau of Japan, I will explore how the Great Recession, through parental wealth, impacted enrollment rates in different prefectures throughout Japan. While literature exists showing that enrollment decisions in the United States are sensitive to housing market fluctuations, asking the same question outside of the United States could result in new findings which could further advise student loan and financial aid policy in Japan.



### Tipping the Scales: Do Gasoline Prices Fuel the Obesity Epidemic?

**Matthew Glowacki**

Mentor: Dr. Sarah Estelle  
Department of Economics and Business

Above normal body mass index (BMI) has become the norm for adults in the U.S., with overweight or obesity affecting two thirds of adults. Now, with gasoline prices falling, American households saved \$700 in annual gasoline expenditures in 2015 relative to 2014, it raises the question of whether this savings will translate into more expenditures on healthy activities. This paper examines the effects of changing gasoline prices on the obesity epidemic in the United States. I model consumer behaviors related to obesity within a rational choice framework allowing that gasoline prices might change mode of transportation through a substitution effect and/or any number of physical activities that an individual may participate in more or less due to an overall income effect associated with changing gasoline prices. Cross-sectional data from the American Time Use Survey (ATUS) over 2006 to 2008, provide detailed information on the amount of time Americans spend in a wide variety of activities including shopping, housework, and physical exercise, and incorporates individuals' BMI. Also using monthly state-level gasoline prices from the U.S. Energy Information Administration (EIA), this study employs year and state-level fixed effects to identify a casual connection between gasoline prices and obesity.

### The Influence of Religion on College Campus Crime

**Nicholas Glowacki**

Mentor: Dr. Sarah Estelle  
Department of Economics and Business

The feeling of safety on college campuses is an important aspect to millennial college students. According to the *Student Poll*, which surveys college students in the United States, seventy percent of 2007 college freshman view the safety on campus as an important factor in deciding which college to attend. In this research, I explore whether religious affiliated institutions have lower campus crime than nonreligious affiliated institutions. If criminal behaviors are the result of rational choices, how much does religious influence increase the cost of crime to decrease these choices? The Office of Postsecondary Education (OPE) provides campus safety and security panel data on the number of violent and property crimes on each U.S. college campus. Merging these crime statistics with detailed school characteristics from the Integrated Postsecondary Educational Data System (IPEDS), this research will identify colleges with a religious affiliation and examine the relationship between campus crime and religion.

### Which Activities Matter? The Effects of Preschool Curricula on Future Educational Outcomes

**David Green**

Mentor: Dr. Sarah Estelle  
Department of Economics and Business

As the literature in economics examining child participation in preschool has grown substantially in the past two decades, little has been done to determine what aspects of an early childhood education program make it effective. While most research in this field studies the broad effects of preschool participation on later-life educational and labor market outcomes, this paper investigates the relationship between engaging in specific math- or reading-related activities during preschool and children's future educational outcomes. Understanding the effects of particular activities is crucial for informing decision making by parents who send their children to preschool and policymakers trying to incentivize optimal early childhood investment. The Head Start Impact Study provides nationally-representative child-level data on the frequency with which children engage in certain math- and reading-related activities, such as reading stories aloud and playing math games, as well as teacher evaluations of children's math and reading aptitudes in second grade. I identify the effects of including specific activities in an early childhood education curriculum on future educational success by controlling for a variety of childcare provider characteristics and the socioeconomic background of children's families.





### Sexual Assault on Campus: How Does Socioeconomic Background Determine a Student's Likelihood to Report?

**Melanie Julison**

Mentor: Dr. Sarah Estelle  
Department of Economics and Business

This study examines the effect of students' family income on the number of reported sexual assaults on U.S. college campuses. Media coverage of college sexual assault pervades the news cycle. Studies have shown that sexual assault not only negatively impacts individuals physically and psychologically, but also negatively impacts their productivity and future labor outcomes and wages. While many colleges have increased efforts toward awareness and implemented prevention programs for sexual violence, it is still underreported by the individual and by the schools. The U.S. Department of Education College Scorecard Data and Campus Safety and Security Data provide information on the socioeconomic makeup of colleges and the number of sexual assault reports annually of each college and university in the United States. Past studies indicate that an individual's incentive to report crime is dependent on both their personal socioeconomic background and that of their environment. Social support is a benefit from reporting that may have a direct relationship with income. Potential social and psychological costs influence an individual's decision to report sexual assault. By studying reporting of sexual assault at colleges across the nation, this research will determine whether college and individual characteristics influence the probability that sexual assault occurs and is reported.

### Done Fuming Over High Gas Costs: Do Low Gas Prices Increase Automobile Purchases?

**Maxwell Kaiser**

Mentor: Dr. Sarah Estelle  
Department of Economics and Business

Recently, the United States has experienced the lowest gasoline prices per gallon in over a decade due to new technologies such as fracking and the opening of several oil reserves. These new, low gas prices allow households to experience false positive savings because the gasoline financial burden is lessened. This paper studies the effect on consumer demand for cars while paying specific attention to the effects of gasoline prices on automobile purchases. The data consists of nationwide, state level of monthly gasoline prices, gross state product, and car sales between 2005 and 2016. Evidence shows, historically, that the price of gasoline has impacted the way that automobiles are purchased. In times of high gas prices, consumers demand highly fuel-efficient vehicles as opposed to large passenger vehicles or gas-guzzlers. This paper aims to show the impact of all-time low gas prices on the market as a whole and whether an increase in automobile sales is experienced.

### Do Families Choose Segregation? The Impact of Local Education Market Composition on School Segregation

**Kaylee Kish**

Mentor: Dr. Sarah Estelle  
Department of Economics and Business

Recent school choice policies have raised important questions about the potential unintended consequences of competition among schools. This paper investigates the effect of the composition of a local education market as characterized by the number and type of schools nearby and the subsequent levels of segregation in each of the schools. Variation in preferences, values, and resources lead individual families to choose different types of schools, such as private, public and charter, for their student. I predict that these motivating factors will be consistent within racial groups, for example Hispanics attending Catholic schools in higher proportions due to the correlation between their race and religious preferences. Using panel data on K-12 schools in the US including precise geographic location, I estimate the impact on a given school's racial composition of nearby schools. This research accounts for endogenous school location decisions by controlling for observable time-varying school characteristics as well as time-invariant unobservables through school fixed effects. This empirical analysis will provide policymakers with more information about how the composition of a local education market influences the segregation levels of schools in that market.



## Smoking as a Predictor of Teenage Pregnancy

**Jessica Lindquist**

Mentor: Dr. Sarah Estelle  
Department of Economics and Business

Teenage pregnancy is an ongoing social and economic issue because those who become pregnant as teenagers have additional academic, personal, and financial challenges throughout their lives. Determining the relevance of an individual's time preference on the likelihood of becoming pregnant may identify helpful precautionary measures. A rational decision regarding sexual activity as a teenager involves benefits that are incurred more immediately, while the cost of sexual activity including possible pregnancy is delayed. This paper examines whether teenage smoking, as a proxy for time preference, is a significant predictor of teenage pregnancy. If teenagers who choose to smoke have a higher rate of time preference, then they might also weight more heavily the immediate benefits of sexual activity relative to the future costs. Using data from the National Longitudinal Study of Adolescent to Adult Health, this paper separately identifies the effect of time preference from other determinants of teenage pregnancy by employing a school fixed effects model and controlling for individual and family characteristics. The results suggest that a female teenager's decision to smoke regularly increases her likelihood of becoming pregnant by 3.85 percent. The results of the male regression models show there is no relationship between regularly smoking and getting someone pregnant, but smoking large quantities of cigarettes per month increased the probability of causing a pregnancy.

## A Chip Off the Block? Does Parental Marital Status Influence the Health Choices of Children?

**Lauren Mioduszewski**

Mentor: Dr. Sarah Estelle  
Department of Economics and Business

Existing economic research has established that parental divorce can have negative consequences for a child's mental health, home environment, and educational attainment. This study extends that research to examine whether parental divorce leads to poor health behaviors in children. With divorce rates hovering around 40 and 50 percent (U.S. Census Bureau), more American children may be at risk of experiencing negative effects of divorce. Negative health effects could be a result of children mirroring their parents' health behaviors, because parental behavior is a leading influencer on behavior of children. The National Longitudinal Survey of Youth 1997 provides panel data on individuals born between 1980 and 1984 including child health behaviors and will allow for child fixed effects to account for unobserved individual heterogeneity. This study will provide additional insights to parents about the consequences of divorce on their children and to policy-makers and educators who might respond with health interventions intended to counteract negative health influences at home.

# ECONOMICS AND BUSINESS

## The “Missing Women” and Gender Income Equality: Evidence from China’s One-Child Policy

**Liping Wang**

Mentor: Dr. Sarah Estelle  
Department of Economics and Business

China’s one-child policy limited all but 55 ethnic minorities in China to having one child during their lifetime. This policy dramatically reduced the total population in China but also skewed the sex ratio due to Chinese parents’ deeply rooted cultural preference for sons. Previous literature that examined the effects of the one-child policy mainly focused on the sex ratio, but little attention has been paid to some of the consequences. This paper discusses the phenomenon of the “Missing Women” and analyzes subsequent changes in the gender wage gap using data from the Chinese Household Income Project (CHIP) in 1988, 1995, 2002 and 2007. The theory of labor demand implies that if male and female labor are not close substitutes, a decrease in the supply of women workers could increase women’s wages and shrink the gender pay gap. Moreover, if an only daughter receives greater human capital investments than if a son was also born to the same family, a woman’s productivity may increase and consequently increase wages. These mechanisms may suggest the gender pay gap is subject to being narrowed under the influence of the one-child policy.

## The Impact of the Western Hemisphere Travel Initiative on U.S Travel to Mexico

**Matthew Webb**

Mentor: Dr. Sarah Estelle  
Department of Economics and Business

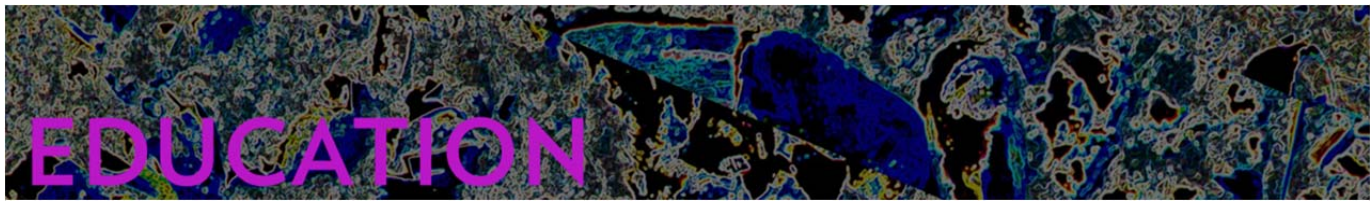
On June 1, 2009 the Western Hemisphere Travel Initiative (WHTI) imposed new regulations on travel across U.S borders. These regulations required that all individuals crossing the U.S-Canada and U.S-Mexico borders present a valid passport or other accepted documentation. These requirements may discourage cross-border travel due to the additional monetary and time costs of obtaining a passport, increased border wait times, or intimidation due to the impression of increased security at the border. Studies find that the regulations of the WHTI caused a significant decline in travel across the U.S-Canada border (Bradbury, 2012), however no such study has examined the U.S-Mexico border. For decades, U.S residents have traveled to Mexico in greater numbers than to any other country (OTTI, 2015). Disruption of these travel flows may have extensive negative economic implications for the Mexican tourism industry. This paper employs data from the U.S Bureau of Transportation Statistics (BTS) to test the hypothesis that the WHTI caused a decrease in U.S citizens’ demand for travel to Mexico, other factors held constant.



*Hope Hancock, Mellon Scholar, with her communication project at the Celebration, 2016.*



*Matthew Webb, Economics and Business, at the Celebration, 2016.*



## Life on the Edge: How Project Based Learning Affects Undergraduates Engineering Education

**Cindy Alexander and Melanie Lloyd**

Mentor: Dr. Stephen C. Scogin  
Departments of Biology and Education

*This research was supported in part by an award to Hope College from the Howard Hughes Medical Institute through the Undergraduate Science Education Program.*

Recently, there has been a surge in project-based learning (PBL) as a method to engage and inspire students in the classroom (Sundberg, Armstrong, & Wischusen, 2005). One newly implemented PBL experience at Hope College is the entry-level EDGE engineering course. EDGE focuses on challenging engineering students in an authentic design project during their first year at Hope. This course is unique in that the scaffolding guides students through the design process as they construct products for real-world customers. This study focused on discovering how students responded to this PBL experience. Personal reflections completed at the end of the course were collected from 84 students over the first two years of the EDGE project. These reflections were qualitatively analyzed using grounded theory (Strauss & Corbin, 1990). Using Strauss and Corbin's (1990) paradigm model, a conceptual model was developed to explain how this course affected students' perception of engineering. Emergent themes centered on students confronting the question: Is engineering for me? The unique structure of the course and the customer focus provided an authentic context for students to realize what a career in engineering would be like. Evidence suggests some students in the course gained valuable career insight, increased confidence, and enhanced communication skills. This study provides evidence that PBL can successfully develop the soft skills (i.e., non-cognitive skills) necessary for career success (The Engineer of 2020, 2004). In addition, the results of this study inform future efforts to structure PBL courses.

## Exploring Alternative High Schools: Does Emotional Intelligence Matter?

**Barbara Bollhoffer and Grace Horn**

Mentor: Dr. Laura Pardo  
Department of Education

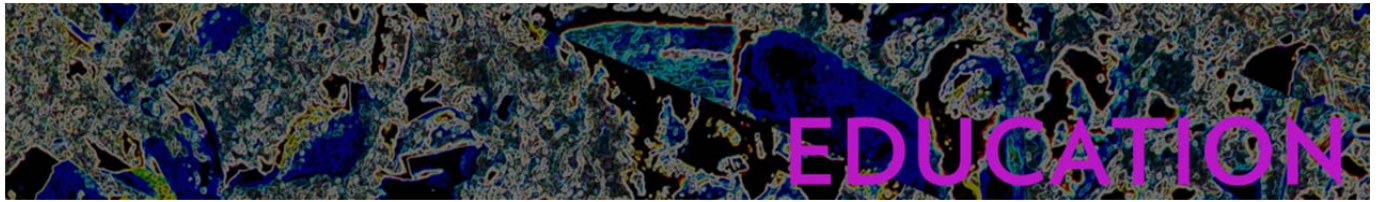
In this multi-year, qualitative study, we explored local alternative high schools to see how adding the component, Emotional Intelligence (EI) to a school's curriculum affected the learning environment for students who attended these schools. In this phase of the project, we worked with the students and teachers at Pioneer Tech High School, an alternative high school operated by Hamilton Schools. We created an observation protocol based on Daniel Goleman's 2005 book: *Emotional Intelligence: Why It Can Matter More Than IQ*, and on an extensive literature review on successful alternative high schools. We observed classes during the school day at Pioneer Tech to determine when and to what extent the school implemented the variables of a successful alternative school and EI. The data sources analyzed for this presentation included the observation protocol, observation field notes, interviews with students and school staff, and focus group conversations. Initial findings will inform the next phase of the project, the design and implementation of an EI framework developed collaboratively with the research team and the staff at Pioneer Tech.

## Self-Determination Skills: Are Ready for Life Students Prepared for the Future?

**Savannah Girmscheid and Mikayla Freyling**

Mentors: Dr. Jane Finn and Dr. Elizabeth Horton  
Department of Education

Ready for Life is a program on Hope College's campus that works with post-secondary students with developmental and intellectual disabilities who are seeking a college experience. These individuals, who would normally not be able to be involved in higher education, are given the opportunity to attend selected Hope College courses in conjunction with receiving specialized transition skills instruction from their Ready for Life instructors. These skills are essential for these students to possess in order for a smooth transition from the program to the adult world. The *Transition Planning Inventory-2* (TPI-2) was administered to the Ready for Life students in the fall of 2015, in order to measure their level of competence with specific transition skills according to Michael Wehmeyer's ARC definition of self-determination autonomy abilities. Descriptive statistics, a one sample T-test,



## Teachers and Children Together, Better Prepared to Teach and Learn: The Impact of the 2015 Summer Enrichment Program

**Abby Gust and Logan Sikkenga**

Mentor: Dr. Patricia Griffin  
Department of Education

and a Pearson Correlation reveal the transition skill areas with a satisfactory level of competence compared to those skills that should be improved upon before leaving this unique program.

The present study collected anonymous data, using questionnaires, from Hope students and parents of child attendees to the Summer Enrichment Program (SEP). The 2014 and 2015 SEP sessions were funded by a PNC Bank *Grow Up Great* grant. The 2015 SEP incorporated changes in response to data collected during the 2014 SEP. The 2015 SEP included eight Hope Early Childhood Education (ECE) students. Hope students planned, implemented and assessed developmentally appropriate activities to meet the needs of a diverse group of 3- to 5-year-old children, with the support of the Director of the ECE program. Recruitment for the SEP intentionally targeted children who attend local Head Start and Great Start to Readiness programs, in order to insure diversity and include children who typically would not have educational/enrichment opportunities during the summer. The program benefitted Hope student teachers by providing the opportunity for them to apply what they learned through ECE coursework and the opportunity to participate in a co-investigation with faculty. The program benefitted child attendees and their families by providing opportunities for children to interact with well-qualified educators, experience low student-teacher ratios and participate in developmentally appropriate activities. Questionnaire responses included quantitative data from responses to a Likert scale and qualitative data drawn from responses to follow-up, open-ended questions. Responses from Hope students and parents were overwhelmingly positive. Preliminary qualitative data analysis was focused by question and analyzed across all respondents to identify consistencies and differences. Major themes from Hope student questionnaires included that they benefitted from the real-world experience. Students specifically identified benefits from guiding children, planning lessons, differentiating instruction and interacting with families. Major themes from parent questionnaires included that their children made academic progress in areas including writing, reading, math, language and creative arts. Several parents reported the SEP experience supported their children's school readiness.

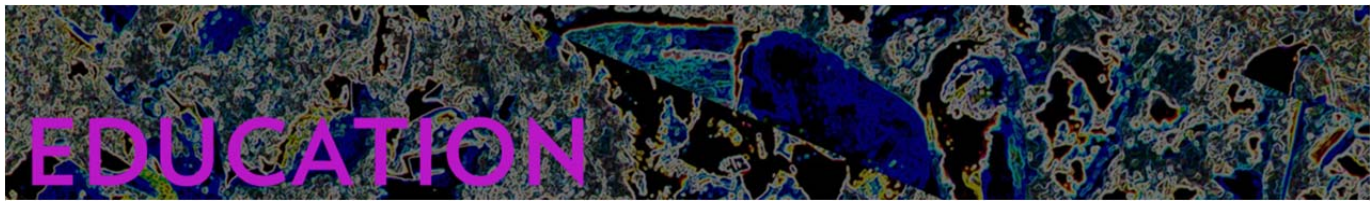
## Case Studies of Students' Experiences in a Project-Based Learning Environment

**Regan Jekkals and Christopher Kruger**

Mentor: Dr. Stephen C. Scogin  
Departments of Biology and Education

*This research was supported by the Nyenhuis Award from the Howard and Margaret Sluyter Fund.*

Students' lack of motivation for school is a concern in K-12 education. Almost 50% of dropouts list lack of interest as one of their primary reasons for leaving school (Bridgeland, Dilulio, & Morison, 2006). In response, some programs have been developed in recent years to engage students in authentic learning. STREAM is an innovative middle school program in western Michigan that uses the outdoors and project-based learning to engage and educate students in science, technology, reading, engineering, art and mathematics. Using cross-case comparisons and survey data, this study investigated students' attitudes about the program. Quantitative survey data were collected from 57 students, and 19 students participated in semi-structured interviews. Overall, the majority of students from the sample had positive attitudes toward the program. Cross-case comparisons revealed that students had positive attitudes about the program for different reasons, and specific aspects of the program affected student attitudes differently.



### Pictorial Mnemonic-Strategy Interventions for Children with Special Needs: Illustration of a Multiply Randomized Single-Case Crossover Design

**Evan Johnson**

Mentor: Dr. Yooyeun Hwang  
Department of Education  
Collaborator: Dr. Joel R. Levin,  
University of Arizona

An innovative single-case crossover design containing multiple forms of randomization was implemented with eight participants in seven weekly sessions, during which instruction was given in the use of two different pictorial mnemonic (memory-enhancing) strategies: one designed to improve the children's learning of the dates of various inventions and the other designed to improve the children's acquisition of unfamiliar vocabulary items. A composite randomization statistical test revealed that when compared with the children's own preferred learning methods, the mnemonic-strategy approach produced the predicted facilitation effect. At the same time, it was evident that children's performance on the vocabulary task was enhanced to a greater extent than was their performance on the inventions task. In-depth examinations of both individual student performance profiles and the tasks/procedures were conducted, yielding recommendations and challenges for follow-up single-case intervention research on the topic.

*This research was supported by the Frost Research Center at Hope College.*

### Math and Reading Skills Improvement Through-out an After-School Program

**Clarissa Johnston, Whitney Holmes, and Breanna Wisneski**

Mentors: Dr. Jane Finn and Dr. Vicki-Lynn Holmes  
Departments of Education and Mathematics

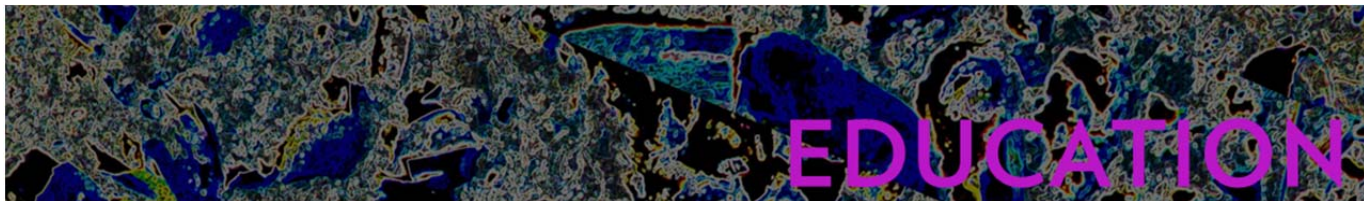
The Children's After School Achievement (CASA) Program on Hope College's campus works with at-risk elementary students from the Holland area. These elementary pupils are mentored by Hope College students and focus on improving reading and math skills. This study compared the growth of the CASA students' math and reading after one year in the program. Students were given the Brigance Comprehensive Inventory of Basic Skills (CIBS II) subtests of word recognition, oral reading, reading comprehension, and math grade level placement. They were assessed in Fall 2014 and then again in Spring 2015. A paired T-test determined the significance of the change in students' scores for the academic year. A one-way analysis of variance (ANOVA) was conducted to determine if students' improvement in the different areas of literacy significantly differed from one another. It was found that students improved significantly in all of the assessed areas. A limitation of our study was not being able to control for outside variables.

### Balancing High-Stakes Testing Pressure and Learning 21st Century Skills—Is it Possible? The STREAM Story

**Christopher Kruger and Regan Jekkals**

Mentor: Dr. Stephen Scogin  
Departments of Biology and Education

Project-based learning (PBL) is an evolving instructional method with the potential to improve collaborative skills and content knowledge in science and math. STREAM School, a seventh and eighth grade program at a rural Midwest school district, offers an innovative approach to PBL by connecting students and their learning to the outdoors through a partnership with a non-profit environmental education organization. This mixed methods study used data from standardized tests and interviews with students, teachers, and parents to investigate this program's influence on content knowledge and collaborative abilities. Preliminary ANOVA and MANOVA results revealed that standardized test scores did not differ significantly between STREAM and non-STREAM students. There was, however, a significant interaction between test date and participant group, the implications of which were explored during post-hoc analysis. Upon qualitative investigation of student interviews, it was found that STREAM does also have the potential to improve collaborative abilities. Results of this study contribute to ongoing conversations about authentic science learning, standardized testing, and social cognitive learning within the classroom.



## Assessing Course-Based Research Experiences in Hope College Biology Courses

**Marissa Smith**

Mentor: Dr. Stephen Scogin  
Departments of Biology and Education

*This research was supported in part by an award to Hope College from the Howard Hughes Medical Institute through the Undergraduate Science Education Program.*

While literature indicates authentic research experiences benefit undergraduates, many students do not get the opportunity to participate in small-group research experiences with mentor professors. In an effort to provide more students with these opportunities, course-based research experiences (CREs) were designed to integrate research into whole class settings. CREs allow students to gain research exposure that prepares them for graduate programs and future careers in science. CREs also serve as transitions from traditional “cookie cutter labs” to real research experiences increasing students’ laboratory and cognitive skills. This study analyzed the outcomes of CREs for students in Biology 107 (introductory course) and Biology 301 (microbiology) at Hope College. Using grounded theory methodology (Strauss & Corbin, 1990), researchers analyzed pre-post interviews and focus group transcripts of students enrolled in both courses. During interviews, students were asked about their ideas on the nature of science, how scientific research is conducted, and the criteria for authentic research. Matrix analysis (Miles, Huberman, & Saldaña, 2014) was used to investigate the differences and similarities within and between students in the two courses. Our findings revealed that student ideas about research and science did change slightly from the beginning to the end of each course. In addition, differences were noted in how students in the two courses viewed science and scientific research. These results will inform future efforts to refine the CREs at Hope College to be more authentic and beneficial for students.

## Unlocking Literacy: Key Strategies for ELLs with Disabilities

**Lindsay Watkins and Breanna Wisneski**

Mentors: Dr. Elizabeth Horton and Dr. Jane Finn  
Department of Education

The percentage of English language learners (ELLs) in American schools continues to boom. Although the population of students continues to shift in our nation, schools are not changing rapidly enough to keep up with the changing demographics. Research reports that approximately 56 percent of ELLs who receive special education services have reading deficits (Office of Special Education and Rehabilitative Services, Offices of English Language Acquisition, & National Institute of Child Health and Human Development, 2003). It is necessary to identify reading interventions that are effective in helping ELLs with disabilities and ELLs at risk for disabilities to improve in their reading abilities. The purpose of this current study was to conduct a meta-analytic review of the literature to identify interventions that were successful in teaching reading to at-risk ELLs and ELLs with disabilities. The findings of the meta-analysis revealed that the majority of research has centered on reading instruction at the primary and elementary level, and few studies address the needs of older, at-risk readers. The interventions with the highest effects focused on teaching basic reading skills such as phonemic awareness and phonological awareness, and fewer studies addressed reading comprehension. There is a need for more research on interventions that teach reading skills to ELLs with disabilities.



*Breanna Wisneski, Whitney Holmes and Clarissa Johnson with Professors Jane Finn, Education, and Vicki-Lynn Holmes, Math, presenting their research at the Michigan Council for Exceptional Children (CEC) conference on March 4.*



## The Durational Effect of Self-Myofascial Release Using a Foam Roller on Range of Motion and Flexibility

**Samuel Barthel, Zachary Boersema, Elizabeth Bransdorfer, Andreas Slette, and Christine Zhao**  
Mentor: Dr. Brian Rider  
Department of Kinesiology

Research has demonstrated that foam rolling is effective at improving lower extremity flexibility and range of motion in the short term. However, there is limited research on the use of foam rolling and the lasting effects on the upper body. Therefore, the purpose of this study was to examine the durational effect of foam rolling compared to two different acute warm-up conditions on upper body flexibility and range of motion. Approximately 30 insufficiently active college students, (18 to 22 years), were recruited for this study. Participants were randomly assigned their testing condition order and served as their own control. Participants underwent a familiarization session prior to beginning the study. All sessions were separated by one week. The warm-up conditions included static stretching, foam rolling, and arm cycling. Each condition lasted 2.5 minutes. Following the condition, the participants' flexibility and range of motion was assessed via sit-and-reach, latissimus dorsi flexion, and shoulder extension tests. These tests were administered at various time points (10, 20, 30 minutes) following the warm-up. During the 10-minute time periods in between tests, the participants remained inactive and were seated at a computer. They were also asked to report their level of physical relaxation on a visual analogue scale. Significant improvements in flexibility and range of motion over time would suggest that foam rolling could be a more viable option to increase flexibility, range of motion, and overall comfort among sedentary individuals. These findings could provide a novel method of improving quality of life among individuals who spend many hours at a computer. This study is ongoing, and results will be available during the poster celebration.

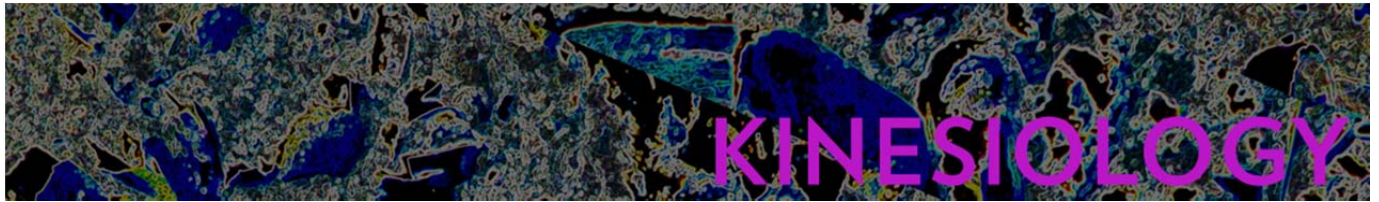
## The Qualitative Fundamental Motor Performance Characteristics of Preadolescent Obese Children

**Samuel Barthel and Elizabeth Bransdorfer**  
Mentor: Dr. Steven Smith  
Department of Kinesiology

*This project was supported by the Herman Miller Foundation for funding the grant that supports the Foundation for Fitness program at Hope College, a Jacob E. Nyenhuis Student/Faculty Collaborative Research Grant, and the Fritzzi Sennett Summer Research Fund for Kinesiology.*

This study examined the qualitative motor performance characteristics of 35 preadolescent obese children (18 female, 17 male) in the Midwest of the United States. An available sample of children ages 6 to 13 were classified as obese based on a BMI score of 30 or greater. The Test of Gross Motor Development-2 (TGMD-2) was used to assess all subjects. This test measures the qualitative motor ability of children using two subtest categories of fundamental motor skills including locomotors (running, hopping, skipping, jumping, leaping and galloping) as well as object control skills (throwing, catching, kicking, bouncing a ball, rolling a ball and striking). All participants received a raw score, standardized score, sum of standards and gross motor quotient score. All scores were compared to national norms established by the authors of the TGMD-2. The results indicated that the group norms of the obese children were significantly below the mean scores of the national average for all measures including locomotor standard scores ( $M=3.80$ ,  $SD=2.44$ ,  $p<0.001$ ) and object-control standard scores ( $M=4.43$ ,  $SD=2.89$ ,  $p<0.001$ ) and the gross motor development quotient ( $M=64.69$ ,  $SD=15.05$ ,  $p<0.001$ ). The researchers concluded that the significantly lower motor performance scores of obese children may lead this population to participate less in health enhancing movement opportunities as they grow into adolescence and adulthood. The authors noted that the TGMD-2 is designed for children ages 3-10 and has a significant ceiling effect for older children. A younger population may reveal more robust conclusions in further study. Additionally, further study is recommended to determine whether programs aimed at lowering obesity levels in children can have an impact on qualitative fundamental motor skill performance.





### The Effects of Proprioceptive Neuromuscular Facilitated Stretching and Plyometric Exercise on Broad Jump Performance

**Brian Birckelbaw, Ian Dukehart, Natassia McQueen, Aleksandrs Molenaar, and Travis Toia**  
Mentor: Dr. Brian Rider  
Department of Kinesiology

The broad jump is a test used to measure horizontal power. This test is often employed in sports such as football and rugby, where horizontal power is critically important for success. Little research has been done examining the most effective ways for athletes to warm-up prior to broad jump testing. Thus, the purpose of this study was to assess and compare the acute effects of three separate warm-up conditions on broad jump performance in college football players. The three conditions were: A) Proprioceptive neuromuscular facilitated (PNF) stretching which is a method of stretching that targets flexibility through passive and active stretching, B) Plyometric exercise which involves high intensity bouts of explosive movements to stretch and contract the muscles, in order to increase overall power and C) Static stretching in which the individual stretches the muscles to their end range-of-motion and holds the stretch for 30 to 45 seconds. Approximately 20 football players were recruited for this study. Participants were randomly assigned their testing condition order and served as their own control. Testing was done during the offseason on non-training days. Participants underwent a familiarization session prior to starting the study. All sessions were completed in the course of one week on non-consecutive days. On testing days, participants first performed an initial set of three broad jumps. Then they underwent one of the three warm-up conditions. Lastly, they performed another set of three broad jumps. The time between warm-up and jumps was standardized at 1.5 minutes. Significant findings as to the effect of plyometrics and PNF stretching on broad jump performance could change the way power athletes' warm-up prior to testing and/or competition. This study is ongoing and results will be available during the poster celebration.

### The Effect of Caffeine on Shot Accuracy and Power in Male Collegiate Lacrosse Players

**Justin Bouma, Jennie Moderwell, and Samuel Hansel**  
Mentor: Dr. Maureen Dunn  
Department of Kinesiology

Caffeine is a stimulant that is becoming more commonly used in sports and athletic events in an effort to increase performance and decrease effects of fatigue. The purpose of this study was to examine the effect of caffeine on sports performance, measured in shot accuracy and maximum shot power, of collegiate lacrosse players. The design of this study evaluated if caffeine ingestion (4 mg/kg) would significantly affect lacrosse shot power and accuracy compared to a placebo. This was a double-blind study. Following one familiarization trial, participants were randomly assigned to ingest either the caffeine or placebo in a double-blind counter-balanced manner on one of two testing days. Shot speed was measured using a radar gun while shot accuracy was assessed using a net cover with holes in each corner. The participants shot from a distance of 10 yards. Total shots made compared to shots attempted was measured. The data gathered yielded no significant differences between groups, although there was a trend towards an increase in maximum shot speed after caffeine use (Placebo:  $81.0 \pm 7.1$ mph, Caffeine:  $83.2 \pm 7.0$ mph,  $p=.115$ ). There was no difference found for shot accuracy with and without caffeine (Placebo:  $13.8 \pm 4.1$ , Caffeine:  $14.1 \pm 4.5$ ,  $p=.809$ ). While there was little evidence to support caffeine increasing lacrosse sport performance from this study, further research using a larger sample size and more trials might yield more significant results.



## The Effect of Runner's Tea on Fat Oxidation in Recreational Runners

**Vanessa Brockhouse, Casey Campbell, Chelsea Root, and Elizabeth Sitterley**  
Mentor: Dr. Maureen Dunn  
Department of Kinesiology

Ingestion of Runner's Tea, a matcha green tea product, may have potential for increasing fat oxidation in various populations of runners. This within-groups study was designed to determine whether or not Runner's Tea would have an effect on fat oxidation during a 30-minute steady-state running task at 65%  $\text{VO}_2$  max in recreational runners aged 19-22 years ( $n=10$ ). Each participant consumed either 8 ounces of Citrus Mint Runner's Tea or 8 ounces of a placebo citrus mint tea (no green tea or caffeine content) 30 minutes prior to exercise. Participants ran 30 minutes at 65%  $\text{VO}_2$  max, and Respiratory Exchange Ratio (RER), Rating of Perceived Exertion (RPE), and Heart Rate (HR) were taken 6 times throughout each exercise trial at equal intervals. Results showed no main effects for group ( $p>0.05$ ), and also no interactions between groups over time for RER ( $p=0.116$ ), RPE ( $p=0.776$ ), or HR ( $p=0.212$ ). Currently, no evidence exists to support improvements in fat oxidation when consuming Runner's Tea compared to placebo tea.

## Chiari Malformation in a Collegiate Football Player

**Jamie Bulthuis**  
Mentor: Professor Margaret Frens  
Department of Kinesiology

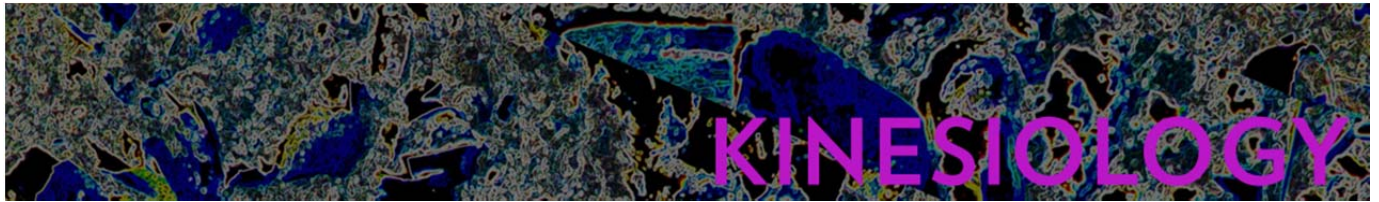
This is a case study on the topic of Type I Chiari Malformation in a Collegiate Football Player, occurring with many other complex associations. Chiari Malformation is defined as the caudal descent of the cerebellar tonsil through the foramen magnum measuring more than three to five millimeters. Chiari I malformations are often isolated abnormalities, however, in this case it is associated with cervical cord syrinx, platybasia, headaches, and cervical spine instability. Cervical cord syrinx, also known as hydrosyringomyelia, is characterized as a collection of cerebral spinal fluid inside the central canal of the spinal cord. Cervical cord syrinx can cause flaccid weakness of the upper extremity and cause a "cape-like" distribution of pain and sensory loss through the neck and shoulders. Platybasia is defined as an abnormal flattening of the base of the skull. This is measured by a base skull angle greater than 143 degrees. Platybasia is common in patients with Chiari I Malformation. In this case, the Chiari is resolved with a posterior fossa decompression and a fusion of the first three cervical vertebrae, C1 to C3. This project reviews the correction method as well as limitations to returning to high-contact athletics according to the National Athletic Trainers' Association Position Statement: Preparticipation Physical Examinations and Disqualifying Conditions in 2014.

## An Investigation of Dietary Habits in Overweight and Obese Children; Impact of a Childhood Wellness Intervention

**Caitlyn Campbell**  
Mentors: Dr. Mark Northuis and Dr. Kyle Morrison  
Department of Kinesiology

According to the CDC, 17% of children in the United States are obese and another 15% are overweight. Among children of the Holland-Zeeland area in Michigan, a staggering 28% of children are overweight or obese. In an effort to try and combat this epidemic, Foundations for Fitness was established in the fall of 2014 on Hope College's campus. This is a program that provides families with exercise and lifestyle education while placing an emphasis on physical activity, nutrition, and family behavior modifications. The goal of the program is to take a holistic approach to improving the children's health and fitness. Not many studies have looked into the nutrition of children in intervention programs like this one for reasoning related to the time-consuming nature of performing diet analyses and the problems surrounding self-reported data. This study investigated the differences in the diets of the children at week 1 of the 10-week program and at week 8. Their diets were compared to that of a control group of health experts' children. The goal of this study is to identify if this intervention model is successful in changing the diets of the participating children. If so, other programs should consider adopting this model. Further, the results will help Foundations for Fitness develop their curriculum in a way that most benefits the children.

*This research was supported by the Constantin Kinesiology Student Research Fund.*



## Excess Post-Exercise Oxygen Consumption

**Casey Campbell**

Mentor: Dr. Mark Northuis  
Department of Kinesiology

Anaerobic metabolism primarily meets the body's energy demands at the onset of exercise until aerobic metabolism is able to sufficiently supply ATP. The portion of energy that aerobic metabolism is unable to supply is termed oxygen deficit. Sixteen collegiate track runners (age 18-23 years) participated in a study to determine the effect of traditional middle distance and long distance training on the respective training groups' oxygen deficit values. A short-term (4 minute) treadmill test was used to determine the differences in oxygen deficit and cardio-respiratory values of two training groups. Changes in oxygen deficit over an 8-week aerobic training were measured via area-under-the-curve calculations and comparisons were made between the middle distance and distance training groups' physiological responses.

## Effect of Different Tempo Music on Balance Performance in Fatigued College Students

**Kristen Coffman, Katrina Greathouse, Michelle Hance, Lauren Hazekamp, and Kathleen Williams**

Mentor: Dr. Maureen Dunn  
Department of Kinesiology

Music has been shown to have positive effects on posture, while also decreasing heart rate and respiratory rates. Additionally, it can act as a distraction from pain and fatigue. Previous research has shown that music may increase balance; however it is not yet clear if the tempo of the music influences the degree to which balance is improved. Therefore, the purpose of this study was to determine the effect of listening to two different music tempos on fatigued individuals' postural sway during unilateral quiet standing. Twelve recreationally active colleged-aged participants underwent a fatiguing task on a cycle ergometer and two balance tests: one before and one after the fatiguing exercise. Balance was analyzed using a force plate. Participants stood with their right foot centered on the force plate with eyes open for 20 seconds and then with their eyes closed for 10 seconds. During the post fatigue balance test, slow tempo music, fast tempo music, or no music (control) was played. It was hypothesized that slow tempo music would have a calming effect on the autonomic nervous system and allow participants to focus, resulting in improved balance performance, and less postural sway. Significant results would offer music as a technique for improving balance in competitive and personal activities, such as dance, gymnastics and yoga. Additionally, more research could be conducted to implement music as a form of rehabilitation. This study is ongoing, and results will be available during the poster celebration.

## The Effect of Creatine Monohydrate on Male Ice Hockey Players' Skating Sprint Speed

**Thomas Doherty, Jordan Kalsbeek, Ryan Restum, and Brandon Richardson**

Mentor: Dr. Maureen Dunn  
Department of Kinesiology

Free creatine is a protein-like substance that is synthesized in the body and can be ingested by consuming animal products such as meat or fish. It utilizes the enzyme creatine kinase to create phosphocreatine, which, in turn, produces ATP, the body's energy source. The phosphocreatine system is key for providing energy during short, high-intensity exercise, which is equivalent to a shift during an ice hockey game. Few studies exist that have examined the effect of creatine ingestion on ice hockey skating performance, yet the intake of creatine monohydrate may increase the sprint speed of hockey players after a 5-day "loading phase". Eleven Hope College ice hockey players participated in 3 repeated 70-foot skating sprints with 2 minutes of rest between each sprint. Participants were then assigned into either a creatine group (n=7) or a placebo group (n=4). The week after the pretest, participants ingested the assigned supplement 4 times a day for 5 days. Each dose contained 5 grams of creatine or 5 grams of placebo along with 8 ounces of gatorade. After the "loading phase" the participants performed a posttest, which followed the same protocol as the pretest. Positive results would allow hockey teams to use creatine supplementation to increase players' sprint speed as well as decrease the amount of rest time needed to be able to perform another maximal shift.



## Achilles Tendon Rupture in Collegiate Athletes

**Max Elder**

Mentor: Professor Margaret Frens  
Department of Kinesiology

The Achilles tendon is a thick band of fibrous connective tissue originating from the distal end of the gastroc-soleus complex and inserting on the posterior portion of the calcaneus. This tendon serves to connect the gastrocnemius and soleus muscle to the foot, allowing force production and transmission from the lower extremities through the feet. The Achilles tendon is one of the largest and strongest tendons in the body due to the extreme force demands required of the structure. Activities such as running and jumping are much more efficient in humans due to the presence of the Achilles tendon. As humans age, the tendon begins to deteriorate, sometimes resulting in a rupture. This significant orthopedic injury is generally the result of explosive force, exceeding the tensile strength of the tissue in recreational male athletes aged 40 - 55. However, a recent occurrence of ruptures at Hope College suggests a possible change in the typical age and profile of a patient with a ruptured Achilles tendon. This case study serves to examine one such case and explore the changes in age, gender, and athletic profile of Achilles tendon ruptures.

## Peroneal Tendon Subluxation: a Case Study

**Emily Florek**

Mentor: Professor Margaret Frens  
Department of Kinesiology

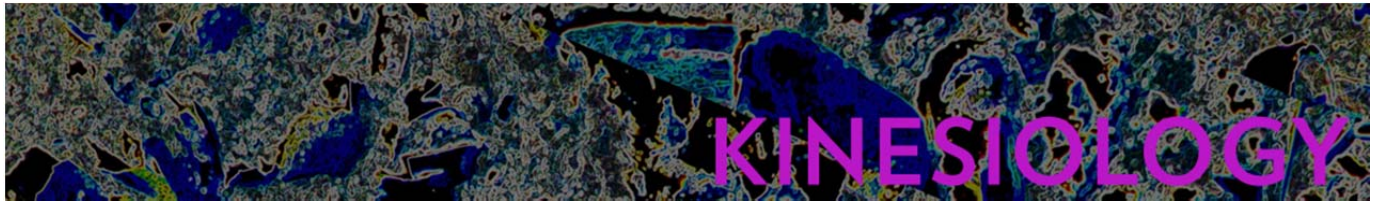
Subluxation of the peroneal tendons is an uncommon musculoskeletal pathology characterized by the peroneal tendon partially dislocating from the retromalleolar groove of the fibula. The peroneal tendons subluxate as a result of a complete tear of the superior peroneal retinaculum. This pathology leads to instability of the ankle and overall dysfunction of the joint. The gold standard of treatment is surgical intervention to repair the retinaculum or deepen the retromalleolar groove. Subluxation of the peroneal tendons is commonly misdiagnosed as lateral ankle instability due to recurrent lateral ankle sprains. Therefore, it is imperative for health care professionals to recognize the differences between these two pathologies. This case study examines a patient who was diagnosed with peroneal tendon subluxation and was treated through surgical intervention.

## Chiropractic Care in a Division III Setting

**Emma Forlow**

Mentor: Professor Margaret Frens  
Department of Kinesiology

Medical coverage has been integrated into collegiate sports settings since the early 1900s. Traditionally this role has been filled by team doctors and athletic trainers. As allied healthcare professionals, athletic trainers work under the supervision of a team physician, but also in conjunction with other healthcare professionals. Starting in September 2014, Hope College began utilizing the resources of a chiropractor on a weekly basis. Chiropractic care is a complementary form of medicine. The function of a chiropractor is to correct subluxations within joints in which "alignment, movement integrity and/or physiological function are altered, although contact between joint surfaces remains intact" (WHO). The subluxations lead to poor health or function of the body and reduce the ability of the body to adapt to the ever-changing stimuli and prevent it from responding optimally. Athletic trainers here at Hope College have stated that utilizing chiropractic care as a member of their healthcare team has brought a new dimension to the care that is provided by correcting structure and soft tissue dysfunction, enhancing tissue healing, and facilitating normal functioning. Results from a satisfaction survey that was administered to Hope College athletes indicated that they were highly satisfied with the treatment they received, and they were able to stay competitive and continue to participate at the high level that was expected of them within the Division III athletic setting at Hope College.



## The Acute Effects of Foam-Rolling and Dynamic Stretching on Flexibility

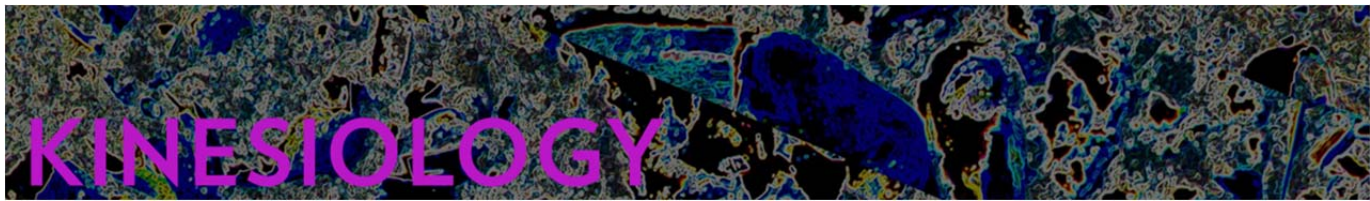
**Sandra Garcia, Hannah Johnsen and Lily Mehta**  
Mentor: Dr. Kevin Cole  
Department of Kinesiology

Myofascial release, via the foam rolling method, has commonly been used as a post exercise recovery technique. This study tested the effectiveness of foam rolling on flexibility prior to exercise. Foam rolling effects were compared to the effects of dynamic stretching in a sample of 20 Hope College students. The participants were tested 3 times over the course of 2 weeks by foam rolling and dynamic stretching for 10 minutes each. On the first testing day, baseline flexibility measurements were taken without prior warm-up. Participants were then randomly assigned into two groups that met for two additional days of testing separated by at least 48 hours. Each group either engaged in foam rolling or stretching on the first day; they switched on the second day. Flexibility measurements were taken after both days through hip and knee ROM goniometer assessments and sit-and-reach testing. It was hypothesized that foam rolling would result in greater flexibility when compared to dynamic stretching. Improvements were seen between the pretest and foam rolling for sit-and-reach (pre:  $35\pm 8$  cm, post:  $38\pm 7$  cm,  $p=0.004$ ), dynamic stretching (pre:  $35\pm 8$  cm, post:  $36\pm 6$  cm) and foam-rolling ( $p=0.005$ ), Hip ROM pretest and dynamic stretching (pre:  $74\pm 13$  degrees, post:  $81\pm 11$  degrees,  $p=0.002$ ), right hip ROM pretest and foam rolling (pre:  $74\pm 13$  degrees, post:  $83\pm 11$  degrees,  $p=0.000$ ), left hip ROM pretest and dynamic stretching (pre:  $73\pm 12$  degrees, post:  $81\pm 15$  degrees,  $p=0.002$ ), and left hip ROM pretest and foam rolling (pre:  $73\pm 12$  degrees, post:  $82\pm 13$  degrees,  $p=0.001$ ). Foam rolling was found significantly more effective in increasing flexibility on the sit-and-reach test as compared to dynamic stretching. There is a need for more studies on the effects of foam-rolling prior to exercise.

## ACL Reconstruction Techniques and their Implications on Rehabilitation

**Mikaela Harrell**  
Mentor: Professor Margaret Frens  
Department of Kinesiology

Anterior cruciate ligament (ACL) tears are currently one of the most prevalent lower extremity injuries occurring in competitive athletics. The athlete's goal is usually the same: to return to play as soon as possible. However, ACL reconstruction surgery is notorious for taking approximately six to nine months to heal in order for the patient to return to functional activity. Depending on the patient, various ACL reconstruction techniques can speed up the rehabilitation process while maintaining the integrity of the new ACL graft. While single bundle grafts are standard, easy to harvest, and time efficient, double bundle grafts are more anatomically fitted and produce better overall functional results. To place the grafts, there are various techniques used. Three techniques are compared based on efficiency and overall outcomes over the course of this research. The anatomic anteromedial technique, a standard procedure, is performed by drilling holes from the outside of the knee into the femur and tibia, threading the new ACL graft through the holes, and securing with screws. Rehabilitation lasts approximately 36 weeks. The All-Inside technique uses a Retro Flip Cutter to drill the femoral and tibial holes from the inside of the knee out, creating sockets. There is less trauma to the bones, therefore, the patient is able to reach functional activity sooner. This technique is especially indicated for skeletally immature patients. Lastly, the Shelbourne technique takes the new ACL graft from the contralateral, healthy patellar tendon. The trauma is then dispersed between both knees, speeding up the rehabilitation process to only nine weeks. Advantages and disadvantages to all of these techniques are compared and analyzed based on current research and local orthopedic opinions.



## Effect of Varying Velocity on Post-Activation Potentiation of Vertical Jump Performance

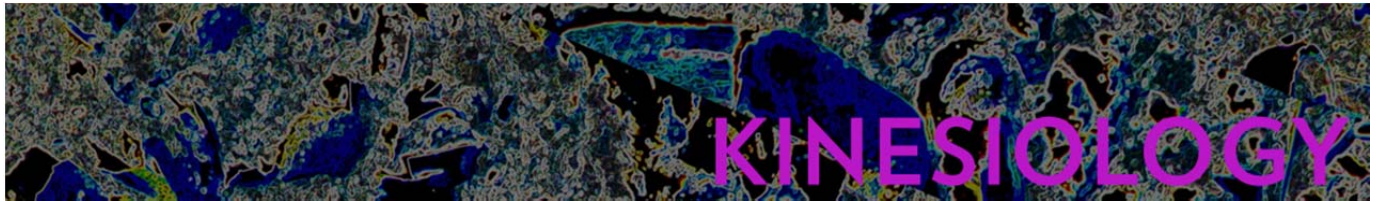
**Taylor Hatfield, Justine Mucinski, Micah Sall, and Karissa Winkler**  
Mentor: Dr. Kevin Cole  
Department of Kinesiology

Post-activation potentiation (PAP) is a phenomenon where muscle performance is enhanced after a bout of high-intensity activity. Minimal research has been conducted on varying velocities of contraction and its effect on PAP. Discovering optimal conditions for PAP will benefit athletes in explosive sports. This study was designed to determine if different velocities of leg press at 70% of one repetition maximum (1RM) improved vertical jump performance on the Vertek® and Just Jump Mat®. It was hypothesized that faster leg press velocities would improve vertical jump more than slower leg press velocities. Twenty Hope College students (13 females, 7 males) participated in seven randomly assigned testing sessions (~ four weeks duration). The testing days consisted of a familiarization, two baseline, and four testing days. Testing days consisted of a warm up, five unilateral leg presses at 70% 1RM at assigned velocity and a six-minute rest followed by three jumps on the Just Jump Mat or Vertek. Each participant completed each velocity for each jump condition. There was no significant improvement between the pretests and subsequent velocity tests when measured by the Vertek ( $p=0.462$ ) or mat ( $p=0.732$ ). Mean VJ height for females for initial ( $16.2\pm1.72$ ), fast ( $16.4\pm1.68$ ) and slow ( $16.5\pm1.69$ ) conditions showed no significant difference. Mean VJ height for males for initial ( $22.2\pm2.70$ ), fast ( $22.0\pm2.81$ ) and slow ( $22.4\pm2.86$ ) conditions showed no significant difference. There was a highly significant correlation between the Vertek and mat results ( $r =0.941$ ,  $p<0.01$ ), validating the jump mat as a legitimate measure for vertical jump. Limitations include study design, participant commitment, type of participant and type of leg press routine. Future studies should include manipulation of contraction velocity, rest intervals, and percentage of 1RM along with subjects.

## Understanding Pain through the Lens of Merleau-Pontian Phenomenology: How it Applies to Prehabilitation and Rehabilitation

**Byoungjoon Jang (Brandon)**  
Mentor: Dr. Chad Carlson  
Department of Kinesiology

Pain plays an enlightening role in the process of rehabilitation. Phenomenological views of pain strive to contextualize the effect and experience of pain on the individual. Pain is a fundamental part of an individual's experience that represents limitations of oneself. A 20th-century continental philosopher Maurice Merleau-Ponty provides a framework of phenomenology that current physical therapists, nurses, and even neuroscientists utilize to comprehend pain. Previous articles and studies have demonstrated the importance of understanding pain as a phenomenon that affects one's perception of reality rather than a glitch or breakdown of the body. In this project, I will apply Merleau-Pontian phenomenology to our understanding of pain. In doing so, I will show that characteristics of pain in prehabilitation movement settings can enhance physical therapy and rehabilitation practices. CrossFit presents a unique training model that embodies pain with variance and togetherness from which the field of physical therapy can learn and adopt. The element of variance—being exposed to non-repetitive set of exercises—and togetherness—exercising with others—equips patients and therapists with the ability to address pain.



### Comparing the Effect of Sodium Bicarbonate on Time to Exhaustion on a Cycle Ergometer Test in Men vs. Women

**Morgan Leep, Lindsay Lehman, David Lenzi, and Sam McNulty**  
Mentor: Dr. Maureen Dunn  
Department of Kinesiology

Taking sodium bicarbonate as an ergogenic aid has been shown to improve time to fatigue in highly trained athletes in quick bouts of strenuous exercise. This supplement has been previously shown to act as a buffer and may reduce the amount of hydrogen ions in the blood, allowing the participant to continue exercise for an extended amount of time before fatigue sets in. The purpose of this study was to examine the difference that sodium bicarbonate has on time to exhaustion on a cycle ergometer test in moderately trained men and women. Twenty college students, ten males and ten females, were assessed for time to exhaustion and lactate levels during a high-intensity cycle ergometer test, designed to elicit fatigue within 2-4 minutes. Participants were given either 16 oz. of water or 0.3g/kg of sodium bicarbonate dissolved in 16 oz. of water two hours before exercise, and then asked to cycle for as long as possible. It was hypothesized that men would have a greater mean difference in time to exhaustion while taking the supplement than women. Significant results would allow sodium bicarbonate to be given prior to gender-specific sports, to allow a greater advantage. This study is ongoing, and results will be available during the poster celebration.

### Injury to the Hip in Military Personnel: A Case Study

**Tyler Marone**  
Mentor: Professor Margaret Frens  
Department of Kinesiology

The prevalence of injury in the military is one of the leading causes of delay of graduation or withdrawal from basic combat training. This case study was a college-aged female who serves in the Army National Guard. On January 24, 2015, this client suffered a third degree rectus femoris, iliopsoas strain, as well as a labral tear in the left hip. The mechanism of injury was a sit-up. Because of her need to complete AIT (Advanced Individual Training), her recovery was placed on a "rushed" status. Throughout her three month period of recovery, she underwent a variety of diagnostic testing and visits to various medical specialists. She was cleared for active military duty on April 30, 2015. This study explores the frequency of injury during military training and the experiences of this client throughout her recovery.

### The Effects of Foam Rolling on Vertical Jump and Flexibility in Division III Female Power Athletes

**Betel Mulat, Aurelie McCarus, Megan Gregorski, and Gwendolyn Casper**  
Mentor: Dr. Brian Rider  
Department of Kinesiology

Certain types of stretching have been shown to decrease muscular power in the lower extremities. Foam rolling is a form of self-myofascial release that helps to stretch and evenly realign muscle fibers. Previous research has suggested that foam rolling not only increases flexibility and ROM but does so without the subsequent decrease in power output. In fact, recent research has shown that foam rolling may even improve muscular power output among certain athletes. Therefore, the purpose of this study is to examine the effect of three different warm-up conditions on flexibility and vertical jump in a group of athletes whose sport involves explosive muscular power. Hope College female track athletes (sprinters and high jumpers), volleyball and basketball players were recruited for this study. Participants engaged in one familiarization session and three testing sessions: A) A stationary cycling warm up which consisted of four minutes of cycling at 50 rpm on a Monark Cycle Ergometer, B) A dynamic warm up which consisted of eight minutes of lower body dynamic stretches and C) The foam rolling condition which included two sets of 30 seconds of rolling on each leg addressing the gluteal, hamstrings, quadriceps, and calve muscles. Each session occurred 72 hours apart from one another. Participants were randomly assigned their testing condition order and served as their own control. Each condition session measured vertical jump height on a vertical jump mat, sit and reach flexibility, and knee and ankle range of motion. Significant results would allow foam rolling to be recommended as an effective mode for warm up immediately prior to events in which power output plays a vital role. This study is ongoing, and results will be available during the poster celebration.

# KINESIOLOGY

## Vestibular Role in Concussion

**Brandon Parcell**

Mentor: Professor Margaret Frens

Department of Kinesiology

Sports related concussions have gained a great deal of publicity in recent years. The prevention, management and rehabilitation of this injury is complex. The purpose of this case study is to examine the effects of vestibular therapy use on an athlete who has sustained multiple concussions and suffered from post-concussion syndrome. After a concussion, the vestibular system is compromised due to the energy crisis in the brain. Vestibular therapy is one of the techniques used to assist with post-concussion syndrome. It aims to tease out and reduce symptoms of a concussion by challenging the complex vestibular system which controls balance, posture, retinal fixation, and proprioception. In this case, the athlete saw decreased symptomology with vestibular therapy. More research on when vestibular therapy can begin with post-concussion syndrome is warranted.



*Vestibular testing after a concussion.*

## Cervical Spinal Fusion in an Adult Male Recreational Athlete

**Stephen Waltersdorf**

Mentor: Professor Margaret Frens

Department of Kinesiology

This is a case study of an adult male recreational athlete who has had two spinal fusion surgeries in his cervical spine. A spinal fusion surgery consists of removing the intervertebral disc and replacing it with a cage or cadaver bone. The two bones are then screwed and plated together to provide stability. People usually need a spinal fusion surgery after suffering a ruptured disc or when they have stenosis, or narrowing, of the spine near the nerve roots or spinal cord. Some causes of stenosis are being over 50 years of age, ruptured disc, and previous injury to the spine. This individual had both a ruptured disc and stenosis, indicating the need for a spinal fusion surgery. The success rate of these surgeries is near 100% and the need for a second surgery is extremely low. If a patient needs a second surgery it is usually performed on the opposite side that the first one was done. Causes for a second surgery could be several reasons: graft shift, smoking, excessive motion in the healing process, or graft rejection.



*Emily Florek and Brandon Parcell, both kinesiology students, at the Celebration, 2016.*





### Exploring the “Pre-College Schooling” Attribute of Tinto’s College Persistence Model through Public vs. Private Education

**Kirstin Anderson**

Mentor: Dr. Virginia Beard  
Department of Political Science

Vincent Tinto’s 1975 model of collegiate persistence is considered nearly a paradigm in the body of research devoted to graduation from higher education. Though it has been revised over time by the empirical research of other leaders in the field, the base structure and underlying logic behind Tinto’s model has remained important and valid. Tinto’s model begins with certain pre-existing conditions for students entering college; these include family background, individual attributes, and pre-college schooling. Existing research has paid some attention to the conditions of family background and individual attributes, but most importantly, researchers consider pre-college schooling to mean simply high school GPA or class rank. Largely ignored have been Tinto’s words in his influential 1975 work, which read, “The characteristics of the high school are also important because they directly and indirectly affect the individual’s aspirations, expectations, and motivations for college education.” This project serves to explore characteristics by examining what effects a public high school education versus a private high school education may have on the way students progress through Tinto’s model of college persistence.

### A Turning Point For Japan

**Toru Ashida**

Mentor: Dr. Jeffrey Polet  
Department of Political Science

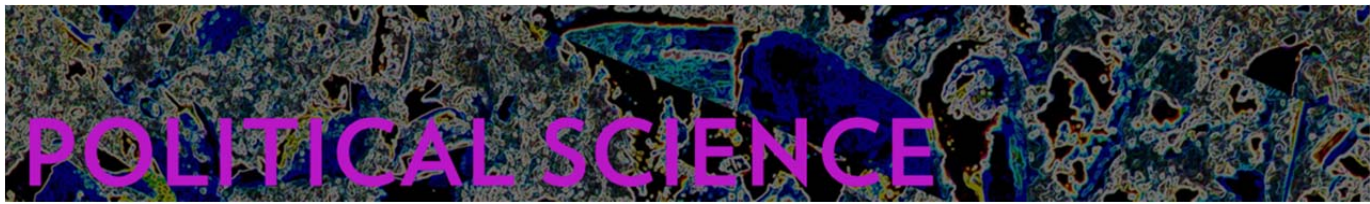
The year 2015 was a politically active year for pacifists and also for the non-politically interested public in Japan. The last year was significant because the Japanese government officially joined the Trans-Pacific Partnership (TPP) trade agreement and reexamined the right of collective self-defense and the right of the security council. It is not too much to say that Japan is one of the representatives of pacifistic countries. Not just the older generation, but also the younger generations started to worry and recognize the existence of the security council and the right of collective self-defense in Japan. At the press conference in May 15, 2014, Prime Minister Shinzo Abe reinterpreted the constitution and argued for a policy of collective self-defense, which marked a turning point in Japan. This policy has proved controversial and has sparked public outcry. Many leftists worried about this new policy which might lead to “war.” The purpose of this project is to understand and comprehend the meaning of the Japanese constitution, the policy of governmental peacekeeping, the right of the collective self-defense, and the authority of the security council to be the leader of the global society to create and balance world peace. These issues need to be considered against the public response. Taken together, they seem to be indicating a new direction for Japan. This research examines the right of collective self-defense, the actions of the security council and Trans-Pacific Partnership, and to discuss the factors that indicate a new direction for Japanese politics.

### Should the Federal Government be Involved in State-Funded Public Education?

**Corben Barnett**

Mentor: Dr. Virginia Beard  
Department of Political Science

In the United States, personal choice is highly valued. The individual is paramount to the American ideal, and the country’s Founders made it a point to focus on the rights that each person has to make the best life that they possibly can for themselves and their family. In terms of education, that choice has arguably been taken away from the public and placed in the hands of bureaucrats that draw lines based on zip codes and property tax rates to send children from certain areas to certain schools. Through the use of theories on policy change, I propose a plan to alter the education system in the United States. Careful policy analysis reveals the possibility of creating a system that is more responsive to parents and students who desire improved educational quality, broader selection opportunities, and



greater efficiency in public educational funding. This paper includes the investigation of a state-funded voucher system as a more efficient and effective way to offer public education. Such a program seems likely to offer more control and better educational outcomes than the current policy arrangement.

### Divergent Neighbors: Post-Revolution Development in Tunisia and Libya

**Austin Beaudoin**

Mentor: Dr. Jeffrey Polet  
Department of Political Science

The uprisings that swept across the Middle East and North Africa from late 2010 to 2012, frequently referred to collectively as the “Arab Spring,” brought about swift and far-reaching change in the political life of several Arab states. Several of these democratic uprisings resulted in the fall of long-reigning autocratic regimes, two notable examples being Tunisia and Libya. Both of these countries succeeded in knocking dictators out of power, but the governments that replaced them were drastically different: Libya was left in a power vacuum that has yet to be filled by a widely recognized authority, while Tunisia was able to form a robust and competitive democracy. This project will attempt to explain why such contrasting results were found in the two neighboring countries, focusing on their varying degrees of access to political participation offered by the pre-revolution regimes. In Tunisia, a democratic government was possible because Tunisians were more able to participate in political life prior to toppling the despot than Libyans were.

### Service Providers: A Faith-Based Comparison

**Hunter Brumels**

Mentor: Dr. Jeffrey Polet  
Department of Political Science

Over the past few years, service organizations and aid service programs have gained prevalence in society due to increased need and the Bush administration’s push for faith-based service organizations to be considered equal and receive equal financial assistance from the government. This has prompted many researchers to begin looking into the differences between faith-based organizations (FBOs), secular service providers, and government agencies that provide services to low-income families and individuals. Scholars have agreed that, based on research, these different types of organizations differ in terms of accessibility, delivery of services, and transparency. It is common to believe that some types of organizations do better than others at accessibility, delivery of services, and transparency of the organization. This research paper will focus on the common distinctions made about FBOs and address the differing qualities and the level of success achieved by each type of organization, determining which type of service provider is better at which organizational factors and overall is a better service providing entity.

### What America’s Prison Policy Means

**Alexander M. Carpenter**

Mentor: Dr. Virginia Beard  
Department of Political Science

This project examines policy in the context of the American prison system. Incarceration in America has reached an epidemic level. Globally, the United States boasts the largest percentage of incarcerated citizens per capita. The focus of this study is on policies regarding sentencing and the implications of sentencing, with the design to highlight disparities caused by said policies. By reviewing scholarly literature, empirical data and current policy, this study expects to find socioeconomic and racial disparities within the current system. This conclusion is not short of implications, but the empirical evidence alone should be implication enough that something, somewhere in the current policy simply does not work.



## The Impact of U.S. Defense Spending on Long Term Economic Growth

**Daniel Carrick**

Mentor: Dr. Virginia Beard  
Department of Political Science

There is much debate on the impact and effects the United States defense spending has on its economy. This paper furthers that discussion by asking specifically if there is a positive correlation between level of defense spending across multiple categories and US economic stability and growth. Using two models for measuring spending impact on economic growth—the Roma Model and the Production Model—and looking at the impacts of technological advancements made by military contractors, my research shows large defense spending is necessary to prevent recession and to foster growth in the US economy. Thus, I show that higher levels of federal defense spending most likely lead to positive long-term economic output and growth.

## Smitten in the Mitten: Examining Trump Support in Michigan

**Thomas Conerty**

Mentor: Dr. Jeffrey Polet  
Department of Political Science

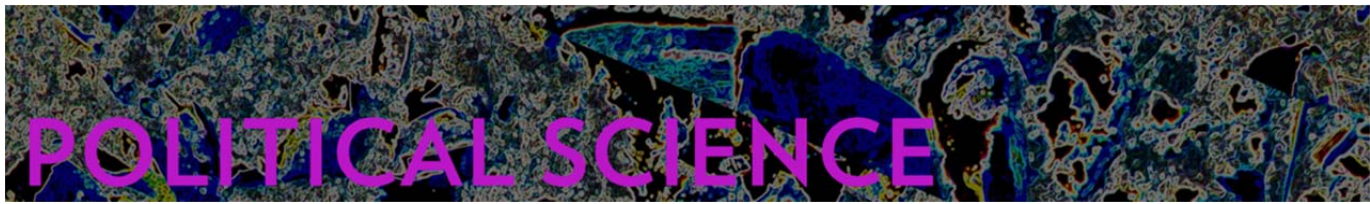
The rapid ascension of Donald Trump’s 2016 presidential campaign, coupled with its sustained potency, has confounded political scientists from its inception. A campaign doomed for failure has thus far captured a plurality of support and seems destined to capture the Republican nomination barring a contested nominating convention. Many variables exist that might explain this surprising success, especially economic metrics: wealth, class, and education have all been thoroughly explored as explanatory variables for Trump’s primary wins. However, less examined are the social variables that might influence voter behavior, especially as it tends toward Trump. This paper breaks down Donald Trump’s primary election success in Michigan on a county-by-county basis, examining the relationship between white mortality rates, white suicide rates, church attendance, and divorce rates. While virtually no correlation exists between church attendance or divorce rates, a strong correlation appeared between white mortality rates, especially among males, white suicide rate, and a county’s support for Donald Trump. This correlation perhaps indicates a crisis wherein white Michiganders perceive a decline in their culture and thus seek a strongman leader promising to “restore” America through stringent immigration and deportation policies and stays on Muslim immigration into the United States.

## Reconsidering Drug Policy—Marijuana

**Elliott Digison**

Mentor: Dr. Virginia Beard  
Department of Politics

When analyzing the policy and decisions of policymakers we want to keep in mind the effectiveness, efficiency, equity, liberty/freedom, political feasibility, social acceptability, administrative feasibility, and technical feasibility of the suggested alternatives. The importance of each of those characteristics is really in the eye of the beholder. For example, drug testing candidates for welfare programs has been shown to be an ineffective policy in the states where it is in place, yet in some places it still has widespread support. Clearly those policymakers are looking at other criteria than just effectiveness or efficiency. That same kind of evaluation can be applied to the federal policy on drug enforcement, specifically in regards to marijuana. In brief, research has shown that African-Americans use marijuana at the same rate as whites, yet are convicted and incarcerated at higher rates. Overall rates of marijuana consumption have also increased over time, including the teen/young adult age, in spite of large budgetary devotions to government agencies such as the DEA and ATF who enforce the federal policy on drugs (Controlled Substances Act). This research will seek to understand both how marijuana became included in the Controlled Substances Act, the outcomes of the policy, as well as propose policy alternatives that may better satisfy the evaluative criteria that political scientists have in mind.



### An Analysis of Cultural Prejudice and its Impact on Education

**Sarah Downing**

Mentor: Dr. Virginia Beard  
Department of Political Science

Gender inequality is a global issue. Women are still treated as inferior in both developed and developing nations. This can be caused by longstanding cultural prejudice that perpetuates gender stereotypes. Literature has found that an increase in educational opportunities leads to female empowerment, but is unclear in what ways and does not clearly define empowerment. This research design seeks to explore the factors that link education to empowerment and what the concept of empowerment means in a developed country such as the United States.

### Healthcare: Does the Affordable Care Act Work?

**Andrew W. Dunn**

Mentor: Dr. Virginia Beard  
Department of Political Science

This project intends to examine policy aimed at healthcare in the United States, specifically, the impacts of the Affordable Care Act. The goal of universal healthcare is a relatively new concept to America, and as such, it has a number of controversial issues. The impacts of the affordable care act have been hotly contested by political pundits from its initial implementation. The focus of this study is on the impacts of the ACA and how it has impacted the ability of Americans to not only obtain health insurance, but also make use of affordable health services. By reviewing scholarly literature, empirical data and current policy, this study intends to analyze the effects of the ACA on the citizens of America.

### Why Women are Failing to be Elected to Higher Political Offices

**Rosemarie Falsetta**

Mentor: Dr. Virginia Beard  
Department of Political Science

Previous research firmly establishes an array of factors that contribute to the success or failure of female candidates running for a political office. For example, a women's appearance consistently proves to take precedence over the policies that female candidates hold. There is a gap, however, in this research that specifically focuses on women who run for the executive branch. Do the same factors influence the likelihood of success for women seeking the presidency? I examine what factors contribute to the failure of women candidates being elected to such higher political offices. It seems that more than any other factors, stereotypes and beliefs about the existence of 'feminine issues versus masculine issues' stand as barriers to female success in earning high-level political office. Stereotypes and beliefs about what issues a woman *should* deal with frame all other factors that influence female electability. Thus, this research explores public beliefs and attitudes about female candidates and how such beliefs affect women's election to higher political offices.

### Is Poverty Higher Among Immigrants Than Among Other Minority Groups?

**Mahja Foster**

Mentor: Dr. Virginia Beard  
Department of Political Science

The purpose of this research is to determine what factors influence the socioeconomic well-being of legal immigrants to the United States, and why those factors are important. In line with other research, this project defines a family's socioeconomic well-being as a combination of their annual income, work experience, and educational background. This project investigates what factor(s), such as a legal immigrant's country of origin, economic status of origin, prior education before immigration, reason for immigration, state of current residency, or even the ability to access governmental programs like welfare, affect the socioeconomic well-being of legal immigrants. Once the importance and sequencing of the influential factors on immigrant well-being is determined, this project will go further and seek to explain *why* certain immigrants have better or worse socioeconomic standing than other ethnic minority groups in the United States.



## Free Speech on College Campuses

**Zachary Francisco**

Mentor: Dr. Virginia Beard  
Department of Political Science

First Amendment rights and how they should extend on college campuses is a debated issue amongst college students and administrators alike. By the Supreme Court definition, the First Amendment protects all speech except: advocacy of illegal action, fighting words, commercial speech and obscenity. Public universities must abide to the first amendment, while private schools such as Hope College do not. Using empirical research, I attempted to come up with a reason as to why this issue has been so controversial. My results appeared to be straight forward; however my recommendation draws from normative results and the impact that school administration can have on handling an incident or preventing one altogether. While studying Hope College and meeting with school administration, I have come to the conclusion that the school's ability to put ethics ahead of strict policy interpretation, and principles ahead of pride, can serve as an effective solution for large public universities as well.

## Analysis of Immigration Public Opinion and its Effect on Immigration Reform

**Alejandra Gómez Limon**

Mentor: Dr. Virginia Beard  
Department of Political Science

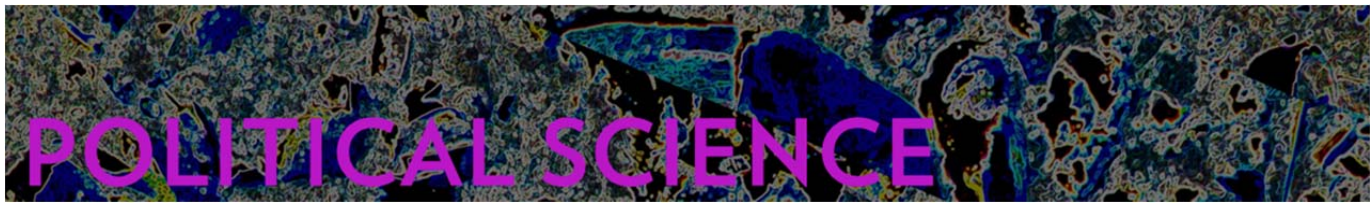
Current popular media coverage as well as discourse by elected officials suggests confusion regarding immigration in the United States. Research by the Pew foundation reveals that Americans are historically wary of admitting refugees (Desilver 2015). And yet nearly 59 million immigrants have arrived in the U.S. in the past fifty years, after the passage of a 1965 bill that rewrote U.S. immigration policy ("Modern Immigration" 2015). Most recent public opinion research on American perceptions of immigration shows mixed results. Just over 45% of Americans say immigrants in the U.S. are making American society better overall and for the long run, while 37% say they are making it worse (16% say immigrants are not having much effect). Nearly half of Americans want to see immigration to the U.S. reduced (49%), and 82% say the U.S. immigration system either needs major changes or it needs to be completely rebuilt. And yet the public is split in its views on whether immigrants are making things economically, politically or socially better or worse off ("Modern Immigration" 2015). Overall, the literature does not offer a clear picture on how these views that Americans hold regarding immigration and immigrants affect what changes they want to see in the U.S. immigration system. Thus, this study primarily analyzes how people's stereotypes—or what policy literature would categorize as deeply held beliefs—about immigration/immigrants translate into their preferences on immigration policy. Also missing in the current research is an understanding on if and how the policy preferences of the general public regarding immigration translate into actual policy formation. Thus, this paper secondarily addresses how immigration policy preferences impact the policies that result regarding immigration.

## What Factors Enabled Passage of the LIFE Act and Failure of the DREAM Act?

**Alejandra Gómez Limon**

Mentor: Dr. Paula Booke  
Department of Political Science

Light has been shed on the topic of America's broken immigration system because of the upcoming 2016 elections. This has made candidates and all Americans wonder: if we have had a broken immigration system for this long, are there any ways to fix the issue, and have Congress and the President worked together to find a solution? My presentation offers a comparative analysis of the successful Legal Immigration Family Equity (LIFE) Act of 2000 (Pub. L. 106 - 553 and - 554), and the unsuccessful Development, Relief, and Education for Alien Minors (DREAM) Act (H.R.1842) of 2011. Through the policies' evaluation, the reasons and corresponding factors for each bill were determined and examined. The results then contributed to a personal reformed proposal that would allow for Congress and the President to aid America's broken immigration system.



## Migration from Poor to Rich Countries

**Sarah Heffner**

Mentor: Dr. Jeffrey Polet  
Department of Political Science

Across the globe there is a widespread crisis of migration taking place due to conflict, poverty, social strife, or political turmoil. During this election cycle, the issue of immigration is a main topic of debate and creates multiple divides among the American people. Some believe that it is understandable for immigrants to want to pursue “The American Dream” and want to make it easier for them to enter the country. Others, however, want it to be stopped completely for fear of them taking jobs or causing violent crime. The purpose of this study is to research the economic benefits and disparities that come along with the migrations of people to the United States from poor countries or communities.

## The Impact of the U.S. State Department “Think Again Turn Away” Campaign on ISIS Recruitment

**Hunter Ihrman**

Mentor: Dr. Virginia Beard  
Department of Political Science

Since 9/11, technology, social media, and the Internet have become vehicles for the recruitment of extremist supporters. With the increased threat of the Islamic State of Iraq and Syria (ISIS) in the Middle East, federal agencies and civilians alike have recognized the need for digital counter-messaging to oppose extremist messages. In December 2013, the U.S. State Department launched its “Think Again Turn Away” campaign. This program increased the social media presence of the State Department, leading to the production of anti-ISIS media. By analyzing ISIS recruitment media and American counter-messaging, this project determines the impact of the “Think Again Turn Away” campaign on ISIS recruitment.

## The Relationship Between Politics, Media and Ethnicity in Kenya

**Catherine Namwezi**

Mentor: Dr. Virginia Beard  
Department of Political Science

In many emerging democracies, ethnic affiliation remains an important public identity maker. What factors perpetuate this politicized ethnicity? How people understand politics and themselves is largely shaped by and reflected in the vehicles through which they access information. These vehicles include media outlets such as radio, newspaper, television, and more recently, internet-based social media. This paper asks how and in what ways media affects and reflects ethnicity as an organizing category for how people interface with the public arena. Using Kenya as a case study, this project proposes to explore questions surrounding how media and politics interact. This project uses an original dataset of media content analysis—from newspaper, internet, and radio station sources—alongside public opinion survey data and insights from participant observation to ascertain if and how ethnicity remains a salient public identity and what these findings suggest for the future of political stability and democracy in the country, and thus other emerging democracies. Thus, this project asks if ethnicity is a politicized identity that trumps other public consideration and if it fills such role, how ethnicity as a political identity is created, reinforced and disseminated with a focus on the role of media as a democratic institution.



### How Do Public Beliefs About Gender on Various Dimensions Influence Female Candidate Policy Preferences in the Form of Their Stated Foreign Policy Agendas?

**Alexandra Piper**

Mentor: Dr. Virginia Beard  
Department of Political Science

Previous research has examined the differences in voter preferences and media attention towards male and female presidential candidates. This research finds that gender stereotypes exist in the minds of voters and in how media presents political candidates and information. These public beliefs and media coverage are found to affect female presidential candidates' campaigns in many ways. However, there is little research on how these beliefs affect the agendas of the candidates. Research has shown that many voters believe men are better able to handle military and defense matters. I use a variety of presidential campaigns, including Hillary Clinton, Carly Fiorina, Michelle Bachmann, Mary Ruwart, and Jill Stein, as case studies to analyze how these public beliefs influence female candidate policy preferences in the form of their foreign policy agenda. This research will continue through to include data from the 2016 presidential election.

### Tax the Rich: Studying our Tax Policy and the 1%

**Matthew Rueping**

Mentor: Dr. Virginia Beard  
Department of Political Science

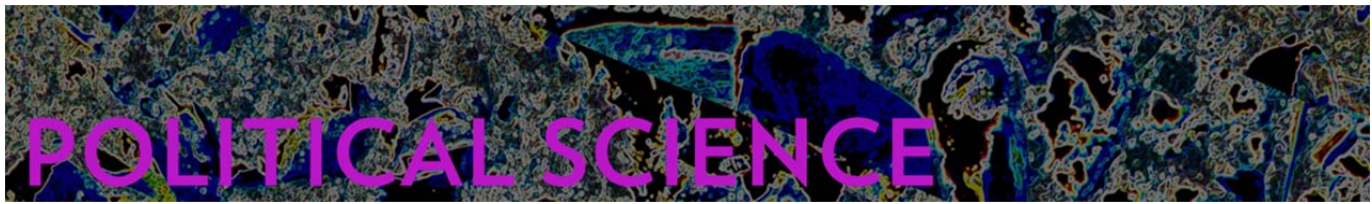
Tax collection is a necessary part of a functioning political entity. Yet there are debates about who should be taxed, who should pay more in taxation, and how tax policies can best be arranged to benefit society with the public goods tax money provides. This paper investigates ideas regarding the taxation of the "top one percent" of income earners in the United States. There has been a notion in the past few years that taxing the rich at increasingly higher rates will help to improve the financial situations of people in lower income brackets. In other words, there is a potentially high level of support for a taxation system built around the policy idea of redistribution. Proponents of a redistributive tax system often frame it as being more "fair," a notion I will evaluate as part of my research. What exactly is fair? Furthermore, how does a policy creator determine the level at which to draw the line for each tax level? Who determines when a citizen is "rich enough" to warrant higher levels of taxation? Furthermore, does a "fair" system necessarily lead to a situation that is best for the American economy? I will be researching accelerated tax rates and their effect on the economy and median income of each socio-economic class. These are difficult questions to answer because they encompass moral, economic, and political issues. I aim to answer some of these questions to generate better understanding regarding tax policy and to evaluate what is effective and what is not.

### The Evolution of Vulnerable Children Policy in America

**Nola Tolsma**

Mentor: Dr. Virginia Beard  
Department of Political Science

How has policy regarding vulnerable children groups evolved in America? Children who face homelessness, poverty, maltreatment or foster care are at a disadvantage for future success. This paper provides an analysis of foster care policy within the literature on policy impacting vulnerable groups in general and vulnerable categories of children specifically. Lifetime opportunities are severely limited for children who spend time in the foster care system. Current research shows that specifically education and employment outcomes are harmed significantly for youth with unstable home environments. This research will investigate how policy surrounding foster care children in America started, how it has evolved, and the changes being discussed for the future through the lenses of various public policy theories on why and how policy change occurs.



## Post-Secondary Education Among Foster Care Alumni

**Nola Tolsma**

Mentor: Dr. Virginia Beard  
Department of Political Science

Among foster care alumni, less than ten percent graduate from post-secondary education. While there is good evidence proving that education plays a significant role in one's likelihood to succeed in the future, the factors restricting foster care alumni from college graduation are less agreed upon. This research proposal seeks to identify which factors are the most significant in foster care alumni's likelihood to graduate from post-secondary education.

## Examining the Overrepresentation of African Americans in the Foster Care System from a Policy Perspective

**Grace Wiesner**

Mentor: Dr. Virginia Beard  
Department of Political Science

In 2013, African Americans made up 14% of the 0-17 population and 24% of the 0-17 population in foster care in the United States (2013 KIDS COUNT Data Book). Statistics on the obstacles facing youth when they exit—through aging out—the foster care system are frightening as these young adults are at a much greater risk for being diagnosed with a mental health disorder, experiencing homelessness, living in poverty and dropping out of high school. The issue of the overrepresentation of African American children in foster care has experienced increased legislative attention in the last ten years specifically; however, it will continue to remain an important policy issue until it is eradicated. Potential policy solutions include: increasing the size and scope of available social services, expanding the emphasis on cultural competency training, and reorganizing funding to allow for stipends in guardianship placements. This project seeks to explain policy change under this topic from the viewpoints of Institutional Theory and Elite Theory.

## The Psychology of Politics

**Valerie Zavislak**

Mentor: Dr. Jeffrey Polet  
Department of Political Science

The research will analyze the relationship between political participation and patterns of voting behavior. Political participation will be assessed through political involvement and knowledge of government policies. Participation can be reflected or assessed in looking at individual voting patterns and behaviors. The study will assess how attitudes influence individual voting preferences and different patterns of voting behavior, assessing why people vote the way they do. Individuals with stronger party affiliation will have a higher level of political participation or involvement. These individuals will also have a higher rate of voter turnout overall. The study will look at how emotion and cognition drive political attitudes that influence their voting preferences. The research will further assess how knowledgeable people are of governmental policies. The research will emphasize the impact of public opinion that drives government policies and will address what has been done to increase political participation and voter turnout in upcoming elections.



*Elliot Digison,  
Political Science, at  
the Celebration, 2016.*



*Catherine Namwezi,  
Political Science, at  
the Celebration, 2016.*





## Affording an Active Lifestyle

**Grace Bergt, Lauren Boyle,  
and Katelyn Dufek**

Mentor: Dr. Sonja Trent-Brown  
Department of Psychology

*The research was funded by the  
W.K. Kellogg Foundation.*

Previous researchers have shown a positive association between family income and children's activity level outside of school (Dearing et al., 2009). In the current study, researchers examined the correlation between income and activity preference among preschoolers, ages three to five, in western Michigan. Participants were selected from six preschools, which were partnered with the Outdoor Discovery Center Macatawa Greenway. This was a nature-based learning initiative funded by the Kellogg Foundation. Understanding the relationship between these two variables could be helpful for combatting inactivity and the consequences of unhealthy development in preschool children. This study involved 430 child-participants in the Holland/Zeeland area in classrooms that were classified by income as Tuition Based or Great Start Readiness Program (GSRP). GSRP is a government-assisted funding program for preschoolers who may face obstacles for academic success in the state of Michigan. Activity preference of students was measured by researchers using a modified version of Leary's Preschool Activity Preference Measure (2009). Additionally, demographic and income information were made available to researchers by the school administrators. Using means comparisons and correlational analyses, researchers examined the relationships between income, activity preference, and gender. Researchers predicted that preference for outdoor/non-sedentary activities would positively correlate with income. Moreover, it was hypothesized that boys would have a higher preference for non-sedentary/outdoor activity than girls. Next, boys in tuition-based classrooms would demonstrate a higher preference for non-sedentary/outdoor activity than their male peers in GSRP classrooms. Finally, across the six preschool sites, researchers predicted that there would be a significant difference between mean activity preference scores for tuition based classrooms and the mean activity preference scores for GSRP classrooms; with tuition-based classrooms predicted to have higher mean activity preference than their GSRP counterparts. Implications for this study would be beneficial for various educational programs seeking to reduce disparities between income levels.

## Implicit Desires vs. Explicit Standards: What Matters More for Partnering Behaviors?

**Natasha Jaina Bernal, Tara Murray, and Chloe Werkema**

Mentor: Dr. Carrie Bredow  
Department of Psychology

Most research on mate selection has focused on people's self-reported (explicit) measures of mate criteria, which are assumed to guide partnering decisions and behaviors (Buss et al., 2001; Fletcher et al., 1999). However, while some evidence has found that greater correspondence between mate standards and partner characteristics predicts greater relationship satisfaction (Eastwick, Finkel, & Eagly, 2011), other work has found little connection between people's reported mate criteria and the partners they select. This discrepancy may be explained by the conscious inaccessibility of some attitudes influencing partnering behaviors. In the present study, we examined whether (a) *implicit* measures of mate criteria are distinct from *explicit* standards, and (b) implicit and explicit preferences *uniquely* predict current and future relationship choices and evaluations.

Unmarried undergraduate students (n=203) completed three SC-IATs (Karpinski & Steinman, 2006), representing three major trait dimensions: attractiveness/vitality, warmth/trustworthiness, and status/resources. Participants also completed a questionnaire assessing their self-reported mate standards, relationship evaluations, and partner's characteristics. Participants were contacted 7 - 10 months later and invited to complete questionnaires similar to that used at T1.

Results revealed a negative correlation between implicit and explicit preferences for attractiveness/vitality ( $r=-.15$ ,  $p<.05$ ) and no significant correlations for



warmth/trustworthiness and status/resources. Regression analyses showed different ways that implicit and explicit standards predicted relationship evaluations. For warmth/trustworthiness, greater correspondence between people's *explicit* preferences and their partner's traits predicted greater relationship satisfaction ( $p < .01$ ) and lower ambivalence ( $p < .05$ ), whereas greater *implicit* preference-partner fit predicted greater perceived partner fit ( $p < .01$ ) and relationship commitment ( $p < .10$ ). Neither implicit nor explicit preference-partner fit on status/resources predicted relationship evaluations. For attractiveness/vitality, gender moderated the associations: *explicit* preference-partner correspondence predicted men's evaluations, but *implicit* preference-partner correspondence predicted women's evaluations. Preliminary follow-up analyses provided suggestive evidence that implicit preferences at T1 may also have implications for people's relational evaluations of later-formed relationships.

### Activity Preferences and Cognitive Development in Children: Effects of Children's Preference for Active Outdoor Activities Versus Sedentary Indoor Activities on Cognitive and Literacy Scores

**Kristen Garrett, Emily Forster, and Kara Niffin**  
Mentor: Dr. Sonja Trent-Brown  
Department of Psychology

*This research was supported by the Outdoor Discovery Center Macatawa Greenway and the W.K. Kellogg Foundation.*

This study assesses children's preferences for active outdoor and sedentary indoor play based on an outdoor science enrichment intervention for preschool children. Researchers analyzed the relationship between the children's activity preferences and their cognitive and literacy scores. A previous systematic review was conducted about the relationship between sedentary behavior and cognitive development in early childhood. Included in this comprehensive review were 37 studies (either experimental studies or observational studies) that discussed how "optimal cognitive development" in early childhood is related to many different domains, including physical activity (Carson et al., 2015). A large majority of children engage in excessive sedentary behavior, which results in detrimental effects to cognitive development (2015). For the current study, participants were recruited from local preschools through partnership with the Outdoor Discovery Center Macatawa Greenway (ODCMG) in Holland, Michigan and the Kellogg Foundation. Participants were both male and female preschool students (ages 3-5). Preferences for active outdoor or sedentary indoor activities were examined using two items from a self-report interview measure designed for use with preschoolers. We expect that preference toward active outdoor play will positively correlate with higher cognitive and literacy scores. The Teaching Strategies GOLD™ instrument observes the overall development and capabilities of children prior to first grade. With this holistic approach, GOLD™ is used as a tool to identify and assess school success predictors in order for teachers and administrators to have an accurate account of each child's readiness for school. The current study used the GOLD™ results to indicate cognitive and literacy capabilities among participants. Results of this study should encourage parents and teachers towards active outdoor play for their children and will guide recommendations for future research and planning.



## Health Disparity Among American Preschool Children: A Comparison of Body Mass Index Across Selected Ethnic Groups

**Alejandra Guzman, Kara Lurvey, Sarah Thoman, Cara Schipper, Amanda Gibson, Lauren Boyle, Manna Shintani, Katelyn Dufek, Tingxuan Zhang, Esveide Mendoza, Grace Bergt, Taylor Prokott, and Leslie Miller**  
Mentor: Dr. Sonja Trent-Brown  
Department of Psychology

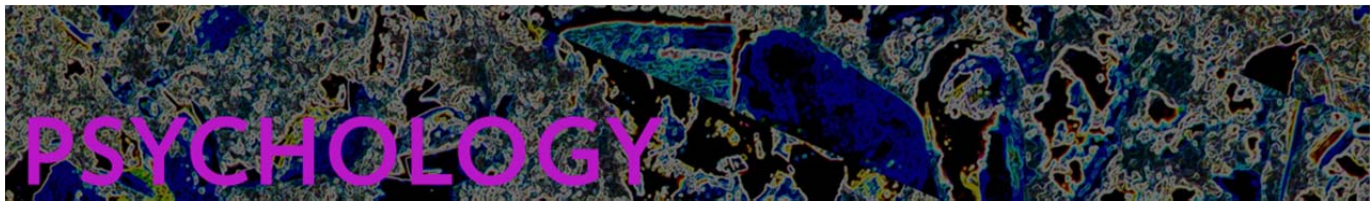
The purpose of this study is to explore the relationship between ethnicity and BMI-for-age in preschool children. Obesity rates have been rising for adults and children, with estimates for preschoolers reaching 43 million (de Onis et al., 2010). Various factors influence children's health in the United States: access to healthcare and healthy food options, safety of outdoor exercise, and socioeconomic status, especially for children of minority background. Prior studies have demonstrated the BMI disparity across ethnic groups—white, black, Asian, and Hispanic—in which Asian-Americans were twice more likely than whites to develop type 2 diabetes. Adulthood weight gain for Asian-Americans showed for every 11 pounds gained there was an 84% increased risk of developing type 2 diabetes (Harvard, 2012). To explore health and ethnicity in children, data were collected from preschool participants ranging in age from three to five. Researchers measured height (cm) using a stadiometer and weight (kg) using a standard electronic scale. BMI-for-age was calculated, and was based off of the CDC's Tool for Schools. Participants completed an activity preference 'game' involving pointing to one of two picture options depicting indoor or outdoor activities. A survey was also completed in which the researcher asked their favorite and least favorite activities, specifying inside or outside and sedentary or dynamic activities. Based on existing research, we expect for both European-Americans and Latinos, boys will have greater BMIs than girls. Regarding African-Americans, we predict girls will have a higher BMI than boys. Within gender groups, we expect African-American girls to have the highest BMI, followed by Latino girls, European-American girls, and Asian girls. Regarding boys, we anticipate Latino boys will have the highest BMI, followed by African-American, European-American, and Asian. This work has implications for early intervention programs targeted toward decreasing health disparities based on ethnicity.

## Adaptive Regulation Strategies in Response to Transgression Rumination: Analysis of Written Responses Following Acceptance or Reappraisal Training

**Robert Henry, Natasha Jaina Bernal, Fallon Richie, Anna Snyder, and Anikka Van Eyl**  
Mentors: Dr. Lindsey Root Luna and Dr. Charlotte vanOyen Witvliet  
Department of Psychology

Interpersonal offenses carry negative consequences associated with rumination. Two adaptive regulation strategies—reappraisal and acceptance—have demonstrated positive impacts (Wolgast, Lundh, & Viborg, 2011). One study (Witvliet, Knoll, Hinman, & DeYoung, 2010) found that compassion-focused reappraisal stimulated empathy and forgiveness, whereas benefit-focused reappraisal prompted gratitude. Yet, reappraisal may be more difficult to implement than acceptance. In this study, we evaluated the impact of brief reappraisal and acceptance interventions on participants' written responses. Undergraduates ( $N=92$ ) identified an interpersonal transgression experienced in the past three years. Participants ruminated and were randomly assigned to either positive reappraisal, acceptance, or control (a second trial of rumination) imagery conditions. Participants then wrote about their imagery experience. One week later, participants re-engaged the imagery conditions. Linguistic analyses showed main effects of trial type: in the initial visit, participants used more forgiving and cost language during the intervention compared to initial rumination ( $ps \leq 0.019$ ); a similar pattern occurred during the second visit with cost language ( $p < 0.001$ ). A main effect of trial occurred during the second visit, with participants using more anxious language during rumination ( $p = 0.009$ ). A significant trial  $\times$  condition interaction effect was found for benefit language during both visits ( $ps < 0.03$ ). Confidence interval comparisons revealed that reappraisal prompted more benefit-finding language than rumination during the intervention; additionally, only reappraisers increased their use of benefit-finding language across trials. Overall, participants used more forgiving language and less negative (cost-focused, anxious) language during the intervention trial, compared to rumination. Only

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## Embodied Virtues: A Review of Peripheral Physiological Associations with Human Strengths

**Robert Henry**

Mentors: Dr. Lindsey Root Luna and Dr. Charlotte vanOyen Witvliet

Department of Psychology

*This work was supported by a 2015 grant from Hope College's Frost Research Center.*

participants in the reappraisal condition had an increase in benefit-focused language during the intervention trial. This suggests that the reappraisal condition was more effective than the acceptance or control conditions for promoting benefit-focused language, which past research has linked with increased gratitude.

The theological and cardinal virtues have provided the traditional framework for understanding virtue. Within the past 20 years, researchers in positive psychology have developed a framework outlining six core virtues and 24 key human character strengths. Research within this domain has demonstrated that human health is related to positive psychological traits and states associated with these strengths. Specific autonomic nervous system markers of health include heart rate variability (HRV) as an indicator of self-regulation, heart rate (HR), and blood pressure (BP). In this project, we conducted a comprehensive search of the 24 strengths and peripheral physiology measures in established databases. We hypothesized that character strengths would have adaptive physiological associations (e.g., higher HRV, lower BP). Overall, our results indicated that character strengths tended to have healthy physiological associations. We specifically found that the literature is most heavily concentrated in the areas of forgiveness, religiosity/spirituality, love/charity, and humor. Concerning forgiveness, correlational studies found lower BP with higher forgiveness. Experimental work inducing forgiveness produced reductions in facial muscle tension, BP, and skin conductance, while also buffering HRV from the negative effects of rumination. Religiosity and spirituality appeared to reliably predict only lower BP, especially in the elderly. Most other parameters (e.g., HR, cortisol, skin conductance) had little or no association with religiosity and spirituality. Research on love/charity revealed one physiological association: having a new loving relationship predicted greater vagal activity in response to stress. Humor predicted a healthier immune response and illness protection. Overall, we found a general physiological benefit to demonstrating virtues, although these associations differed across specific traits and responses. Future studies will need to address the virtues that currently lack physiological research and experimentally assess virtues' associations to create a clearer picture of embodied virtues and peripheral physiology.

## Does Helping Increase Well-Being? Experimental Evidence for the Role of Virtuous Behavior in Meaning in Life

**Evan Johnson and Megan Edwards**

Mentor: Dr. Daryl Van Tongeren

Department of Psychology

*This research was supported by a Towsley Research Scholars Fellowship.*

Recent research suggests that many social motives are oriented to the overarching goal of creating and maintaining a sense of meaning in life (Heine, Proulx, & Vohs, 2006). The present study uses empirical methods to establish a link between the social motive of helping and a sense of meaning in life. In this study, we hope to discover whether virtuous behavior increases self-reported meaning in life by randomly assigning participants to either a prosocial action or a neutral action condition. In the prosocial condition, after participants gave informed consent, the researcher appears stressed and asks for help moving boxes in the laboratory. In the neutral condition, participants are told that the study is about obedience and they were instructed to move the boxes. In both situations, participants moved boxes for the experimenter; however, the perceived rationale for the behavior (helping vs. obedience) was experimentally manipulated. Following this interaction, participants in both groups filled out a questionnaire that measured their perceived meaning in life and other indices of well-being. Participants were then debriefed. Results revealed that the effect of the prosocial behavior prime on well-being was moderated by the participant's religiousness. In general, this research helps provide insights for positive ways for people to find meaning in their lives.



## Sleep in Preschoolers: Memory, Health, and Environment

**Ohanes Khacherian**

Mentors: Dr. Andrew Gall and  
Dr. Sonja Trent-Brown  
Department of Psychology

*This work was supported by  
the Frost Research Center at  
Hope College.*

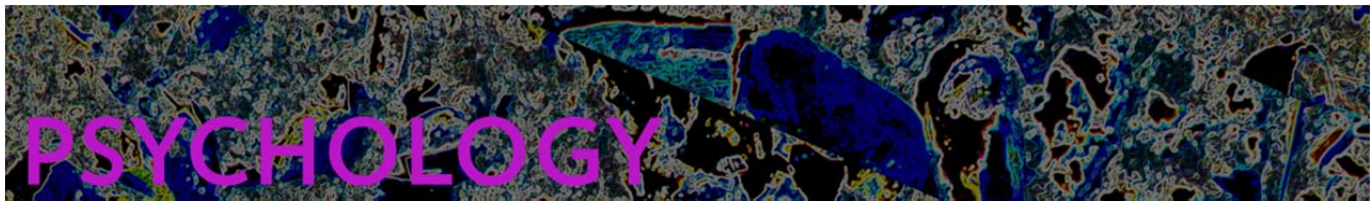
Insufficient sleep is a public health concern. The National Institutes of Health have reported that preschoolers need 11 - 12 hours of sleep daily. Good sleep hygiene includes going to bed at the same time each night, rising at the same time each morning, and avoiding light sources in the evening. However, children today spend more time in front of screens than any previous generation. It is not yet known how these devices affect sleep, memory, and health in preschoolers, at a time when sleep need is very high and sleep patterns are being shaped for the rest of the child's life. In this study, we are measuring the amount of sleep and amount of light at night received by children. The data will be gathered by asking parents to fill out a sleep journal for their preschooler(s) for four weeks and by asking a subset of children (n=20) to wear a FitBit. Also, a survey will be distributed to the teachers and parents asking about sleep and general behavior of the preschooler. We will assess the relationships between sleep and light at night with health (BMI), memory performance, and activity preference. We expect to find a negative correlation between sleep and preschoolers' BMI scores, such that greater amounts of sleep will be associated with lower (healthier) BMI percentiles. In addition, we expect to find a positive correlation between sleep and memory performance. Finally, we predict that increased light at night will be negatively correlated with sleep quality and quantity. This project seeks to increase awareness of the importance of sleep in young children. If parents appreciate the importance of sleep, this will likely lead to healthier lives in their children, and the children will have an excellent opportunity to reach their fullest potential.

## Can Childhood Activity Level and Outdoor Experience Predict Adult Outdoor Exposure, Physical Activity, and Body Mass Index?: A Retrospective Approach

**Kara Lurvey, Alejandra  
Guzman, Sarah Thoman,  
Esveide Mendoza, Leslie  
Miller, Grace Bergt, Taylor  
Prokott, Cara Schipper,  
Tingxuan Zhang, Lauren  
Boyle, Manna Shintani,  
Katelyn Dufek, and Amanda  
Gibson**

Mentor: Dr. Sonja Trent-Brown  
Department of Psychology

Previously, research has explored connecting children with nature (Louv, 2005, Wells, 2006). More recently, work has focused on adults and the experience of "nature deficit disorder" which asserts that adults lack connection to nature (Louv, 2011). Studies have compared the relationship between adults' current levels of nature exposure and preference for physical activities with their childhood experiences (Thompson et al., 2008, Henniger, 1994). These studies suggest that there is a correspondence between childhood experiences and adult preferences. A competing factor is the increased presence of electronic media which is associated with decreased levels of physical activity, thus a higher Body Mass Index (BMI) (Fotheringham, 2000) (CDC, 2001, 2005). The present study explores the relationship between current adulthood outdoor activity level and preferences, retrospective childhood exposure, and BMI. An adult survey will be completed by college students. Questions inquire about current outdoor/indoor activity, preference and frequency, childhood activity preference, technology use, and self-reported BMI. The adult survey will be analyzed to find correlations between retrospective childhood activity preference and current activity preference, technology use, and outdoor activity preference and BMI. BMI-for-age was also computed for preschool participants. An interview assessed each child's favorite and least favorite activities, affinity for inside/outside activities, and sedentary/dynamic activities. We predict that there will be a positive correlation between adults' retrospective outdoor activity preferences and current activity level. We expect that greater technology use will be associated with higher BMI and lower outdoor activity level. We anticipate that adults' current outdoor activity level and their BMI will be inversely related. If there are no significant differences between the adult retrospective and current preschoolers' perspectives, we suggest that the preschoolers may be on a similar trajectory toward the adults' current BMI, nature exposure, and activity level practices which has implications for future health.



## The Relationship between Gender, BMI, and Activity Preference Among Preschool Students

**Esveide Mendoza, Leslie Miller, Tingxuan Zhang, Cara Schipper, Taylor Prokott, Amanda Gibson, Grace Bergt, Lauren Boyle, Katelyn Dufek, and Manna Shintani**

Mentor: Dr. Sonja Trent-Brown  
Department of Psychology

*This research was supported by the Outdoor Discovery Center Macatawa Greenway and the W.K. Kellogg Foundation.*

Children 3 - 5 experience significant changes in growth and development. Activity preferences in these critical ages form significant foundations for lifespan health practices and lifestyles. Previous research suggests that changes in childhood body mass index (BMI) related to adult overweight and adiposity more so in females than males (Guo et al., 2000). It has been suggested that overweight/obesity in childhood is associated with poorer gross motor development and endurance performance, and that an active lifestyle is positively correlated with more effective gross motor development in children (Graf et al., 2003). Moreover, children who are overweight are at risk for diabetes mellitus, high blood pressure, and poor academic performance (Annesi et al., 2007). The current study aimed to investigate relationships across BMI, gender, and social and individual activity preference. Data was collected from 430 children. Participants' height and weight were measured in order to calculate BMI-for-age scores as it is best suited for preschool populations. The interview portion of this study contained responses to three open-ended questions evaluating participants' social and individual activity preferences. We hypothesized that: (1) males would be more likely than females to choose physically-active activities rather than sedentary ones, (2) males would be more likely than females to choose outdoor activities rather than indoor ones, (3) male and female participants who preferred active over sedentary activities would have lower BMI scores, and (4) preferences in social environments would show higher rates of active and outdoor activities. The results of this study have implications for a large span of professions, including parents, teachers, and physicians. Research shows that 50 percent of children who are overweight will be unable to overcome their weight, leading them to become obese adults (Dietz, 1998). Hence, the obese adults of tomorrow could start as overweight children today.

## Can Generosity Increase Well-Being? Identifying Experimental Effects and Possible Mediators

**Hanna Newbound and Alexa Rencis**

Mentor: Dr. Daryl Van Tongeren  
Department of Psychology

*This research was supported by a Towsley Research Scholars Fellowship.*

Studies suggest that threats to meaning elicit negative and defensive reactions, but sometimes can result in positive actions such as prosocial behaviors. By living up to the cultural standards of virtue and morality, those who behave prosocially should perceive their lives to be more meaningful. In this study, we seek to extend the research on virtuous behavior and meaning by assessing the extent to which other-orientation mediates the link between virtuous behavior and meaning in life. This assessment is derived from findings that connect relationships to meaning and meaning to prosocial behavior (Van Tongeren et al., in press). Putting others before the self is a large part of relationships, and therefore we expect other-orientation to have a mediation role in the link between prosociality and meaning in life. Participants were randomly assigned to engage in either a virtuous action that involved other-orientation, or a neutral condition. In the virtuous condition, participants were given 10 raffle tickets on which they could write their own name, or they could allocate some or all of their tickets to friends. In the neutral condition, participants were told to only enter their own names into the raffle. After the donation opportunity task, participants completed various measures and debriefed. Results revealed that generous donation behavior increased well-being relative to not donating. This research highlights an additional way for people to find, or increase, well-being in their lives.



## Exploring Technology Usage and Leisure Activities from Childhood to Emerging Adulthood

**Taylor Prokott, Amanda Gibson, Esveide Mendoza, Grace Bergt, Sarah Thoman, Manna Shintani, Leslie Miller, Tingxuan Zhang, Lauren Boyle, Cara Schipper, and Katelyn Dufek**

Mentor: Dr. Sonja Trent-Brown  
Department of Psychology

*This research was supported by the Outdoor Discovery Center Macatawa Greenway and the W.K. Kellogg Foundation.*

## Flourishing in the Wake of a Disaster: Investigating the Effects of Disaster-Related Stimuli on Meaning, Well-Being, and Religion

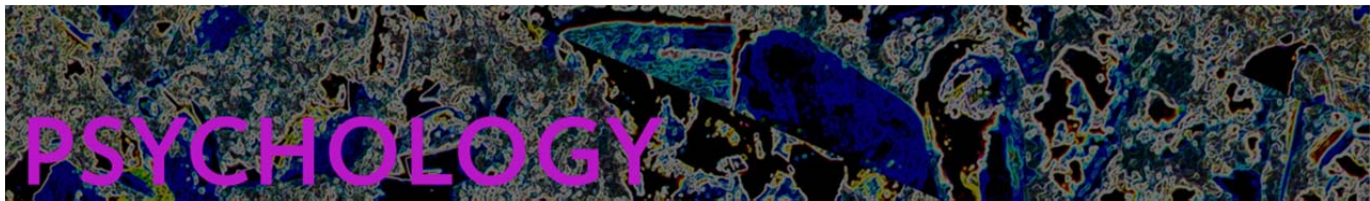
**Alexa Rencis and Rachel Hibbard**

Mentor: Dr. Daryl Van Tongeren  
Department of Psychology

*This work was supported by a grant from The John Templeton Foundation.*

In the past 20 years, there has been a surge in daily technology use. Concurrently, there have been significant changes in childhood leisure activities. We investigate technology usage and activity preference from childhood through emerging adulthood. Electronics usage at various developmental stages may influence perceptions of the usefulness of technology, current activity preferences, and activity levels. Additionally, Leary et al. (2008) showed that the activity preference of parents is correlated with the activity preference of their children. Further, research suggests that physical activity can also influence brain health and learning (Cotman, Berchtold, & Christie, 2007; Ratley & Loehr, 2011). Similarly, Rideout, Foehr, and Roberts (2010) demonstrated that media use was associated with academic performance. Participants were recruited from various collegiate departments. The online Qualtrics survey takes approximately 25 minutes to complete. It examines electronic media use and activity preferences during childhood, during emerging adulthood, and as a prospective parent. We predict that age will correlate with perceptions of and initial implementation of technology and that participants' enjoyment of childhood activities would be related to the influence and encouragement of their parents. We expect that GPA will be related to how students interact with their environment, such as their activity level, time spent outdoors, and time engaging with electronic media. We predict a negative correlation between age and favorable perceptions of technology and a positive correlation between current age and age of initial technology use. Media usage is nearly ubiquitous in our society, but technology develops at such a rate that makes it difficult to track its impact. Many interventions target childhood media use, yet their effectiveness is dependent upon the perceptions of their caregivers and community. College students will be the next generation of parents, and their perceptions of technology will influence how they raise their children.

Disasters can present a context for investigating how disruptive life events affect individuals' meaning in life and religion and spirituality. Disasters are understudied, and it is unclear how they affect meaning in life. The purpose of the current study is to establish that disasters are a threat to meaning and to determine how disaster primes affect meaning in life, religion, and spiritual well-being. The 100 participants in this study were introductory psychology students at a small Midwestern liberal arts college. Participants were randomly assigned to one of three conditions: (1) reading and providing a written summary of a disaster situation while imagining themselves in the situation (disaster prime condition), (2) reading and providing a written summary of an essay about the meaninglessness of life (meaning threat condition), and (3) reading and providing a written summary of an essay about computers (control condition). After reading the prime and writing the summary, participants completed surveys regarding their experienced emotion, meaning in life, religious variables, personality differences, virtuous behavior, and well-being. We predicted that the disaster prime will operate like the meaning threat prime and differ from the control condition across all of the dependent variables. Results revealed that individuals in the disaster prime scenario reaffirmed their meaning in life. This suggests that disasters are a threat to meaning and can elicit responses to regain a sense of meaning. Implications of this include discovering how people overcome challenges, such as disasters, in order to grow and to flourish.



## Embodying Hope: The Impact of Hopeful Thinking on Cardiovascular, Psychological, and Linguistic Indicators

**Fallon Richie, Natasha Jaina Bernal, and Anikka Van Eyl**  
Mentors: Dr. Lindsey Root Luna and Dr. Charlotte vanOyen Witvliet  
Department of Psychology

*This research was supported through funding from the Frost Research Center at Hope College and by an award to Hope College from the Howard Hughes Medical Institute through the Undergraduate Science Education Program.*

Past research has identified a relationship between self-regulatory processes and parasympathetic nervous system function (Geisler, Vennewald, Kubiak, & Weber, 2010). Self-regulation relates to hope in that each can involve motivation, finding pathways toward a goal, and practicing self-control (Vohs & Schmeichel, 2002). Hope has received attention for its mental health benefits, but its connections with psychophysiology have not been explored experimentally. In this study, we examined the impact of hopeful thinking on cardiovascular, psychological, and linguistic indicators.

Sixty undergraduate students participated in an incomplete repeated measures experiment with three imagery conditions. Participants first thought about a specific, personal hoped-for outcome (e.g., academic, professional, relational) and then imagined their hoped-for outcome being fulfilled, remaining unfulfilled, and a neutral control condition. Changes in blood pressure, heart rate, respiration, and high-frequency heart rate variability (HF-HRV) were analyzed. Following each trial, participants completed self-report measures of hope, flourishing, and subjective emotion.

Hope-fulfilled imagery was positively related to positive emotions (joy, gratitude, peace) and inversely related to negative emotions (sadness, anger),  $ps < .001$ . Participants also reported greater levels of flourishing in the hope-fulfilled condition. Linguistic analyses indicated that participants used more hopeful, social, positive emotion, and benefit-finding language in the hope-fulfilled condition ( $ps < .004$ ). The main effect of imagery condition was not statistically significant for the physiological measures. However, an interaction of trait hope and imagery condition revealed that for participants with high trait hope, HF-HRV was negatively impacted by the hope-unfulfilled condition ( $p = .018$ ).

Results demonstrated that hopeful thinking prompted increased state hope, flourishing, positive mood, and positive language whereas hopeless thinking induced opposite effects. Furthermore, hopeless thinking appeared to come with a cardiac cost (i.e., decreased HF-HRV) for people with high trait hope. Provided that goals are appropriate, imagining hopes fulfilled yields emotional benefits and buffers cardiac response for high hope people.

## Cultivating Hope and Happiness through Grateful Remembering: A Two-Study Assessment of Trait and State Gratitude

**Fallon Richie and Nicholas Pikaart**  
Mentors: Dr. Charlotte vanOyen Witvliet, Dr. Lindsey Root Luna, and Dr. Daryl Van Tongeren  
Department of Psychology

Gratitude appreciates the past whereas hope anticipates a positive future (Emmons, 2003; Snyder et al., 1991). Gratitude is associated with life satisfaction and happiness (Froh, Yurkewicz, & Kashdan, 2009), and hope is associated with well-being and decreased depression (Snyder, Rand, & Sigmon, 2002; Cheavens, 2000). We conducted two studies investigating the relationship between gratitude and hope. First, we tested trait gratitude as a predictor of hope and happiness. Second, we conducted an experiment to examine whether gratefully reflecting on a past hope that had been fulfilled would prompt greater state hope and happiness. In Study 1, a hierarchical regression analysis of 255 participants' responses revealed that self-control, patience, and forgiveness accounted for a significant proportion of variance in trait hope and happiness scores. Importantly, in Step 2, gratitude significantly accounted for an additional proportion of variance in both trait hope (20.7%) and happiness scores (8%),  $ps < .001$ . In Study 2, 153 participants wrote about a current hoped-for outcome and completed assessments of state hope and happiness. Participants were then randomly assigned to either 1) gratefully remember a past hope that had been fulfilled or 2) a control condition, after which





participants again rated their state hope and happiness. Participants who gratefully remembered a fulfilled past hope (vs. the control condition) reported significant increases in state hope and happiness,  $ps < .001$ .

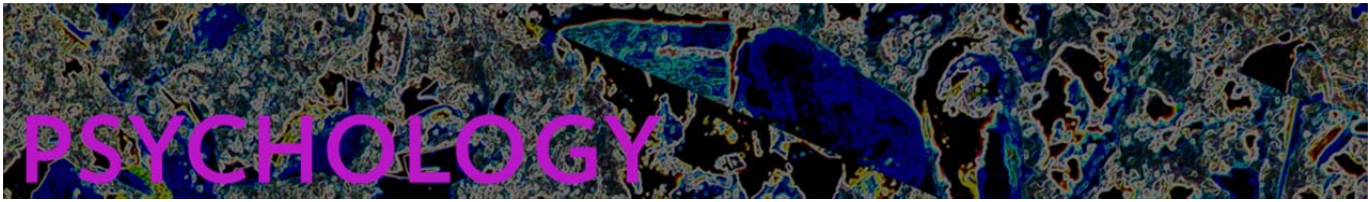
Although gratitude and hope are rooted in different dimensions of time, these studies demonstrated their powerful relationship. In Study 1, trait gratitude predicted hope and happiness, above and beyond the effects of other virtues. In Study 2, inducing state gratitude for a fulfilled past hope significantly increased state hope and happiness (vs. the control condition). This evidence highlights that gratefully remembering past events with appreciated outcomes can be an effective way to prompt increases in current hope and happiness.

### Who Is It?: Vowel Sound Variation Among African American and European American Children

**Dalila Salas and Emily Simmons**

Mentor: Dr. Sonja Trent-Brown  
Department of Psychology

Previous research conducted by Peterson and Barney (1952) has shown vowels are acoustically specified based on their formant frequencies. Their study has been replicated and extended to include temporal and spectral measurements (Hillenbrand et al., 1995). While both of these studies included children, neither included data in respect to the child's gender or ethnicity. Therefore, more data is needed that provides the acoustic targets for children that take age, gender, and ethnicity into consideration. The present study explores variations in phonemic production across age, gender, and ethnicity. There is a gradual lowering of the voice beginning with the onset of puberty, which could begin as early as age 10 (Berger, 2008). The fundamental frequency of a child's voice lowers as well, influencing the phonological space, which could result in differences across gender especially for the 11 to 12 year olds. Children were presented with a list containing neutral consonantal context /h-vowel-d/ words and a second list containing sentence-length stimuli. The /hVd/ words contained each of the 12 General American English vowels as well as three diphthongs for a total of 30 utterances per speaker. We hypothesize that fundamental and formant frequencies will be higher for 8- to 9-year olds than for 10- to 12-year olds and higher for girls (by age 10). With respect to ethnicity, we anticipate no significant differences in frequency measures between European-American and African-American children. This study will contribute to our knowledge of developmental trajectories for specified acoustic parameters. As gender and ethnicity are vital cues for adult speakers, it is important to investigate how salient acoustic parameters are for child speakers and at what ages child parameters begin to approximate adult measures. Results will have implications for audiologists, speech language pathologists, developmental scientists, and others in the field of communication sciences and disorders.



## Perceptual Differentiation of African American and European American Children

**Emily Simmons and Dalila Salas**

Mentor: Dr. Sonja Trent-Brown  
Department of Psychology

*This research was supported by the Frost Research Center at Hope College.*

Previous research presented by Thomas and Reaser (2004) has demonstrated that adult speakers can be perceptually differentiated by listeners with respect to gender and ethnicity. Their study presented data from various studies with respect to adult speakers; however none were presented for children. The goal of our research is to examine how age, gender and ethnicity of child speakers ages 8-12 affect the perceptual accuracy of adult listeners. Following the onset of puberty, these acoustic parameters begin to emerge, enabling listeners to reliably identify speaker characteristics in adulthood (Berger, 2008). The question remains, at what point across the pubertal transition does perceptual accuracy meet the level for adult speakers? Undergraduate college students listened to audio recordings of European American and African American children producing words and sentences containing /h-vowel-d/ target stimuli in General American English. Each block contained items spoken by children of each ethnicity, age, and gender. The listeners identified which ethnicity and gender they believed the speaker to be, as well as how confident they were of their choice. We expect greater accuracy, faster reaction times, and higher median ratings for forward blocks, sentences, and female speakers. We do not expect there to be a difference in identification of European American voices versus African American voices. We also anticipate that accuracy of identification will improve as the age of the speaker increases due to the changing of the voice as a result of puberty. The study will provide greater knowledge of how the age of a child speaker impacts the ability of the listener to identify the speaker's gender and ethnicity. The implications of this data can be extended as a framework for individuals who work with children and in speech-related professions to reduce biases that occur as a result of personal language experience.

## Coping with an Interpersonal Transgression: The Impact of Brief Reappraisal, Acceptance, and Rumination Inductions on Forgiveness and Short-Term Emotions

**Anna Snyder, Fallon Richie,  
Anikka Van Eyl, Robert  
Henry, and Natasha Jaina  
Bernal**

Mentors: Dr. Lindsey Root Luna  
and Dr. Charlotte vanOyen  
Witvliet  
Department of Psychology

*This research was supported by a  
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Student/Faculty Collaborative  
Summer Research Grant and a*

Previous research has demonstrated that emotion regulation strategies are beneficial in coping with negative events (Gross, 1998). For example, Witvliet, Knoll, Hinman, and DeYoung (2010) found that positive reappraisal reduced the negative impact of transgressions. In our study, we utilized a complex design to examine the impact of acceptance, reappraisal, and rumination between subjects over a two-week period. Undergraduate college students (N=98) recalled an interpersonal transgression from within the last year. Participants self-reported anxiety, depression, rumination, acceptance, satisfaction with life, and state forgiveness. During two visits, all participants ruminated and were randomly assigned to learn acceptance, positive reappraisal, or to ruminate again (control). Immediately following each imagery trial, participants completed self-report single items assessing positive (e.g., happiness, gratitude, peace, emotional and decisional forgiveness) and negative (e.g., sadness, anger) psychological experiences. Between participants mixed ANOVAs revealed that regardless of condition, from Visit 1 to Visit 2, participants experienced reductions in rumination, depression, and anxiety with increases in acceptance, forgiveness, and life satisfaction. We also found significant main effects of Visit and Trial, which demonstrated that participants reported increased positive experiences (e.g., gratitude, happiness, empathy, peace, forgiveness) and reduced negative emotions (e.g., sadness, anger) during the second visit and during the intervention trial (compared to the rumination trial). A significant Trial X Intervention interaction effect occurred for gratitude, happiness, peace, forgiveness, valence, sadness, and anger. Confidence interval comparisons revealed that only the individuals who learned acceptance reported increases in gratitude, happiness, peace, empathy, and forgiveness, and decreases in sadness across trials. These results demonstrated



2013 Carl Frost Center for Social Science Research Grant.

### Nurture with Nature: Effects of Nature Learning on Children's Activity Preferences and Animal Knowledge

**Sarah Thoman, Austin Elluru,  
Jordan Taylor, Hillary Smith,  
and Katherine Hauge**  
Mentor: Dr. Sonja Trent-Brown  
Department of Psychology

*This research was supported by  
the Outdoor Discovery Center  
Macatawa Greenway and the  
W.K. Kellogg Foundation.*

that our interventions had differential short-term impacts. Overall, all participants benefited from thinking about the transgressions. While acceptance and reappraisal did not outperform intentionally dwelling on an interpersonal transgression, brief interventions—particularly acceptance—were beneficial for short-term coping with an interpersonal offense.

This study examines children's affinity for the outdoors based on participation in a six-month nature-based science enrichment program for preschool children. We explore the relationship between nature exposure, children's active outdoor preferences, and their understanding of animals in the local environment. Previous research evaluated children in 2nd, 5th, 8th, and 11th grades and showed that the optimal time to encourage compassion for animals was between 2nd to 5th grade, and students between 5th and 8th grade showed the greatest cognitive gains in animal knowledge (Kellert, 1984). Children experience large cognitive gains in preschool and we expect that greater interaction with the natural world will encourage children to enjoy active outdoor activities and promote knowledge of animal species. Participants were recruited from local preschools based on grant funding from the Kellogg Foundation and the Outdoor Discovery Center Macatawa Greenway (ODCMG) in Holland, Michigan. Participants were 229 males and 207 females ages 3 - 5 years old. Activity preferences were evaluated using an adaptation of Leary's (2009) Preschool Activity Preference measure that distinguishes children's preferences for sedentary indoor and active outdoor activities using a self-report item and 19 pairs of images. Animal knowledge was assessed using an interview developed by the ODCMG that includes Michigan native and non-native animal species. Completeness of outdoor learning environments at preschool sites were compared by the percent of the grant budget used. Expected outcomes will be that greater preferences for active outdoor activities will correlate positively with correct animal identification. We expect that children who participate in nature-based learning will show greater preference for outdoor active activities and increased accuracy identifying native animals at the conclusion of the program. Outcomes of this study will show the effectiveness of the nature-based science enrichment preschool program and guide recommendations for future planning.

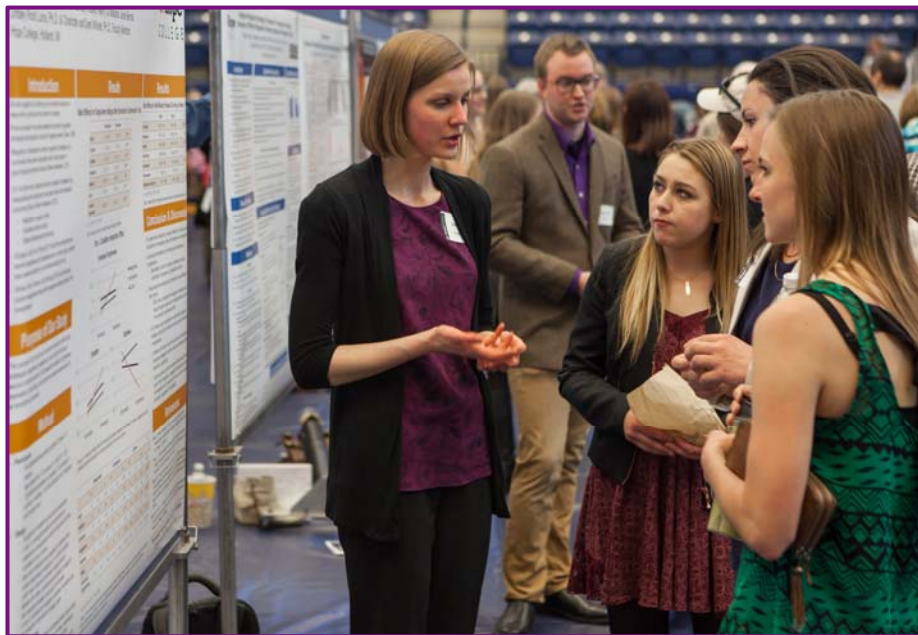
# PSYCHOLOGY

## A Legacy of Hope: An Exploration of Emmanuel Cathedral's Engagement with the Anti-apartheid Struggle from 1984-1994

**Mariana Thomas**

Mentor: Dr. Sonja Trent-Brown  
Department of Psychology

This is an exploration of how Emmanuel Cathedral in Durban, South Africa, as a local faith community, engaged in the anti-apartheid struggle from 1984-1994. The study explores the reasons for the parish's muted response to apartheid while highlighting the overt opposition to the injustices by Archbishop Denis Hurley. The narration explicates the parish's apathy towards apartheid as an example of the Church's universal struggle to remain relevant and actively responsive to society's needs. Moreover, it is explained that the Cathedral's contemporary emphasis on social justice is a result of Archbishop Hurley's ministry as the parish priest after his retirement from serving as Archbishop of Durban. The study concludes by resolving that the role of the parishioners within society is to emulate Archbishop Hurley who prophetically stood for the truth despite the consequences or temptation to maintain the status quo. This auto-ethnographical case study includes interviews with past and present clerical staff, parishioners and associates of Emmanuel Cathedral to understand the lived experience of the faith community during the period in question. In addition, the repositories of Diakonia Council of Churches, Archdiocese of Durban Chancery, Inanda Seminary, St. Joseph's Theological Institute and the Nelson Mandela and Robert Sobukwe Library at the Seth Mokitimi Methodist Seminary are utilized to historically frame and enhance the interviews, promoting a continued commitment to social justice within Emmanuel Cathedral and encouraging a future of prophetic action.



*Anna Snyder, presenting her psychology project at the Celebration, 2016.*

# SOCIOLOGY & SOCIAL WORK

## Needs Assessment of Community-Based Service Provider to Children with Disabilities and their Families in Zhengzhou, China

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This study was the third year of a series of studies that explored the programs available to children with disabilities in China. The purpose of this research was to gain the perspective of professionals and volunteers who work with children with disabilities in regards to the surrounding context of the work they do. Those interviewed were asked about their positive experiences, challenges, strengths, barriers, and areas of need that remain in order to provide adequate and complete service to this population. A convenience sample of workers and volunteers from an organization called GIFT was taken. GIFT is a domestic, Chinese, faith-based (Christian) charitable service organization that is a registered NGO in China. GIFT is headquartered in Zhengzhou, the capital of Henan province. It provides services to meet the needs of the parents of children with disabilities. Through helping the parents, GIFT is able to also help the children with disabilities. A grounded theory approach to qualitative research was used. In order to complete this evaluation, the following process was followed:

- 10 interviews of 11 professionals at GIFT, along with 2 focus-group interviews
- Transcription of raw data set (interviews)
- Triangulation with multiple coders was used in the Open coding process to increase confirmability of findings
- Triangulated axial coding to identify cross-cutting and organizing themes

*Children with disabilities, their families, and friends participate in GIFT initiative at park in Zhengzhou.*



Photo used with permission

## Sex Trafficking Intervention: A Therapeutic Approach to Helping Victims

**Ashley Krause**

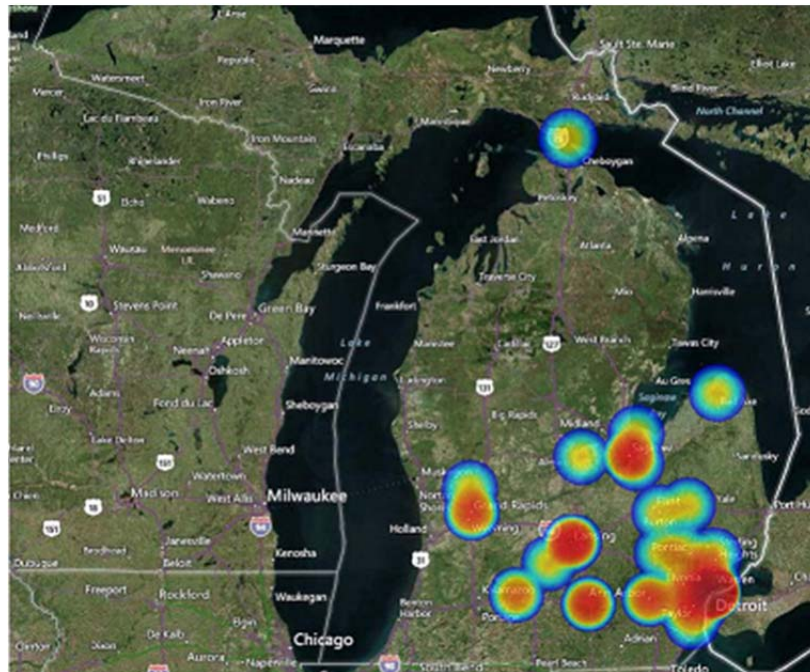
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This project aims to educate mandated reporters on how to intervene with sex trafficked victims. Sex trafficking is not a new problem in our society, but often goes unidentified as a result of lack of education and awareness of the topic. Many professionals are in a position to intervene safely and effectively, but may lack the tools needed. Medical personnel in particular are in the unique position of having the responsibility to both identify victims and treat their immediate medical needs. The objectives of this project were two-fold: 1) To conduct a needs assessment of medical personnel around the topic of sex trafficking interventions, and 2) use the needs assessment to aid in creating an intervention module. Research participants were selected using snowball sampling that included 11 medical personnel. A series of seven questions were asked in open-ended interviews as well as two quantitative-scaled questions. These interviews were conducted either in person or by telephone at the participant's convenience. The analysis of these interviews was done both by hand and by computer. Results of the study yielded three primary areas of concern for the medical personnel: 1) what

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resources to connect a victim to, 2) how to identify a victim by knowing what signs to look for, and 3) the demographic of the victims of trafficked. Additional findings were that the first barrier in assessment and intervention from the practitioner's standpoint was getting the victim to report, and second, if the practitioner had encountered situations similar to trafficking, they had a higher self-reported sense of competency. We have developed a training module in response to this research and have developed a continuing education training course for medical practitioners and social workers.

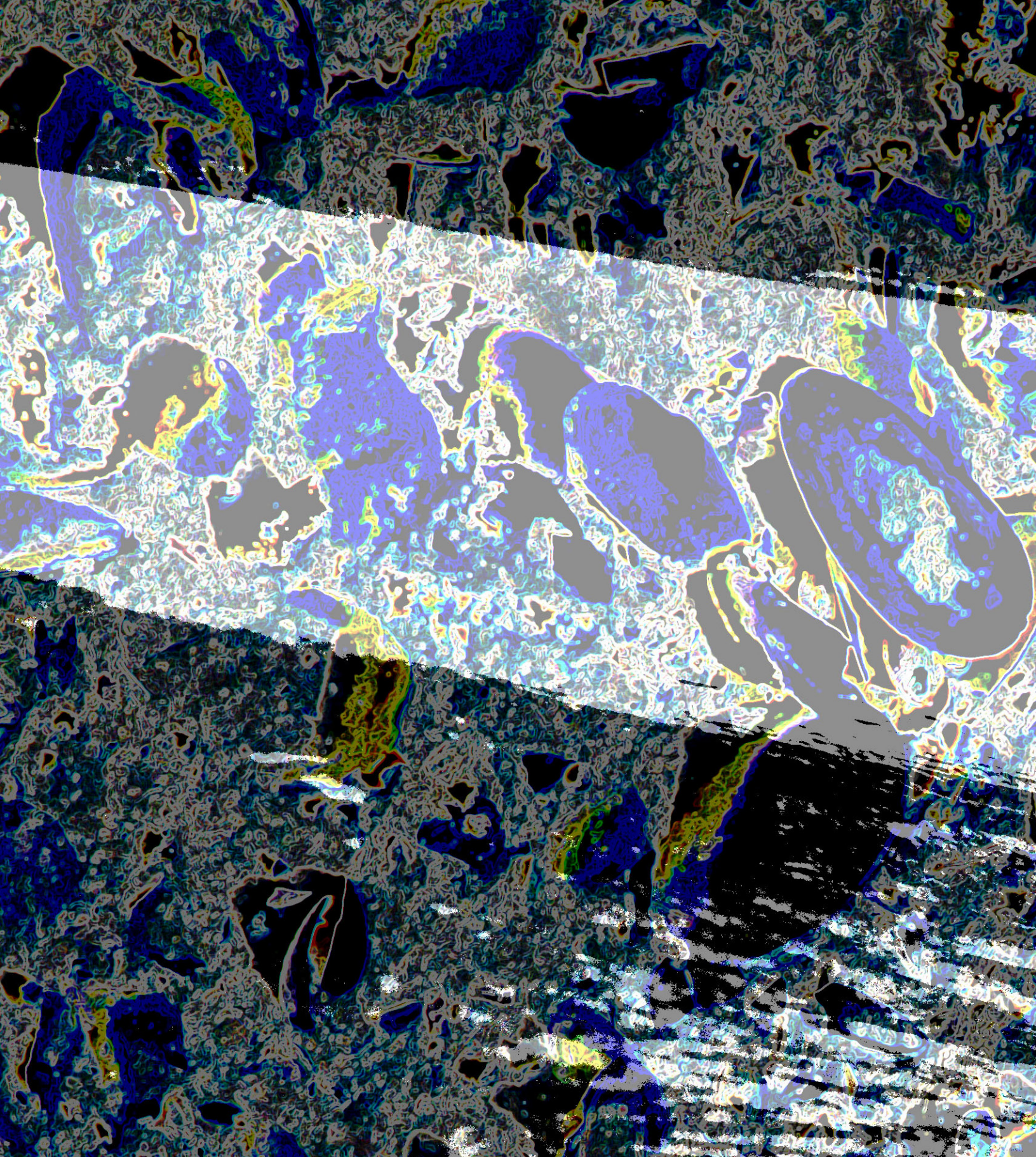


*These maps only reflect cases in which the location of the potential trafficking was known. Some cases may involve more than one location and are not reflected in this map.*

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This book, as well as a sampling of posters from the Celebration, can be viewed on Hope's Digital Commons Repository on the Van Wylen Library website, <http://digitalcommons.hope.edu/>.



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