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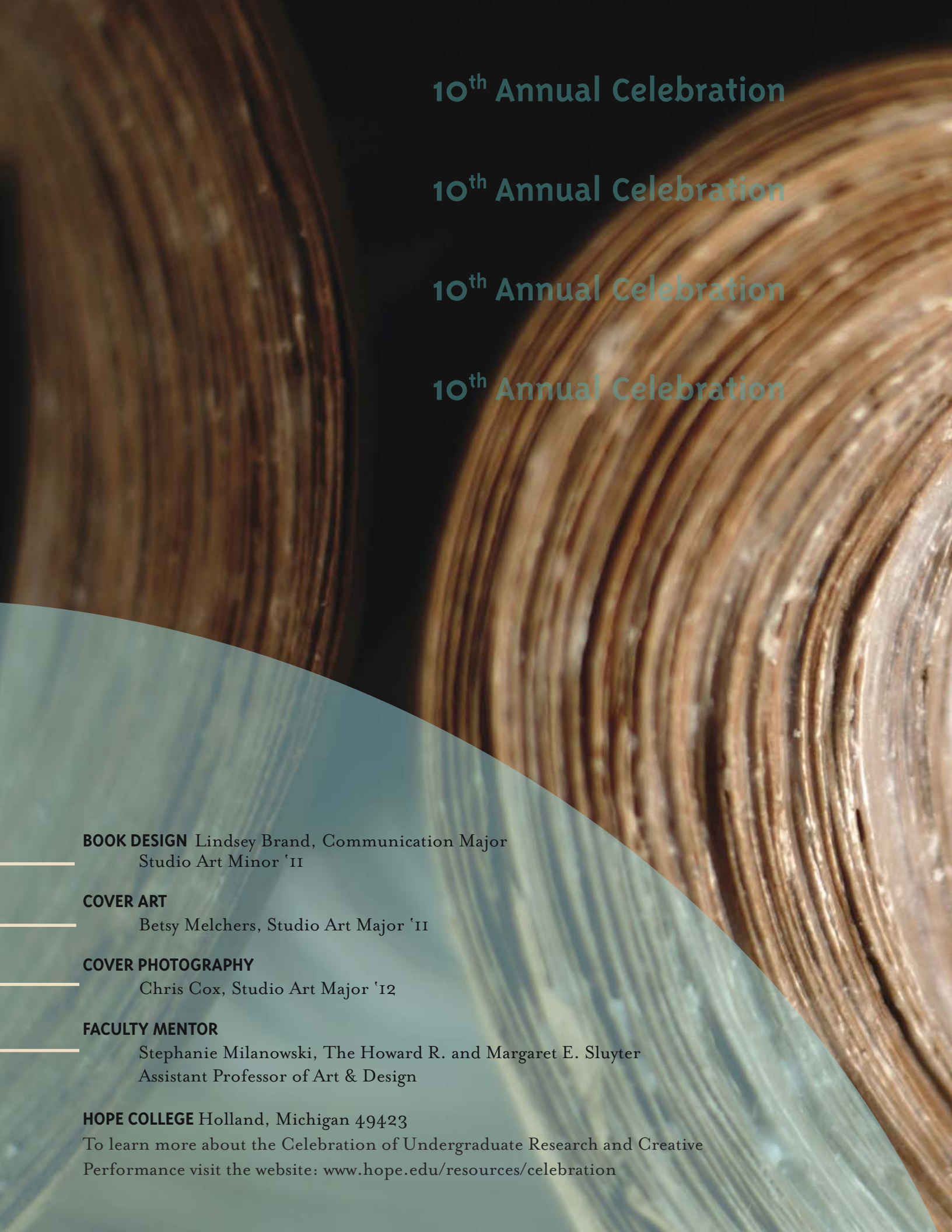
Hope College Abstracts: 10th Annual Celebration of Undergraduate Research and Creative Performance

Hope College



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COVER PHOTOGRAPHY
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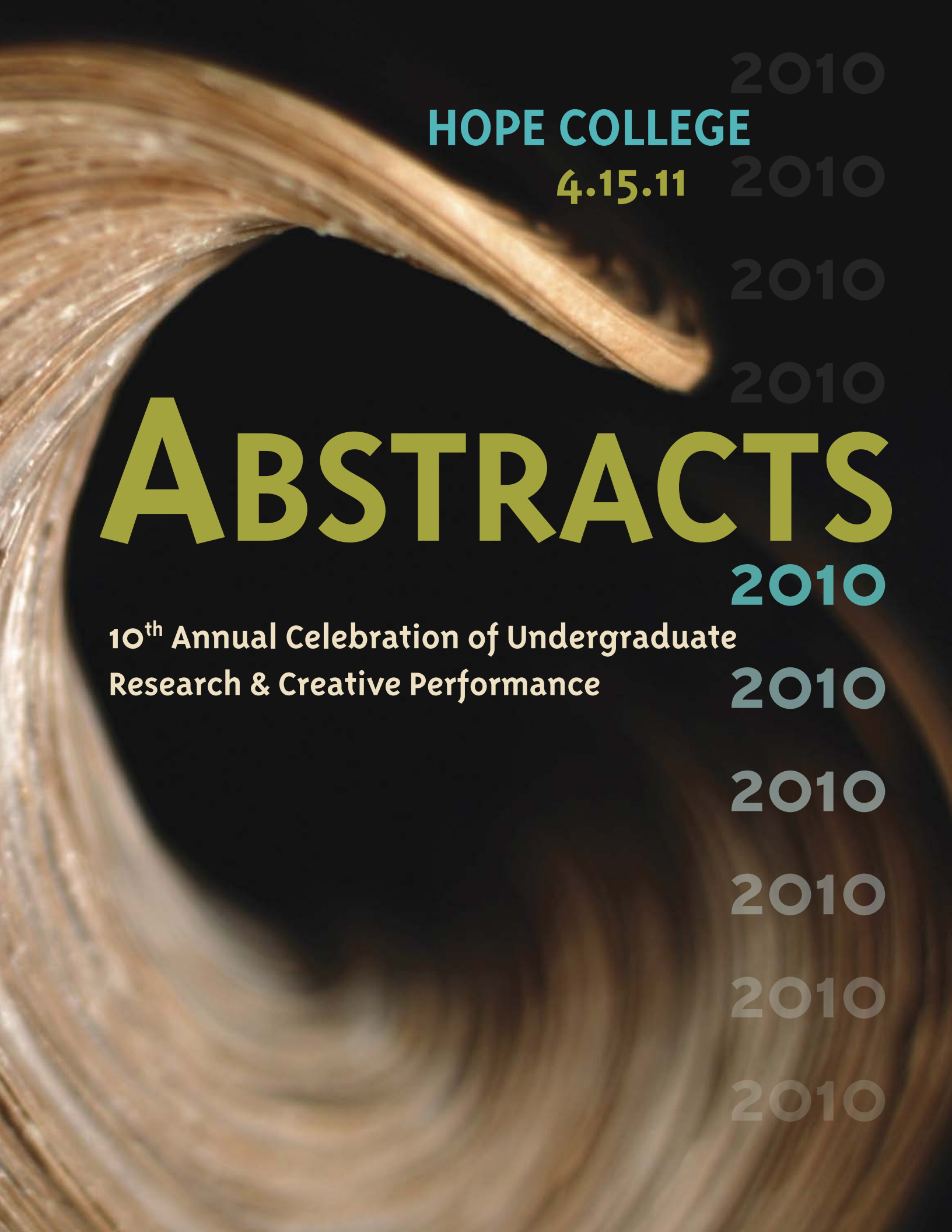
HOPE COLLEGE Holland, Michigan 49423
To learn more about the Celebration of Undergraduate Research and Creative Performance visit the website: www.hope.edu/resources/celebration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HOPE COLLEGE
HOLLAND, MICHIGAN 49423

Right: Stephen Pedersen '11 with History faculty mentor Jonathan Hagood

Below: GES REACH high school students, Nick DeJongh, Lauren Slenk and teacher Maria Mourino take sampling notes and pack the peat bog core for transport

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LETTER FROM THE PROVOST

April 15, 2011

DEAR FRIENDS,

Welcome to the Tenth Annual Celebration of Undergraduate Research and Creative Performance at Hope College. This event provides a signature lens into the kind of learning that makes Hope College distinctive among its peers—*learning by doing*. The booklet in your hands and the posters you will study in the DeVos Fieldhouse are the culmination of the work of hundreds of Hope College students and their faculty partners. Each project represents a collaboration between the present and the next generation of scholars—a teamed effort that brings the classroom to life and inspires the kind of learning that lasts a lifetime.

This signature academic event is the capstone to Hope College's participation in the National Undergraduate Research Week. The campus community has been treated to a host of excellent presentations, inspiring conversations, and practical demonstrations—all emphasizing the transformative power of learning by doing. To each person who helped plan the week's activities and to all who took part—thank you.

The projects you'll see at the Celebration are the product of countless hours of work by students, faculty and staff. To each student who labored in the lab or library—congratulations. To each professor who chose to work on a research project with a student instead of pursuing other avenues of scholarly activity—thank you. For each staff member who planned this event, prepared the abstract book, made the arrangements, and generally pitched in to help highlight a true distinctive of a Hope College education—you have my gratitude.

If you are interested in knowing more about the distinctive qualities of a Hope College education, including learning by doing, please visit www.hope.edu. Thank you for your participation in this Celebration. I am confident that you will learn much about our students and professors and their nearly limitless capacity for creativity.

Sincerely,

Richard Ray
Provost

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ART

The Design of the Undergraduate Research and Creative Performance Abstracts Book

Lindsey Brand, Betsy Melchers and Chris Cox
Mentor: Professor Stephanie Milanowski
Department of Art and Art History

Creating a cohesive design throughout the front cover, title page, index page and interior pages was the most critical element in achieving a successful visual solution. In addition, the Abstracts book called for a youthful yet sophisticated style, to capture student/mentor relationships and their highly professional research endeavors. Establishing an underlying grid, utilizing typographic skills, selecting coordinating colors and understanding printing processes were just a few of the advanced graphic design skills used in designing the 2010 Abstracts book.

The design process began with a "Call for Cover Art Submissions," a concept to promote the creativity of fellow Art & Art History students. After careful review of original submissions, Lindsey selected the final cover art based on its "ability to appeal to a wide audience". The chosen artwork created from thin strips of cardboard and archival adhesive was created by Betsy Melchers and photographed by Chris Cox '12.

Janae Stewart
2010 Student Dance Concert

DANCE

Can You Hear That?

Ashley Berger
Mentors: Professors Steven Iannacone, Matthew Thornton and Alicia Díaz
Department of Dance

Injustice, suffering, hope: Native American history is the least celebrated and richest culture of our nation. "Can You Hear That" was initially inspired by Otto Dix's racially exaggerated painting, *Drawing for Martin Koch* (1922). This dance solo confronts stereotypes of Native American peoples and the search for identity and humanity despite the Hollywood films, sports mascots, and years of misrepresentation in U.S. history textbooks. An original track was complied for the piece consisting of several clips ranging from Disney's *Peter Pan* (1953) "What Makes the Red Man Red," to stories from Jay Rosenstein's documentary *In Whose Honor* and the Native American Heritage Celebration of Michigan's Native American History in *Forgotten Warriors: Company K in the Civil War*. This piece was performed in the Fall 2010 Student Dance Concert.

And So the Sea Swallowed Tristan the Mad

Janae Stewart
Mentors: Professors Steven Iannacone, Matthew Thornton and Alicia Díaz
Dance Department

"And So the Sea Swallowed Tristan the Mad" is a dance solo based on Salvador Dali's painting entitled *The Boat* (1934-36). A large figure, half ship and half human, is the subject of this painting. The choreography explores the surreal and unnatural quality of this figure. The sound score demonstrates the qualities found in the setting of the painting and gives voice to the subject matter. The colors and hues used in the painting are represented in the costuming, and the loose and flowing shirt is reminiscent of the sails in the artwork. During the performance, hair is braided back and a mask is worn to embody the lack of presence in Dali's figure since it has no head, meaning no face and no hair. The lighting adds to the quality of the work and helps to unify all the artistic elements when the solo is performed (as in the 2010 Fall Student Dance Concert at the Knickerbocker Theatre). "And So the Sea Swallowed Tristan the Mad" takes the audience through a journey both above and below the water in order to experience the eerie and bizarre world of Salvador Dali.

DANCE

Does Subject Matter, Matter?

Mikella Bryant
Mentor: Professor Alicia Díaz
Department of Dance

Doris Humphrey was an exquisite early 20th century dancer and choreographer who rivaled great personalities of her time, such as Martha Graham. After years of working in the dance world, Humphrey came to the conclusion that subject matter is only important to the choreographer and that the audience is indifferent to it. "Does Subject Matter, Matter?" is a video piece that explores Humphrey's idea deeper by presenting interviews of both dancers and non-dancers immediately after they attended a dance performance. Participants were asked to give general impressions of a particular dance piece and whether they thought about subject matter while viewing it. The results depicted an unusual outcome. Non-dancers, who are presumably less educated in dance, seemed more perceptive audience members. They were more interested in subject matter while the typical dancer tended to focus primarily on matters of technique, use of space, and movement dynamics.

ENGLISH

Sierra Leone: Violence, Trauma, and Recovery

Carl Dunker and Alyssa Zeldenrust
Mentors: Drs. Ernest Cole and William Pannapacker
Department of English

The civil war in Sierra Leone is over, but problems persist and many people still struggle to reclaim their dignity and livelihoods. Through the production of interdisciplinary learning materials and documentary films, we hope to create opportunities for the Hope College community to interact with and learn from the people of Sierra Leone. This project relies on close collaboration with Dr. Ernest Cole, whose passion for his homeland and film footage is the source of our work. Dr. Cole travelled to Sierra Leone in 2009 to obtain film footage from a variety of sources and returned during the summer of 2010 to obtain additional interviews and film footage from people who have been affected by the civil war. Our documentary work draws from interviews with amputees and rape victims, former combatants, non-profit workers, and government officials to create a comprehensive picture of modern Sierra Leone which allows the viewer to understand a variety of perspectives. This project started in Dr. William Pannapacker's "Theory and Practice of the Digital Humanities" (ENG 295) class, which focuses on collaboration with faculty on multimedia projects. A goal of this course, and of our project, is to enhance traditional scholarship and take full advantage of new technologies to foster interdisciplinary dialogue. Through our ongoing research and documentary work, we are exploring ways to use technology to make Sierra Leone accessible to Hope students and faculty.

HISTORY

The Organization for Tropical Studies and the Evolution of Tropical Ecology

Stephen Pedersen
Mentor: Dr. Jonathan Hagood
Department of History

This project consists of an examination of the reasons that the Organization for Tropical Studies (OTS) in its current form has proven both necessary and advantageous to those who have made use of it. The project focused on two major areas. It began by investigating the origins of modern ecology, and to a lesser extent, biology prior to the establishment of tropical studies as a true discipline, as a means of examining the growth of field culture in the scientific community. Without that perspective, the sudden emergence of both OTS and its contemporaries would lack much of its impact. The second section of the project was devoted to OTS itself as a representative for the general feeling in American scientific circles of the 1950s–1970s, when tropical studies truly came into being as a distinct disciplinary subcategory and a useful means of demonstrating the motives of many of the first tropical scientists. OTS, both as an organization and a measure of feeling in the scientific community, was very much a product of its time. Due to limitations of access, interest, and knowledge, research undertaken in the first years of OTS would not have been possible in the decades prior. Similarly, a great number of the first participants found themselves drawn to the program through their experiences during World War II and the decade prior, generating much of the impetus for the founding of such a program. Although the desire for discovery that undoubtedly fueled many of OTS's first members holds true among scientists of all eras, the 1950s provided the only feasible era for the Organization's founding through its unique combination of growing momentum in the requisite fields and the changing realities of a globalizing society.

Paris and Shanghai: Splendor Under Siege

Matthew Keller, Sara Batts, Stephen Prior, Lucia Martis, and Amanda Dewey
Mentor: Dr. Gloria S. Tseng
Department of History

Many large cities during the period of World War Two are comparable, so why were Paris and Shanghai chosen for this exhibit? The decision to juxtapose Paris and Shanghai was not a random one. Before the war, both Paris and Shanghai were known as cities of modernity; Paris had the original reputation, with Shanghai receiving the title of "the Paris of the East." Both cities were hotspots for political radicals and various other forms of "pushing the envelope," such as fashion or film. The connection of modernity, as well as the experience of occupation by an Axis power during the war, makes these cities ideal and relevant for comparison and contrast.

HISTORY

The German Reformation: the Role of Local Governments in Evangelical Reform Movements

Brent Wilkinson
Mentor: Dr. Janis Gibbs
Department of History

In his classic essay entitled "Imperial Cities and the Reformation," Bernd Moeller states that "the Reformation was never the work of a town council," arguing that during the Reformation, city governments did not impose religious change without the consent of those they governed. The research tested this hypothesis in order to see if in any known case, evangelical movements with popular support were successfully resisted by the government. By examining secondary sources on the factors that affected the spread of evangelical ideas in southern and western Germany, it became evident that Moeller was correct. Although the cases studied showed no town council successfully resisting a popular evangelical movement, the councils' roles may be divided into three groups: those that aided popular evangelical movements, those that opposed evangelical movements that had little popular support, and those that led their city to adopt the Reformation by introducing evangelical ideas where they had not previously seen popular support. These cases also provided Professor Gibbs with a basis of comparison for her work on the failure of the Reformation in Cologne.

This research was supported by a Pagenkopf History Research Scholarship.

Brent Wilkinson and Professor Janis Gibbs researching "The German Reformation: the Role of Governments in Evangelical Reform Movements"

HISTORY

Tortillas in Transformation: Domestic Change in Mexico

Katharine Matejka
Mentor: Dr. Jonathan Hagood
Department of History

The study of Mexican history reveals transformations of peoples and cultures. Over thousands of years of change, tortillas remain a constant presence. Most women in Mesoamerica planned and cooked the meals for their families with almost no help from the men in their household. Tortillas, the staple of most meals, take upwards of six hours to prepare every day. Not until the 20th century did innovations make changes in tortilla-making possible. By studying these changes, we can analyze how the modernization of Mexico changed the expectations for Mexican women and domestic work. This study analyzes how these changes affected women by studying interviews and writings as well as looking at cookbooks. These sources reveal how the amount of time women spent making tortillas decreased with industrialization, but their responsibilities in the kitchen remained constant. Understanding this situation will give a greater understanding of gender roles and conflicts in Mexico. The transformation in tortillas will also reveal a mirrored transformation in Mexican industry and a striving for modernity.

Becoming Latino: America's Latin Culture

Sara Pridmore
Mentor: Dr. Jonathan Hagood
Department of History

Popular culture today exposes North Americans to different aspects of Latin American culture, but we are not fully informed as to where these cultural elements originally came from or what they meant to their creators. The North American lifestyle has accepted these elements of Latino culture, yet popular culture has lost the significance of these traditions, foods, and dances. The main focus of this study was to identify how cultural elements have been taken from Latin America and to compare their significance in the United States and in their originating country through studies of the history of specific Latin American dances. This project also explored how these Latino traditions came to the United States and how they were altered to fit North American culture. This research clearly demonstrates that although people within the United States believe they are enacting aspects of Latino culture, these cultural elements in fact represent a completely different idea than what they originally meant to the Latin Americans who invented these traditions, because they were made to appeal more to the average North American citizen. By understanding the complexities of the meanings of the Latino culture and comparing them to the North American interpretation of them, we can better learn the significance of particular Latino and Latin American cultural elements.

MELLON SCHOLARS

María de Zayas y Sotomayor: A Transnational Protofeminist in Seventeenth Century Spain

Tessa Angell
Mentors: Drs. Anne Larsen, Anne Heath and William Pannapacker
Departments of Modern and Classical Languages and Fine Arts and
Mellon Scholars Program

Over the past few decades there has been a "rediscovery" of the work of early modern women writers; one such author who has peaked the interest of scholars is Spanish writer María de Zayas y Sotomayor (1590-1661). Although very little is known about her life, she is acknowledged to be Spain's first protofeminist, and her work, which addressed themes such as domestic violence and gender equality, was widely circulated at the time of publication. This research attempts to understand her place as a female author in Golden Age Spain, but more importantly, in a transnational community of early modern writers, the *querelle des femmes*, which was an ongoing literary debate in early modern Europe concerning the nature and status of women. I propose that Zayas's *Novelas amorosos y ejemplares* and *Desengaños amorosos* reflect many characteristics of literature circulated by the *querelle*; by studying these two collections of novellas, Zayas can be situated within the transnational community of the *querelle des femmes*. Despite the fact that Zayas lived and wrote during a time when Spanish women were kept *encierro* (enclosed, locked up), she was able to effectively engage in the literary debate on the nature of women, ultimately for the goal of attaining expanding opportunities and education for women.

Leonardo da Vinci, Francis I, and the Struggle for International Prestige in 16th Century France

Athina Alvarez
Mentors: Drs. Anne Heath and William Pannapacker
Mellon Scholars Program

Leonardo da Vinci spent his final years at the Manoir du Cloux in the company of the French King, Francis I. In competition with other European states, Francis I did everything he could to forge an image of France as strong, balanced, and formidable—and the arts were an essential part of his quest for prestige. For that reason, the King commissioned Leonardo to rebuild the Chateau de Romorantin, which became a major example of the aspirations of France in the 1500s. My project explores the planning, construction, and ultimate abandonment of Romorantin in the context of the larger fortunes of 16th century France, the career of Leonardo, and the rule of Francis I; moreover, it explores how the arts have been a crucial element of state prestige power in the past, and, by implication, in the present.

MELLON SCHOLARS

Exploring Hope College's Rare Book Room: A Treasure Trove of Resources for Students of Art History

Kristen Dunn
Mentors: Drs. Anne Heath and William Pannapacker
Mellon Scholars Program

Over the course of four weeks last May, Professor Anne Heath and I assessed the contents of the Rare Book Room. From the start of the project, we established our central research question: Is there anything of significance in the Rare Book Room that would have potential for an art show? As each book was assessed, a Google Document was created in order to sort each book. Some books of interest are as follows: *Catalogues van de Tentoonstelling de Vrouw 1813-1913; Meerhuizen-Amsteldijk*, a catalogue for an exhibition of women from 1813-1913; *The Poetical Works of Thomas Campbell* published in 1843; and several Holy Bibles ranging from 1476-1716. Each of these books was of interest not only because of their outward physical properties, but also because of the detailed illustrations provided in the pages. Throughout this process, other book exhibits at various libraries were examined: the Newberry Library, the Morgan Library, the Beinecke Library and the Andover-Harvard Theological Lab. As each show's materials were compared and contrasted, Professor Heath and I came up with potential exhibits for the gallery in the art department: 16th century Books, Dutch Books, The History of the Book, Moving from the Manuscript to the Printed Book, Reconstructing the Reader, and Highlights from the Collection. At the end of our research, we discovered that the Rare Book Room does, in fact, offer the art department enough material for a show in 2012, which would consist of books that are interesting for their physical properties: whether a beautiful cover, gorgeous typography, or fascinating prints.

From Monster to Mainstream: Removing the Gothic from *The Phantom of the Opera* and Other "Monster" Narratives

Kelli VanDyke
Mentors: Drs. Elizabeth Trembley, Anne Heath and William Pannapacker
Departments of English, Fine Arts, and Mellon Scholars Program

From its origins as an early twentieth-century Gothic novel, the story of *The Phantom of the Opera* has been retold throughout the next hundred years through novels, theatre, and film. As authors and directors discovered new ways to explore the original novel, it began to lose many of its original gothic elements, most notably the unambiguous depiction of the protagonist as a "monster." This is consistent with a pattern of removing or complicating the gothic elements of other "monster" narratives such as Bram Stoker's *Dracula* and Mary Shelley's *Frankenstein*. This study examines the remaking of *The Phantom of the Opera* in the context of the transformation of other works of gothic literature in different genres for different audiences in changing historical and cultural contexts.

MELLON SCHOLARS

Americanization and the National Catholic War Council

Julie Oosterink
Mentors: Drs. Jeanne Petit, Anne Heath and William Pannapacker
Department of History and Mellon Scholars Program

In the United States, the First World War emboldened citizens to promote patriotism and the qualities of America in which they truly believed. Catholic Americans responded heartily to this call for "Americanization." They formed the National Catholic War Council, a service organization that worked in cities across America as well as in France. The NCWC strove to teach immigrants the essentials of American citizenship, prove Catholic loyalty to America, and form the foundations for a more cohesive American community. Much of the work carried out by the National Catholic War Council occurred in Catholic Community Houses around the country. These houses fell under the direction of Catholic lay women, who were known as secretaries. They entered the impoverished neighborhoods of immigrants and encouraged both a preservation of the Catholic faith and an acceptance of American citizenship. This research will examine the challenges confronted by the Women's Committee of the National Catholic War Council through their work in community houses around the country. Primary documents including reports and letters written by secretaries and others associated with the Women's Committee of the NCWC will be analyzed to better understand the individual and collective Americanization goals of the NCWC. Furthermore, reports of success in the actualization of these goals will better shape an understanding of the influence the NCWC had on American society.

This research was supported by the Pagenkopf History Research Scholarship.

"Shakespeare's Sister"—Victorian Women and Emily Brontë's *Wuthering Heights* Through the Lens of Elizabethan Drama

Madalyn Muncy
Mentors: Professors Julie Kipp, Anne Heath and William Pannapacker
Mellon Scholars Program and Departments of English and Fine Arts

Emily Brontë, author of *Wuthering Heights*, engaged in a conversation with Shakespeare's work most clearly in her novel's use of elements found within *King Lear*. As first suggested by Virginia Woolf, my project seeks to examine the ways in which Brontë's prose responds to Shakespeare's drama and how her novel functions as a social commentary on 19th century gender politics, specifically, notions of literature that exclude women from high-canonical status. In that sense, Brontë's novel helped to establish the legitimacy of a women's literary tradition.

MELLON SCHOLARS

Thabo Mbeki's African Renaissance: A Transformative Vision for African Development?

Daniel Owens
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In a series of speeches in the late 1990s, former South African Prime Minister Thabo Mbeki detailed his vision for an "African Renaissance" in the 21st century. Mbeki's plan, centered on a rediscovery of the African past, has been a subject of debate among scholars and politicians in the past fifteen years. As the global ramifications of events in Africa are on the rise as we move into the second decade of the 21st century, understanding the current state of affairs on this troubled continent is increasingly important for those outside Africa. This project focuses on the rhetorical meaning of the term "renaissance." Drawing on Mbeki's speeches on African unity and development, along with a collection of articles, I trace the origins of the term in an African context, from its roots in the Pan-African unity movement of the late 19th and 20th centuries through its current application by Mbeki. Using Senegal as a case study, I explore the current state of progress of Mbeki's African Renaissance. My research reveals that the term "renaissance" carries a very different connotation for native Africans than it does for Westerners. It also illustrates that while the term adequately fulfills its origins in early modern Europe, to refer to a "renaissance" as a planned initiative for the political, social, and economic development of continent represents a clear departure from its European usage.

Ralph Vaughan Williams and the English Musical Renaissance: *A London Symphony*, "Who Wants the English Composer?", and a New English Music

Katherine Callam
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Nationalistic music was especially prominent in Europe in the late 19th and early 20th centuries. Ralph Vaughan Williams (1872-1958) was an English composer of this era who featured nationalism not only in his compositions, but also in his essays and lectures. One of Vaughan Williams's earliest essays discusses nationalism in music, "Who Wants the English Composer?" (1912). My research investigates the extent to which nationalism appears in a work composed during the same time, *A London Symphony*. A study of the first movement demonstrates that Vaughan Williams integrated many of his ideas about nationalism into that symphony. In addition, the first movement points to Vaughan Williams as a composer who was able to create music that had a recognizably English sound, yet was clearly of the 20th century, demonstrating the complexity of his understanding of the relationship between music and national identity in the era before the first world war.

MODERN & CLASSICAL LANGUAGES

Rescuing Haiti's Next Generation

Delaney Erickson
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On January 12, 2010, Haiti's capital was unexpectedly struck with a disastrous 7.0 magnitude earthquake. It wiped out all shelter, hospitals, and even the presidential palace. With more than 230,000 deaths, children were left to fend for themselves after this already traumatic experience. Not surprisingly, citizens from the United States jumped at the opportunity to help by means of adoption. With this situation came irreversible consequences. Since governmental buildings that hold birth and family records were destroyed, missionaries had no way of knowing which children had lost their parents and which children had not. This research explores whether or not U.S. adoptive families are a good fit for the children who lost their parents in the quake. This is only one of many ways to ensure that Haiti's next generation will be better off.

Verb Use Among Spanish Immersion Students

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The present study examines the linguistic development of elementary school children enrolled in a Spanish immersion program, specifically focusing on their use of Spanish verbs. The driving research questions for the project are: (1) how does the verb use of children develop over time?; and (2) is this development native-speaker-like? The immersion program is located in West Michigan, and all children in the study are native speakers of English learning Spanish as their second language. Students in second and fourth grades were interviewed in pairs using a semi-structured questionnaire to elicit language data. Interviews were digitally audio-recorded, subsequently transcribed and analyzed for verb use. The current paper presents results from verb use analyses of second-and fourth-grade students. First, general frequency data are given to characterize verb use at both levels. Second, errors for each group are examined in relation to variables such as verb meaning, verb tense, person, and verb form (regular, stem-change, irregular). At each level, chi-square tests and a regression analysis are run to examine the power of these variables individually and as a group in predicting student errors. Results from the study will be used to compare verb use between second-and fourth-graders, addressing the question of development over time. Findings will also be discussed in relation to the literature regarding children's acquisition of Spanish as a first language.

MODERN & CLASSICAL LANGUAGES

The Ship Inside *A Tempest:* The Post-Colonialist Arguments of Aimé Césaire and Michèle Césaire.

Abraham M. De La Rosa
Mentor: Dr. Anne Larsen
Department of Modern and Classical Languages

As the process of decolonization continued after WWII, the future of the old French colonies was unknown. In his plays and poetry, the Martiniquais writer Aimé Césaire (1913-2008) constantly criticizes this process of decolonization, making him one of the most influential post-colonialist voices in the francophone world. In his play, *A Tempest: Based on Shakespeare's The Tempest, Adaptation for a Black Theatre* (1969), Césaire utilizes his main characters to represent allegorically the treatment, perception, and inequality that resulted from colonization. Twenty-three years later, his daughter, Michèle Césaire, develops these same arguments in her play *The Ship* (1992). In contrast to her father, Michèle Césaire provides a more current condition of Martinique and offers her perception of the reasons why even decades after decolonization, Martinique has not reached economic stability. This research endeavors to explain the correlation between both plays and the different means that father and daughter utilize to critique the effects of colonization.

Attempting to Silence a People: The Oppression of the Berbers in North Africa

Gretchen Baldwin
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Department of Modern and Classical Languages

A fierce, independent people, the Berbers of North Africa are anthropologically considered to be the original inhabitants of the Maghreb region. Despite their ancient heritage, the Berbers are marginalized, violated, and ignored by the Arab cultures that have settled there. This research, based largely on Amnesty International reports, examines the violations of basic rights enacted by North African governments—most notably Algeria against the Berbers. The specific cases of Lounes Matoub, Algerian Berber singing group Djurdjura, and the police raid at Tizi-Ouzou University are discussed, as well as The Kabyle, a radical opposition group within the Berbers still fighting for their freedom. Despite the Berbers' desire to preserve their identity and not conform to the foreign cultures closing in around them, the Maghreb governments are exacting deliberately discriminatory policies that encourage a movement of violence and disrespect against an ancient people and their culture.

MODERN & CLASSICAL LANGUAGES

Theater as an Expression of African History in *Les Amazoulous* and *La Fille des Dieux* by Abdou Anta Kâ

Jamie Poppema
Mentor: Dr. Anne Larsen
Department of Modern and Classical Languages

Theater is an all-encompassing expression of art, consisting of music, dance, poetry, folklore, history, personality, and emotion. African theater uses all these means and more as a way of educating and expressing a lost culture and a past identity. This research focuses on two plays by a Senegalese author, Abdou Anta Kâ, who wrote *Les Amazoulous* and *La Fille des Dieux*. In contrast to the typical European styles of theater shown in Africa at the time, Kâ uses these pieces to communicate political messages and gender structures through the use of folklore and legends, which substantiate a direct connection to African culture—a connection which the African people would readily understand. The stories clearly reference colonialism as the root cause of the problems that they bring up—problems which were inherent in their society and continued even after decolonization.

Marianne et le Marabout: The Creation of Multicultural Identity in the Work of Slimane Benaïssa

Julia Peterson
Mentor: Dr. Anne Larsen
Department of Modern and Classical Languages

The play *Marianne et le Marabout* (1993) by Algerian playwright Slimane Benaïssa is representative of the difficulties faced by the majority of Algerian immigrants living in France today. Although there is surely a similar experience faced by all Maghreb immigrants, there is a unique relationship between France and Algeria resulting from a complex history of colonization, war, decolonization, and assimilation. Although France continues to become inhabited with more Maghreb immigrants as a result of decolonization, there is a fundamental racism that exists toward said immigrants. The celebration of a hegemonic French national identity and thus, the devaluing of other cultures, leaves the identities of Algerian immigrants fragmented.

In this study, I analyze how the dramaturgy of Slimane Benaïssa deals with the difficult task of personal and cultural identity formation specifically amongst Algerian immigrants who find their roots in Algeria and their family or work in France. This study proposes that Benaïssa's play *Marianne et le Marabout* emphasizes three essential elements which explain the fragmented identity of these immigrants: religion, exile from the homeland, and language. Through the exploration of these three elements and a content analysis of their presence in Benaïssa's work, I show how Benaïssa forges a common identity among Algerian immigrants, thus combating the fragmentation and sense of exile or disconnectedness most feel upon leaving their homes and taking up residence in the banlieue of France's major cities.

MODERN & CLASSICAL LANGUAGES

Oppression and Injustice for Women in the Maghreb

Chelsea Wiese
Mentor: Dr. Isabelle Chapuis-Alvarez
Department of Modern and Classical Languages

Women over the centuries and around the world have suffered for a variety of reasons. In the Maghreb region, of North Africa, women continue to suffer, as no formal recognition of equality between the sexes exists. This research investigates the condition of Algerian and Moroccan women in particular. It includes the testimony of a divorced Algerian woman who has been shunned and fears for her safety in her own home. The condition of Moroccan women, however; greatly improved in comparison to other countries in the region due in large part to the social reforms of King Mohammed VI. Education is more accessible for these women, increasing the literacy rate and decreasing the unemployment rate. King Mohammed VI's reforms included the adoption of the "nouveau code de la famille" in 2004, which addresses the concepts of "co-responsibility," divorce, and polygamy. Injustices persist mainly because of the mentalities of men in the Maghreb. Without changing the mindset of these men, who for years have held control and power, injustices against women will not cease.

Haiti: A Country to be Rebuilt

Joe Habbouche
Mentor: Dr. Isabelle Chapuis-Alvarez
Department of Modern and Classical Languages

On January 12, 2010, an earthquake devastated Haiti, an event which would trigger a flood of relief efforts from around the world. In response, the United States initiated what President Obama claims was the most significant international aid operation ever launched. However, the first few days after the earthquake were filled with chaos and confusion, and the aid did not arrive until it was nearly too late. Furthermore, the United States took control of the situation without negotiating with any other donor country, which further complicated the situation. This ordeal is far from an isolated event for Haiti, a country that has been affected by catastrophes and socioeconomic instability since its independence from France in 1825. The extent of the devastation and the lack of organization involved in bringing international aid to Haiti during these desperate times have revealed the need to help build third-world countries' infrastructures, rendering them truly independent.

Above: Professor Brad Richmond conducting the Hope College Chapel Choir

Left: Rachel Whitmore, first year violin student majoring in Instrumental Music Education at Hope College

MUSIC

In Search of a 'Heart Song': Worship Music at Hope College

Jocelyn Brousseau and Lauren Conley
Mentor: Dr. Julia Randel
Department of Music

Marva Dawn, in her book, *How Shall We Worship?*, suggests, "How we worship both reveals and forms our identity as persons and communities" (4). If it is true that how we worship reveals things about our identity as a community, while at the same time shapes it, how is the worship at Hope College helping to form the people as a community? Given that music is central to our mode of worship, what does the music reveal about us as a community? What effects have the dramatic changes in worship music at Hope had on the community over the last two decades? This research seeks to answer these questions through observation and interviews with current and past participants in worship music at Hope, including band leaders, band members, chaplains, and music faculty. It documents the dramatic shift from "traditional" to "contemporary" music and the ways in which the chapel band's style has continued to evolve since the change was made. In addition, it explores how band members and leaders see their roles as leaders of worship for the community. Close examination of some recent performances and recordings by the chapel band reveal how these ideas about worship, identity, and community are put into practice.

The Cleveland Orchestra Maestri: Determiners of Repertoire, Artists of Determination

Leah Hottel
Mentor: Dr. Julia Randel
Department of Music

Incorporating 20th-century repertoire into orchestra programming, while still appealing to general audiences, is a balance that orchestras struggle with today. This case study examines the repertoire selections of three music directors of the Cleveland Orchestra: George Szell, who was known to favor pre-20th-century Austro-Germanic music, Lorin Maazel, who had a reputation for challenging audiences with 20th-century music, and Christoph von Dohnányi, who was seen as striking a balance. The most complete available list of the Cleveland Orchestra's programs between 1948-2002 was analyzed in order to determine the number of pre-20th vs. 20th-century composers programmed, highest programmed composers overall, and the most programmed 20th-century composers. The study finds that each conductor's predilection did influence the repertoire, especially in the top ten performed composers. Though Maazel's and Dohnányi's lists overlap significantly, indicating their similar tastes in 20th-century music, Dohnányi was more progressive. Despite popular opinion, Dohnányi exposed audiences to a larger variety and amount of 20th-century works than Maazel. This finding indicates that although audiences may not be familiar with or inclined to embrace 20th-century music, the way it is presented by the music director does play a role in how audiences accept it.

PHILOSOPHY

Making Waves in the Baptismal Font: Karl Barth and Infant Baptism

Andrew Peterson
Mentor: Dr. Jack Mulder
Department of Philosophy

At the height of World War II, the German church buckled under the gravity of the Führer's will. As a generation of young men died on the battlefields of Europe and millions of Jewish refugees sighed their last breaths in Nazi prison camps, the German church baptized the infants of Nazi patriots. Such profound unfaithfulness emboldened the great 20th century German theologian Karl Barth to break with the Reformed tradition over the practice of infant baptism. A concern for the ethical context of baptism centered prominently in Barth's reexamination of the classical Reformed understanding of baptism. With the exegetical assistance of his son, Markus Barth, Karl Barth reexamined the New Testament basis for baptism and concluded that infant baptism gravely distorted the biblical view of baptism. Such a radical departure from the orthodox Reformed tradition is uncharacteristic of Barth and constitutes a provocative turn in his thought. This essay argues that while Barth's ethical concerns provide a useful critique from which to reevaluate the classical Reformed understanding of baptism, Barth's treatment of infant baptism is unsatisfactory for two primary reasons. First, in rejecting infant baptism, Barth's argument seeks to dismantle the classical Reformed argument connecting baptism and circumcision. However, his rejection fails to exegetically surmount the New Testament passages connecting baptism and circumcision, which lie at the core of the classical Reformed argument for infant baptism. Second, Barth's own construction of baptism is troubling in the extent to which he distinctly separates Spirit baptism from water baptism. With the help of Calvin's treatise on the sacraments, this essay demonstrates that Barth's bifurcation of baptism is inconsistent with the ecumenical Christological formula crafted at the council of Chalcedon.

This material is based upon work supported by the CrossRoads Project under a Faculty-Study Research Grant funded by the Lilly Foundation.

THEATRE

Costume Designs for *The Pinter Project*

Katie Hoekstra
Mentor: Professor Michelle Bombe
Department of Theatre

In the spring semester of 2010, Katie Hoekstra designed the costumes for the Hope College Theatre production of *The Pinter Project*, which featured a collection of Harold Pinter's works. The Pinter Ensemble performed two short plays, *A Kind of Alaska* and *The Dumb Waiter,* and seven revue sketches, *Request Stop*, *Victoria Station*, *Black and White*, *Last to Go*, *Applicant*, *Night*, and *Trouble in the Works*. As costume designer, Katie attended production meetings and collaborated with the director, John Tammi, and her mentor and the other designers, in order to coordinate their vision for the scenes and to be sure to compliment the set, lighting, and sound. The director envisioned the production to be set in England in the 1960s. Katie chose a color palette consisting of black, white, and other neutral tones. From reading the text, the idea arose that the piece should have a sense of grit and texture to the costumes. Katie began the design process by researching images of men and women's clothing in the 1960s. She then created rough sketches of what she envisioned each of the characters wearing based on the characters created in the text. To give the costumes authenticity and roughness, she chose to pull as many of the costumes as possible from the period stock of clothing in the department. She selected pieces based on period, the monochromatic color scheme, her sketches, and, of course, pieces which contributed to the character as developed by the text and the nuances of the actors. She continued to adjust the ensembles through fittings, a costume parade, and dress rehearsals. Once the designs were finalized, she drew renderings of the costumes from one of the revue sketches, *Request Stop*, which featured all of the Pinter Ensemble.

Katie Hoekstra's costume design sketch for "Request Stop" from *The Pinter Project*

PHELPS SCHOLARS

Reading, Science, and Mathematics: Why is Finland Ranked Higher than the United States?

Claudia Aguilera, Lydia Thornburg and Julia Windom
Mentors: Drs. Wayne Brouwer, Charles Green and Professors Vanessa Greene, Amy Otis–De Grau and John Yelding
Phelps Scholars Program

In the Programme for International Student Assessment (PISA), Finland has the top scores in all three test categories: math, science, and reading. What makes Finland number one? There is no single answer to this question, because Finland and the United States have different education systems, societies, and financial policies. Finland's teachers in the higher grades are required to have a degree beyond the bachelor's. In the United States, one only has to obtain a bachelor's degree to be eligible to teach in a secondary school. While American students spend endless hours preparing to take tests of their basic reading and math skills, their peers in high-performing nations are reading poetry and novels, conducting experiments in chemistry, making music, and studying important historical issues. Furthermore, Finland has less child poverty than the United States, and students below the poverty level struggle more in school. The Finns also spend more, per student, on education. Finland is a small, generally homogeneous country. The United States is ethnically, racially, and culturally diverse, and with greater income inequality. Diversity is the heart and soul of what is so special about the United States. However, the U.S. is much less successful in teaching ethnic minority students than it is teaching majority students. This impacts students' education at school and at home. Reform in American financial policies and teacher requirements would benefit the educational system as a whole and, perhaps, would decrease ethnic gaps in school performance at the same time.

Phelps Scholars Jesse Swatling-Holcomb, Kristin Stevenson, Ilar Edun, Gabriela Olaguibel, and Kelli Van Dyke enjoy time together in the Scholars residence hall

PHELPS SCHOLARS

Is the Holland Christian Community Ready?

Sasha Balcazar, Molly Coyle and Megan Groh
Mentors: Drs. Wayne Brouwer, Charles Green and Professors Vanessa Greene, Amy Otis–De Grau and John Yelding
Phelps Scholars Program

Recently, both Hope College and the city of Holland have tackled the thorny issue of homosexuality. The conversations in the city and on the campus have connected with each other in many ways. We were interested in knowing about the attitudes of city residents toward the acceptance of gays and lesbians in the community. On a Saturday and Wednesday morning in the fall of 2010, we went to the Holland Farmers' Market and asked a variety of people, "Should homosexuality be accepted in our community?" We then asked whether they made their decision based on religious beliefs or on social or political perspectives, philosophical views, etc. Of the 80 people interviewed, 72 agreed with, and eight disagreed with, the acceptance of homosexuality. Those who agreed based their reasoning on political, social, and philosophical ideas. However, the eight people who disagreed had some religious basis for their decision. We also interviewed a local Catholic priest, a local Episcopalian priest, and a local Reformed Church in America pastor. They disagreed as to whether the church should accept homosexual behavior. Nonetheless, they all argued that a person of homosexual orientation should never be turned away from God, and that he or she must be treated with respect, compassion, and sensitivity. However, the Holland community—at least that part of the community that shops at the Farmers' Market—believes that homosexuality should be accepted, acknowledged, and respected. Our findings suggest that there could be on-going tensions between a large segment of the Holland community and some, perhaps a majority, of its religious leaders.

PHELPS SCHOLARS

Cleaner Water in Africa

Anna Balow, Ann Marie Paparelli and Qian Song
Mentors: Drs. Wayne Brouwer, Charles Green and Professors Vanessa Greene, Amy Otis–De Grau and John Yelding
Phelps Scholars Program

There are 1.1 billion people in the world who do not have access to clean water. Fresh drinking water has been a major concern among African countries for a very long time. Kenya, Rwanda, and Uganda are among those that face a great shortage of clean water. The problem is especially severe in rural areas. The major reasons for lack of clean water are government corruption, pollution, and poor or unrepaired water facilities. Government corruption leads to low development of water facilities and a lack of funding for water purifiers. Drinking dirty water can lead to a variety of diseases, including stomach virus, skin infection, and other organ infections. It is estimated that 5,000 children die from drinking dirty water every day in Africa. There has been slow progress toward increasing access to clean water, but the death rate has not yet been significantly lowered. There are nonprofit organizations, like Aqua Clara—located here in Holland, Michigan—and 20Liters, working to improve access to clean water in Africa. Aqua Clara and 20Liters work to build filters by using local components (which lower the production cost), and educate local community on how to build filters (which lowers the foreign labor cost). Our goal is to educate those around us about how to bring clean water to Africa.

Hiccups in Hispaniola: What Socioeconomic Factors Led to Differences in the Health Care and Poverty Level in Hispaniola?

Guillermo Flores, Katelyn Lengacher and Christopher Stewart
Mentors: Drs. Wayne Brouwer, Charles Green and Professors Vanessa Greene, Amy Otis–De Grau and John Yelding
Phelps Scholars Program

The island of Hispaniola is inhabited by two juxtaposed yet very different nations. Initially a Spanish colony, the wealthier nation of France gained control over the western side, forming the nations of Haiti and the Dominican Republic. A long history of struggle in Haiti compared to the relatively more passive history of the Dominican Republic propagated the economic and cultural differences between the two. Many of these socioeconomic factors resulted in the current situation, which is characterized by differences in poverty levels as well as in health care. After analyses of the past history, the current problems facing the Caribbean countries, and the input of current and past residents, we formulated possible solutions to the economic situation, especially health care. Better communication between doctors and the governments, more effort from the governments to stop internal corruption, higher standards of education within Hispaniola, more foreign language classes offered to students, and a slowing of the deforestation rate are all ways to improve the current disparity among the island's residents.

PHELPS SCHOLARS

Global Bilingual Education Systems: How Can Implementing Them Benefit the United States?

Ashley Blauwkamp and Leah Ewald
Mentors: Drs. Wayne Brouwer, Charles Green and Professors Vanessa Greene, Amy Otis–De Grau and John Yelding
Phelps Scholars Program

In an increasingly global society, the emphasis on including multi-language acquisition programs as part of a well-rounded education has intensified in schools worldwide. As a result, multitudes of language acquisition programs have been created, which fall into two categories: transitional bilingual education and dual-language immersion. Both provide short-and long-term benefits to students. Our research delves into six examples of bilingual education systems used in these countries: Canada, China, Israel, Luxembourg, Paraguay, and Uganda. Each country possesses a unique bilingual educational system instituted to bridge cultural and political gaps of conflicting groups, discourage ethnocentric thinking, or better serve and celebrate all factions in a multicultural nation. Although many of the bilingual programs have proven successful in creating and promoting multilingual societies, a few poorly-designed ones have been found detrimental to the academic success of students and are in need of reform. There are advantages and disadvantages of using various components of each program in the United States. Despite being one of the most ethnically diverse nations in the world, conflict and disagreement over the bilingual education has prevented the United States from changing to meet the challenges of globalism. Drawing upon other nations' bilingual education methods could aid the U.S. in establishing schools that better acclimate new minority immigrants as well as expose majority students to other global cultures. This research also examines the multilingual demographics of West Michigan and observes the steps that can be and have been taken to further promote local bilingual education.

The cast of the Phelps Scholars Readers' Theatre production of *What Are You?* November 2010

Left: Nick Darvos, 2010 HHMI Science Education Scholar, provides hands-on investigation of birds with Zeeland, Michigan high school students

Below: Jennifer LaRoche checks nesting success of Eastern Bluebirds at Consumers Energy, West Olive, Michigan

BIOLOGY

Isolation and Genome Sequencing of Two Novel Mycobacteriophages: Optimus and Sassafras

Alexandra Benson, David Blystra, Chrissla Boyea, Rachel Butts, Catherine Calyore, Christopher Davis, Guillermo Flores, Lauren Janness, Kelsey Jeletz, Joshua Kammeraad, Taylor Mann, Danielle Mila, Shayla Patton, Caitlin Ploch, Matthew Ringel, Austin Roblyer, Daniel Schriemer, Thomas Smeltzer, Jonathan Turkus and Holly Vander Stel
Mentor: Dr. Joseph Stukey
Department of Biology

Twenty new mycobacteriophages capable of infecting *Mycobacterium smegmatis* were isolated from soil samples collected on or nearby Hope College in Holland, Michigan. Collectively, the group displayed a variety of plaque morphologies indicating an assortment of different phages. Both lytic and temperate phages appear represented in this collection. Purified phage stocks were used to prepare genomic DNA samples for restriction digest analysis. Of 20 samples analyzed, a total of 13 phages produced just 4 types of restriction digest patterns, indicating some degree of relatedness among some of our new phage isolates. Interestingly, one group of 4 phages (Optimus, Lynx, Aurora and TheCube14) that yielded a similar restriction digest pattern, were all isolated from mulch-covered soil at a depth of 4-8 cm. Two phages, (Optimus and Sassafras), were chosen for complete genome sequencing and comparative genomic analyses. Both phages produced plaques of between 1-2 mm in diameter at 24 hours that enlarged to about 4 mm in diameter after 48 hours of incubation at 37°C. Whereas continued incubation of phage Optimus resulted in cessation of plaque growth by 72 hours, plaques produced by Sassafras continued to enlarge beyond 8 days, reaching a diameter of greater than 10 mm. Phage Optimus produced plaques that displayed a clear center surrounded by turbid rings. Phage Sassafras produced clear plaques with defined edges at 24 hours, but all subsequent growth was progressively more turbid in nature, resulting in plaques with a turbid ring around a center clear zone. Comparison of the restriction digest patterns for Optimus and Sassafras with more than 60 existing mycobacteriophage genomes indicates that Optimus may be a new representative of cluster H, while Sassafras shows some similarity to the F cluster of mycobacteriophages. Results of our analyses of both genomes are reported.

This research was supported by the Howard Hughes Medical Institute, Science Education Alliance

BIOLOGY

Effects of Sunlight and Fire on Autumn Olive (*Elaeagnus umbellata*) Fruit Sugar Concentration: Do Burns Help or Hinder an Invasive Plant?

Hilary Bultman and Danny Ackert
Mentor: Dr. Kathy Winnett-Murray
Department of Biology

Fire has often been used as a control mechanism for invasive plant species, such as Autumn Olive (*Elaeagnus umbellata*). However, little is known about the impact of burning on Autumn Olive's reproductive success. A contributing factor for plant reproductive success is seed dispersal, which is hypothesized to be correlated with the sugar concentration of fruit. Research has demonstrated that fruits with higher sugar concentrations are preferentially chosen by birds and mammals, and therefore should be dispersed more often than fruits with lower sugar concentrations. In this study, we examined environmental factors that may influence the sugar concentration of Autumn Olive fruits, thus theoretically impacting seed dispersal. We sampled fruits from four plant treatment groups: (1) previously burned Autumn Olive plants in high light conditions, (2) previously burned plants in shade conditions, (3) unburned in higher light, and (4) unburned in shade. Whereas average sugar concentrations did not vary significantly between burned and unburned plants, we did determine that sugar concentration was higher among plants growing in higher light conditions (mean in light: 19.51 ± 2.57% sugar, mean in shade: 17.78 ± 3.21% sugar). Furthermore, there was an interactive effect of light environment and burn treatment, suggesting that burning Autumn Olive reduces the affect of light on sugar concentration. Unburned plants had significantly lower sugar concentrations when growing in the shade ($t = 5.48$, $df = 27.8$, $p < 0.00001$), but burned plants had statistically similar sugar concentrations whether in the shade or in direct sunlight ($t = 0.33$, $df = 26.2$, $p > 0.05$). Variation in factors such as light, temperature, and foliage structure at the microhabitat level, could interact with animal seed dispersers' preferences and behavior in ways that strongly influence individual plant dispersal success.

BIOLOGY

Horizontal Gene Transfer of Plastid Genes between Parasitic Plant Balanophora and Hosts

Jeffrey Corajod
Mentor: Dr. Jianhua Li
Department of Biology

Examples of lateral gene flow have been previously described in numerous species of land plants. Mitochondrial horizontal gene transfer (HGT) seems relatively widespread, and the first case of nuclear HGT was recently described between Striga and its monocot host. In this study, we present evidence of HGT in the chloroplast genome of the parasitic plant genus Balanophora. The foreign DNA was found in the IR region of the chloroplast genome in a population of Balanophora from China. The markers sampled place this population of Balanophora sister to its host plants, which were identified as members of the legume family. Based on these findings, we suspect that the close proximity of parasite to host facilitated an exchange of chloroplast genetic material that has persisted in this population of Balanophora.

This research was supported by the National Science Foundation (NSF).

Effects of Population Dynamics and Competition on Parental Investment in Eastern Bluebirds (*Sialia sialis*)

Nickolas Davros and Jennifer LaRoche
Mentor: Dr. Kathy Winnett-Murray
Department of Biology

Parental investment and competition are two important elements of life history strategies affecting reproductive success. The effect of parental investment on reproductive success in a west Michigan population of Eastern Bluebirds (*Sialia sialis*) was investigated, including parameters such as feeding rates, sex of parent, type and size of items delivered to chicks, number of chicks, and age of chicks. We found all measures of parental investment related to provisioning of nestlings to be indistinguishable within mated pairs. We also determined that significantly more food was brought when parents had a large brood (3+ chicks) as compared with a small brood (1-2 chicks). Overall, there was only a 33% success rate for Eastern Bluebird nests during the summer of 2010, largely as a result of high nest predation. We found that Eastern Bluebirds avoided nesting near other Eastern Bluebirds, but not any other nest box-using bird species. Also, identity of the nearest neighbor did not appear to have an influence on the reproductive success of Eastern Bluebirds. The results of this study can help in the understanding of specific ecological interactions among species that may be of conservation interest.

This research was supported by the Howard Hughes Medical Institute (HHMI) and the Cronkite Award.

BIOLOGY

Phylogenetic Relationships Between Series of Lilacs and Support of Ligustrum Relationships Inferred from Sequences of Chloroplast DNA

Jeffrey DeYoung
Mentor: Dr. Jianhua Li
Department of Biology

Syringa, also known as lilacs, is a commonly cultivated plant genus for ornamental purposes, but interspecies molecular relationships are not well resolved. Ligustrum (privets) is another widely cultivated plant genus with many morphological similarities with lilacs. There is some molecular evidence that Ligustrum might have been derives from within Syringa. The purpose of this study is to elucidate their relationships using sequences of different chloroplast DNA regions. The three fragments sequenced are within the small single copy region of the chloroplast genome. The data so far collected supports the derivation of Ligustrum from within lilacs and also suggests close relations between the series Pubescentes (small-leaved lilacs) and Villosae (late blooming lilacs). Nonetheless, the support for the genetic relationships is not strong. Therefore, more molecular evidence from chloroplast and nuclear genomes are needed to further test the hypotheses concerning relationships of Syringa and Ligustrum and among series of Syringa.

This research was supported by the Lilac Fund and the Harvard Subcontract Fund.

Identification of a Cytotoxic Gene in Mycobacteriophage Vix

Danielle Goodman
Mentor: Dr. Joseph Stukey
Department of Biology

The genomes of more than 75 mycobacteriophages, all of which are capable of infecting *Mycobacterium smegmatis*, have now been sequenced and are available in GenBank. Despite the ability of those phages to infect a single host, their genomes exhibit great genetic diversity. In fact, a comparative genomic analysis of all sequenced mycobacteriophages indicates that there are more than 20 genetically distinct versions of genomes represented in this collection. This raises the interesting question of how the different phages wrest control from the host cell during lytic infection and whether they target the same or different points of the host cell metabolism. We hypothesize that mycobacteriophages assume control over their host by making proteins that directly interact and interfere with the functioning of sensitive host cell proteins. We further hypothesize that isolated expression of the genes that encode those phage proteins in *M. smegmatis* will be cytotoxic to the bacterium. The only mycobacteriophage genes previously shown to be cytotoxic to *M. smegmatis* are residents of the L5 genome. A new mycobacteriophage Vix, recently isolated at Hope College, contains a gene (Vix75) that has homology to one of the cytotoxic L5 genes. The Vix75 gene was amplified by PCR and ligated to the promoter region of the inducible *M. smegmatis* acetamidase gene on plasmid pLAM12. The pVIX75 recombinant plasmid was transferred into *M. smegmatis* and transformed cells were tested for growth on medium containing acetamide to induce expression of the Vix75 gene. Our results show that Vix75 is cytotoxic to *M. smegmatis*. We are currently investigating the mechanism of this cytotoxic activity and the relevant host cell target.

BIOLOGY

A Fer Kinase Homologue is Expressed During Zebrafish Development

Jessica Kozack, Erin Hildebrandt and Elizabeth Billquist
Mentor: Dr. Aaron Putzke
Department of Biology

Fer kinase, a non-receptor tyrosine kinase normally involved in the regulation of cell-cell adhesion and proliferation, has also been implicated in both prostate and liver cancer metastasis. However, the function of Fer in both development and cancer formation has yet to be fully characterized. Due to the complexities of functional redundancy with other kinases, it has been difficult to study Fer in other vertebrate model organisms, but the zebrafish (*Danio rerio*) lacks the redundancy of more complex vertebrates, thus allowing for a higher likelihood of elucidating the in vivo function of Fer. Through mining the zebrafish genome database, we have identified a single predicted zebrafish Fer homologue. Our phylogenetic analysis shows that the zebrafish Fer homologue is a descendant of the *C. elegans* FRK-1 protein and an ancestor to the human Fer kinase. We aim to bridge the gap between the invertebrate and vertebrate realms by characterizing the function of the Fer homologue in zebrafish. Initially, we will show the gene expression profile of the Fer homologue during different stages of development via in situ hybridization analysis. Furthermore, using a cross-reactive antibody to human Fer, we have determined by Western blot analysis that Fer protein is indeed expressed during zebrafish development and are now characterizing the requirement of the protein by using morpholino knockdown technology. Processes that can go awry during development are often similar to the cellular mechanisms that result in cancer. By uncovering the developmental requirements for the Fer homologue in zebrafish, we ultimately hope to establish a model in which to study more about cancer mechanisms and ways in which to inhibit tumor growth.

This research was supported by the National Science Foundation REU 0754293.

Screening Extracts from the Tropical Pioneer Plants *Bocconia frutescens*, *Guettarda poasana*, and *Phytolacca rivinoides* for Anti-Parasitic Activity

Erica Jansen
Mentors: Drs. Aaron Best, Dereje Desta, K. Greg Murray and Michael Short
Departments of Biology and Chemistry

Seeds of three species of Costa Rican pioneer plants were tested for anti-parasitic activity against *Leishmania tarentolae*. Initial screening of crude seed extracts revealed leishmanicidal activity in *Bocconia frutescens* with an IC50 value of 2.61 µg/mL. Further fractionation and compound identification revealed four benzophenanthridine compounds in the *Bocconia* seed extract, all of which showed leishmanicidal activity with IC50 values in the ranges of 10-20 µg/mL. Preliminary data show low mammalian toxicity of these compounds, suggesting potential for medicinal use.

This research was supported by the Howard Hughes Medical Institute (HHMI).

BIOLOGY

Interaction Between Galanin-Like Peptide (GALP) and Estradiol in the Control of Reproduction and Energy Homeostasis in Female Rats

Emily Leathley
Mentor: Dr. Gregory S. Fraley
Department of Biology

Galanin-like peptide (GALP) is a known hypothalamic mediator between energy states and reproduction. It has been suggested that sex differences may exist in the actions of GALP and these may be due to GALP-estradiol interactions. The purpose of these studies was to examine GALP's effect on food intake and body weight, metabolic rate and body temperature, sex behaviors, leutinizing hormone (LH) and growth hormone (GH) secretion. We also examined GALP and estrogen receptor co-localization and GALP-induced fos activation in estrogen receptor-immunoreactive neurons of the hypothalamus. To accomplish these purposes, we ovariectomized adult female rats and implanted cannulas in the lateral ventricles that were then used for intracerebroventricular (ICV) injections. Each animal received estradiol (EB) replacement therapy in two groups: EB or no EB (Blank). We found that there were significant estradiol-dependant effects of GALP on food intake ($p<0.05$), hormone secretions ($p<0.000$) and body temperature ($p<0.05$), but not on other measures. As has been shown in male rats, GALP stimulates food intake over the first 30 min after ICV injection in estradiol-treated rats but not Blank rats. ICV GALP significantly ($p < 0.01$) decreased plasma LH levels in Blank rats, but significantly ($p < 0.05$) increased LH in EB rats. Histological analyses revealed that there are significantly ($p < 0.05$) fewer GALP-ir cell bodies in the arcuate (Arc) nucleus of EB rats compared to Blank rats. Furthermore, we found that ERα- and GALP-immunoreactivity are not co-localized in the hypothalamus. Finally, we demonstrate that GALP-induced fos-immunoreactivity is significantly ($p < 0.05$) increased in the mPOA and Arc, but decreased in the VMN. These findings suggest that there is a GALP-estradiol interaction in the hypothalamic targets of female rats and that estradiol apparently regulates GALP neurons indirectly. These data have important implications for sex differences in GALP's actions.

This research was supported by the Wolterink family, the Hope College NSF REY program (Biology Department), and the NIH (K01 DK066238-01A1).

BIOLOGY

Regulation of Stem Cell-like Behavior by the Non-Receptor Tyrosine Kinase, FRK-1, During Post-Embryonic Development in the Nematode, *Caenorhabditis elegans.*

Kelsey Moore, James Bour and Sherri Smith
Dr. Aaron Putzke
Department of Biology

FRK-1, a homologue of the mammalian Fer kinase, is a non-receptor tyrosine kinase which we have found to be required for differentiation and maintenance of epithelial cell types during morphogenesis in the nematode, *Caenorhabditis elegans*. Expression analysis shows that FRK-1 is expressed primarily in epithelial cells, where it is highly localized to the cell-cell contacts to stabilize adhesion complexes until mitosis, when it appears strongly nuclear-localized. In the absence of maternal FRK-1, an epithelial subset of cell known as the hypodermal cells (skin) are specified but not fully differentiated, indicating that FRK-1 is required for maintaining hypodermal differentiation in developing embryos. Furthermore, we have demonstrated a requirement for FRK-1 during embryonic endoderm (gut) proliferation, where in the absence of FRK-1, gut cells hyperproliferate via the non-canonical Wnt signaling mechanism. Additionally, we have characterized a genomic knockout of *frk-1*, which eliminates only zygotic FRK-1 expression and results in early larval lethality. In mutants homozygous for the *frk-1* deletion, we have observed an excess number of lateral hypodermal cells known as seam cells, and loss of asymmetry in the stem cell-like divisions within the seam cell linage. More specifically, our data shows a loss of seam cell fate within the V1-V6 seam cells, resulting in smaller cells that appear to have differentiated as non-seam, hypodermal cells. We are investigating the mechanism by which the loss of FRK-1 causes this cell fate switch, and whether FRK-1 translocation to the nucleus during mitosis is required for the stem cell-like self-renewal exhibited by seam cells during post-embryonic development in *C. elegans*.

Funding for this research was provided by the National Science Foundation REU 0754293 and the Howard Hughes Medical Institute (research fellowship to K.M.)

Biology
Summer Research
Picnic

BIOLOGY

Isolating Pure Compounds from Seeds of *Bocconia frutescens* to Test for Anti-Fungal Activity

Robert Muterspaugh
Mentors: Drs. K. Greg Murray and Michael Short
Department of Biology

Bocconia frutescens is a Costa Rican pioneer plant whose seeds persist for tens to hundreds of years in the buried "soil seed bank." Previous work in our lab has shown that the longevity of these seeds is a result of chemical defense against pathogens and predators. For example, Veldman et al. (2007) identified four alkaloids from the crude seed extract, three of which were highly toxic to arthropods. My work extended this testing to fungi, and showed that the alkaloid 6-methoxydihydrochelirythrine is largely responsible for toxicity to *Pythium irregulare*, a known plant pathogen. Interestingly, this was the one alkaloid isolated from *B. frutescens* by Veldman et al. (2007) that was not significantly toxic to arthropods. Ongoing work in our lab will test these alkaloids for toxicity to other common seed pathogens as well, and will estimate the proportion of total toxicity that is attributable to each of the alkaloids present.

The Use of AroB and Agt1: Nuclear Markers in the Investigation of the Homoploid Hybrid Speciation Origin of *Stewartia Ovata*

Pieter R. Norden
Mentor: Dr. Jianhua Li
Department of Biology

The homoploid hybrid speciation origin of *Stewartia ovata* was investigated using conserved ortholog set (COS) nuclear markers AroB and Agt1. Molecular data has been useful in identification of other homoploid hybrid species, and COS markers were used because of the high number of parsimonious informative sites due to variation within introns. Maximum parsimony and maximum likelihood analysis using PAUP identified the formation of a clade containing both *S. ovata* and *S. malacodendron*, the other North-American species of *Stewartia* that is sister to the clade containing other Asian species of *Stewartia* and is statistically well supported. This data conflicts with data based on chloroplast markers that identifies a clade containing *S. ovata* and Asian species of *Stewartia* that is sister to *S. malacodendron*. This then suggests that an ancestral population of *S. malacodendron* served as a pollen donor, while an ancestral Asian species served as a maternal genetic donor, since chloroplast and mitochondria DNA are inherited maternally. It may be concluded, then, that there is strong statistical support for the hypothesis that *S. ovata* resulted from a homoploid hybrid speciation mechanism, since all species of *Stewartia* contain 2n = 30 chromosomes.

This research was supported by a private donor.

BIOLOGY

Isolation and Characterization of *Saccharomyces cerevisiae* Mutants Defective in Unsaturated Fatty Acid Recognition

Regina O'Brien, Caitlin Peirce and Katherine Heneveld
Mentors: Drs. Joseph Stukey and Virginia McDonough
Department of Biology

When dietary unsaturated fatty acids (UFAs) are present, cells down regulate expression of the enzyme Δ9 desaturase, encoded by *OLE1*, which is responsible for producing UFAs. A screen was designed to isolate mutants defective in recognition of the presence of UFAs, and the subsequent transcriptional regulation of the Δ9 desaturase. Using a reporter gene construct controlled by the *OLE1* promoter, several mutants were identified, and one mutant, KH2, was chosen for additional characterization. The mutation that renders KH2 incapable of molecular response to UFAs is a recessive trait due to a single mutation. While the reporter construct demonstrates that transcriptional regulation of *OLE1* is defective, fatty acid analysis reveals normal regulation in response to UFA supplements, indicating that post-transcriptional regulation is intact. This implies that the mutation is not responsible for universal response to UFAs, but just transcriptional regulation. Further work to identify genes responsible for regulation of *OLE1* was initiated through genomic library screening. Initial results identified a genomic fragment that returned KH2 phenotype to wildtype. However, examination of individual genes on that fragment revealed that one gene may be a suppressor, rather than the gene responsible for the authentic phenotype due to mutation. Additional work is ongoing to determine the identity of this suppressor. In addition, further library work will attempt to identify the authentic gene responsible for *OLE1* regulation.

Generation and Comparative Analyses of Genome-Scale Metabolic Models for the Genus *Shewanella* Using the Model SEED

Caitlin Peirce
Mentors: Drs. Aaron Best and Matthew DeJongh
Departments of Biology and Computer Science

The genus *Shewanella* consists of aquatic microorganisms that are distributed worldwide. Their features include respiratory and metabolic diversity as well as the ability to thrive in extreme environments. The study of *Shewanella's* versatile metabolism can provide insights into the specie's capacity for biotechnology, such as bioremediation and microbial fuel cells. The Model SEED (http://seed-viewer.theseed.org/models), a web-based resource for microbial genome analysis, was used to generate genome-scale metabolic models for sequenced *Shewanella* genomes. The draft metabolic model for *S. oneidensis* was curated, focusing on areas of metabolism that have not been well-curated in previous modeling efforts (e.g., anaerobic respiratory systems, lipopolysaccharide biosynthesis). The goals of this work are to 1) expand the coverage of metabolic diversity in databases used for metabolic modeling, 2) design and refine software tools to facilitate manual curation of metabolic models, and 3) generate a complete *S. oneidensis* metabolic model that can be used with computational tools and high throughput experimental approaches to advance our understanding of the metabolic strategies and physiology of the genus *Shewanella*.

BIOLOGY

Identification of Fungistatic Compounds in the Seeds of *Phytolacca rivinoides*, A Costa Rican Cloud Forest Plant

Anne Short
Mentors: Drs. K. Greg Murray and Michael Short
Department of Biology

Seeds possess a diverse array of adaptations to protect their viability until favorable conditions arise for germination. In species that must spend long periods of dormancy in the seed bank of tropical soils, these adaptations often include chemical defense to ward off fungal pathogens. The Murray lab at Hope College has studied the biology of pioneer plants at Monteverde, Costa Rica for many years, and more recently in collaboration with chemists William Mungall and Michael Short has begun to focus on the chemicals that enable pioneer seeds to survive for tens to hundreds of years. My work focuses on *Phytolacca rivinoides*, the seeds of which accumulate in the soil to densities more than an order of magnitude greater than that of annual seed input. Using a combination of separation and identification techniques, and guided by poisoned-medium fungal bioassays, I have isolated three toxic compounds, and have begun the process of elucidating their chemical structure. The crude extracts containing the three compounds have shown 95% fungal inhibition in proportion to the control at a concentration of 5 mg/mL. These compounds may have potential as anti-fungal drugs to treat patients who are immunocompromized, and are therefore susceptible to opportunistic fungal infections.

Tritrophic Effects of a Fungal Endophyte: Parasitoid Host Preference

Sioned Sitkiewicz
Mentor: Dr. Tom Bultman
Department of Biology

My research involved a tritrophic interaction between the grass tall fescue, aphids, and their natural enemies, parasitoids. Specifically, my research targeted the host preference of the parasitoid based on the diet of their aphid hosts. Aphids were fed on tall fescue that either contained or was free of a toxic alkaloid producing fungal endophyte. Parasitoids that had never parasitized before and parasitoids given previous experience were exposed to both aphid treatment groups, and the frequency of parasitism in each group combination was recorded. Data show that non-experienced or naïve parasitoids significantly prefer aphids fed on an endophyte-free diet (E- aphids). Also, data show a trend for parasitoids preferring E- aphids, regardless of previous experience. It is important to establish a preference pattern in this interaction, because upon its solidification, further research can be performed regarding the specific chemical cues taking place in the acceptance or rejection of a host (i.e., tactile, or aromatic cues). This interaction is relevant to agriculture, as parasitoids serve as biological pest control, and endophytes present in the forage grass, tall fescue, could have detrimental effects on the third trophic level.

This research was supported by the Christine Tempas Summer Research Fund.

BIOLOGY

Isolation and Identification of Fungistatic Compounds from Seeds of *Guettarda poasana*

Ingrid Slette
Mentors: Drs. K. Greg Murray and Michael Short
Department of Biology

Despite formidable pressure from rodents, arthropods, and microbes, the seeds of many tropical plants are able to remain dormant and viable in the soil for tens to hundreds of years. This is especially true of many pioneer species such as *Guettarda poasana* (Rubiaceae). Pioneer plants are fast-growing, shade-intolerant species that specialize on early successional patches and therefore play an important role in forest regeneration. For many species of pioneers, protection against animals and microbes seems to be conferred by toxic chemicals in the seeds. At Monteverde, Costa Rica, *G. poasana* seeds have been shown to accumulate to high densities (> 100/m^2) in the soil, suggesting strong chemical defense. We used several extraction and identification procedures, guided by poisoned-medium bioassays, to isolate and identify anti-fungal compounds responsible for persistence of *G. poasana* seeds in the soil. Crude extracts from *G. poasana* seeds are highly toxic to fungi, and we have isolated ca. nineteen compounds of interest from the toxic fractions using preparative TLC. The first compound successfully isolated and identified was not highly toxic, but ongoing work in our lab promises to identify the toxic individual compounds as we further purify them and are able to obtain NMR spectra. Although our primary goal is to understand the chemical basis for pioneer seed persistence in the soil, some of the compounds responsible may also have pharmaceutical potential.

The Effects of G Protein Consensus Sequence Mutations on VACM-1 Function

Colleen McIntyre
Mentor: Dr. Maria Burnatowska-Hledin
Department of Biology

Vasopressin-Activated Calcium Mobilizing (VACM-1) gene localizes on chromosome 11q22-23 and is composed of 780 amino acids. It is a member of the cullin gene family, which regulates cell cycle progression and inhibits cellular growth through the ubiquitin-proteasome degradation pathway. Because of its inhibitory effects on cell growth, VACM-1 has been proposed as a possible tumor suppressor gene. Sequence analysis of VACM-1 revealed consensus sequences for phosphorylation and interaction with G proteins. Previous studies have shown that a mutation in the PKA-specific phosphorylation site results in VACM-1 losing its anti-proliferative effects, but the significance of the G protein binding site has not been explored. Because G proteins interact with membrane receptors that control cell signaling and growth, this study focused on the effects caused by a mutation in the G protein binding site. Immunocytochemistry and cellular growth assays were employed to determine if this modification affected VACM-1 localization, modification, or cell proliferation. Preliminary results indicate that no protein modification occurs due to the mutations, but the mutants lose their anti-proliferative effects. Further testing will be required to confirm these results.

This research was supported by a private donor.

BIOCHEMISTRY

Identification of Trafficking Motifs Involved in Constitutive and Regulated Trafficking of System x_c^-

Anne Georges
Mentor: Dr. Leah Chase
Departments of Biology and Chemistry

System x_c^-, a sodium independent plasma membrane transport system that exchanges intracellular glutamate for extracellular cystine, has been shown to constitutively traffic to and from the plasma membrane, enabling a rapid response to oxidative stress via regulated trafficking. Trafficking is a common form of regulation among transport proteins, and various amino acid motifs have been shown to play integral roles in the trafficking mechanisms of these transporters. Thus, in an attempt to further elucidate the mechanism(s) by which system x_c^- traffics, this study sought to identify amino acids of xCT, the function-specific protein of system x_c^-, that are involved in its trafficking. Carboxyl-terminal truncations and point mutants of xCT were constructed in a FLAG-tagged cDNA vector and were transfected into PC12 cells, a rat pheochromocytoma cell line. Sites for mutation were selected based on known trafficking motifs of other proteins that traffic. The trafficking behavior of the mutant constructs was assayed using both fluorescence microscopy and a biotinylation protocol in which a membrane-impermeable biotin was used to tag and separate membrane-localized proteins from intracellular proteins. Loss of the carboxyl-terminus appears to significantly reduce cell surface expression. Preliminary analysis of the point mutants suggests that we may have identified putative membrane trafficking motifs.

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Regulation of VACM-1/Cul-5 Expression in Human Endothelial Cells

Bryan Kunkler
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Departments of Biology and Chemistry

VACM-1 (Vasopressin-Activated Calcium-Mobilizing) protein is a cul-5 gene product, and when expressed in cells in vitro, it inhibits cellular growth. In vivo, expression of VACM-1 protein is most abundant in endothelial cells. Previous work has shown that VACM-1 inhibits angiogenesis, an essential process for cancer progression and subsequent metastasis. Factors that regulate VACM-1 expression have not been previously studied. Thalidomide, a teratogenic drug, is known to decrease angiogenesis, but the specific cellular target for its effect is not known. We hypothesized that Thalidomide-induced cell death and inhibition of angiogenesis occurs through a pathway involving VACM-1/Cul-5. Our results show that in rat endothelial (RAMEC) cells and human endothelial cells (HUVEC), treatment with thalidomide significantly decreases cellular growth. These changes were associated with increased VACM-1 protein concentration as determined by Western blot analyses. In human endothelial (HUVEC) cells transfected with anti-VACM-1 siRNA to knockdown VACM-1's expression; Thalidomide-induced cell death was significantly decreased. These results suggest that VACM-1 may play an important role in the pathway of Thalidomide-induced cell death, which may be a new target for anti-cancer drugs.

CHEMISTRY

Purification and Analysis of Contaminated Water Using Slow Sand Filtration and Metal Ions

Joseph Brandonisio
Mentor: Dr. Michael Pikaart
Department of Chemistry

The intent of this research was to improve the efficiency of slow sand water filters at killing harmful pathogens and purifying water. Specifically, the main goals this summer were to find out how much copper sand would retain, and to maximize it. Copper has been used as a germicide for centuries and has a lot of potential for helping to optimize water filters. Last summer's research confirmed that copper could be retained by the sand in the water filters, this summer we measured how much was retained. A variety of different sands were soaked in an array of copper solutions in order to saturate the sand with copper. Afterwards, the excess copper solution was poured off and the sand samples were dried. The amount of copper in each sample was measured using PIXE and the particle accelerator, as well as atomic absorption. A 20% nitric acid solution was used to strip the copper out of the sand and diluted before being tested using atomic absorption. In addition, the residual time needed for the water to remain in the filters for purification was also tested. Miniature sand filters tested how much time the bacteria-contaminated water needed to spend in the filter before sufficient cell death occurred from the presence of copper and lack of oxygen. The filters tested water that had residual times of 1 hour, 24 hours, 48 hours, and 72 hours. For each amount of time, there was a filter with copper present and one without.

Novel Analogs of Curcumins: Development of a Method to Screen for Cytotoxicity Against Murine Cancer Cells

Olivia Brockway, Samuel Tzou and Megan Lee
Mentors: Drs. Moses Lee, Balaji Babu, Sameer Chavda and Dereje Desta
Department of Chemistry

Curcumin is a compound found in *Curcuma longa,* in which the root is commonly used as a spice called turmeric. It is reported to have anticancer properties. Curcumin is effective at inhibiting tubulin polymerization and the proliferation of several strains of cancer. Recently, curcumin has also been found to inhibit the JAK/STAT pathway and induce cancer cells to undergo apoptosis. A new method for screening 75 non-symmetrical analogs of curcumin for cytotoxicity has been established in our laboratory. Each compound is put into a 10 μM solution and added to a plate that is seeded with L1210 cancer cells, a murine strain of lymphoma, and media. After 3 days of incubation, an MTT assay is performed on the treated cells to show the presence of live cells. Analysis of the raw data then shows which compounds are active, fairly active, and not active. The active compounds are further examined and their cytotoxicity, IC50 values, against the growth of L1210 and B16 cells (murine melanoma) in culture are determined. The structure and activity relationships for the new compounds will be presented.

The authors thank Professor Dev Arya and Clemson University for support.

CHEMISTRY

Luminescence Studies of Feldspar Minerals and Implications for Forensic Geology

Sarah Brokus, Danielle Silletti, J. Mark Lunderberg and Joshua Borycz
Mentor: Dr. Graham F. Peaslee
Department of Chemistry

Feldspar minerals are the most common constituents of rock on this planet, and as such, are regularly encountered in sediment samples. Because these feldspar minerals are so ubiquitous, they often provide mineral identification rather than yielding a provenance determination or source-level association by traditional examination. One possible method to rapidly analyze large numbers of diverse soil samples involves measuring the luminescence of feldspar minerals among them, which could rapidly yield highly discriminating characteristics of the feldspars. In this study, a variety of 42 feldspar samples of known provenance were examined by cathodoluminescence (CL) in conjunction with ion beam induced luminescence (IBIL). Previously reported luminescent centers (Mn^{2+} and Fe^{3+}) were observed, and their UV-Visible peak positions vary with stoichiometric changes in the Na-K-Ca composition of the feldspars, as expected. Similarly, Si-O and Al-O lattice defect luminescence in the UV-Visible spectra were observed in addition to a previously unassigned IR luminescence. Additional analysis of the feldspar samples by x-ray diffraction (XRD), electron microprobe (EMP), micro x-ray fluorescence (XRF), and particle induced x-ray emission (PIXE) was performed in an attempt to determine the mechanism for the unassigned IR peak, as well as shifting within luminescent peak signatures.

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Free-Jet Vibration-Rotation Spectroscopy of Unstable Species

Kent C. Kammermeier and Howard A. Dobbs
Mentor: Dr. William F. Polik
Department of Chemistry

Vibration-rotation spectroscopy is used to characterize molecular potential energy surfaces and thereby describe chemical interactions. Unstable species are highly reactive and electronically complex, making them valuable spectroscopic targets. However, such species must be created during the measurement process. This experiment uses an electric discharge nozzle to fragment a precursor molecule which is then analyzed using laser spectroscopy. Both fluorescence excitation and dispersed fluorescence spectra of dichlorocarbene ($:CCl_2$) were recorded. Vibrational levels of the ground electronic state have been assigned from these spectra.

CHEMISTRY

Investigating Biopolymer Function and Probe Dynamics Using Fluorescence Techniques

Alyssa A. Cassabaum, Andrew E. Cook, Christine A. Gobrogge, Alyssa M. Stevenson, Arcelia S. Ortega, Christian J. Calyore, Jacquelyn D. Lewis, David A. Paul, Amy L. Speelman and Conrad M. Tobert
Mentor: Dr. Brent P. Krueger
Department of Chemistry

The Hairpin Ribozyme is a small catalytic RNA, with both endonuclease and ligase activities, that undergoes a large structural change as part of its function. Fluorescence-detected resonance energy transfer (FRET) experiments have provided significant data about the function of the Hairpin Ribozyme, but are limited due to a number of assumptions. To better understand these assumptions and how they impact structural dynamics measured through FRET experiments, we examine model DNA and RNA motifs labeled with fluorescent probes. These motifs, based on the Hairpin Ribozyme, are examined using several spectroscopic fluorescence techniques: bulk steady-state, bulk time-resolved, and single-molecule, all of which provide FRET data. These methods are utilized to determine how the limiting FRET assumptions affect results and how the dynamics of the fluorescent labels contribute to the overall dynamics measured in FRET experiments. Thus far, our experiments have centered on the fluorescent probes Cy3 and Cy5. Preliminary analysis has demonstrated consistent FRET values among the three methods.

This research was supported by Gentex Corporation, the Howard Hughes Medical Institute, the National Institutes of Health, the ACS-Petroleum Research Fund, the National Science Foundation REU and MRI Programs, and Research Corporation.

Monoubiquity of Histone H2B and Gene Regulation in Saccharomyces Cerevisiae

Rachel Doud
Mentor: Dr. Michael Pikaart
Department of Chemistry

Previous studies have shown that covalent modifications of core histone proteins affect chromatin structure and function. This summer we specifically looked at monoubiquitylation of histone H2B in *Saccharomyces cerevisiae*, commonly known as baker's yeast. Through the use of western blot techniques and analysis, we detected monoubiquitylation in multiple strains of yeast. The second part of this project specifically focused on the glycolytic/gluconeogenic pathways in yeast metabolism during the switch from anaerobic fermentation to aerobic respiration in culture. We wanted to see if the expression of specific genes increased or decreased as glucose levels changed. Using RT-PCR analysis, changes in four genes: sam1, fbp1, pck1, and pyk1 were monitored. Understanding how glucose levels change gene expression can provide valuable insight into how chromatin modifications affect cellular responses to changing environmental conditions.

CHEMISTRY

Chemically Modified Electrodes: Determining Thin Film Thickness

XiSen Hou and Olajide Banks
Mentors: Drs. Kenneth Brown, Graham Peaslee and Paul DeYoung
Department of Chemistry

Chemical modification of electrodes is key in developing electrochemical sensors that can detect various substances in our environment, such as hydrazine, which the EPA has classified as a compound that causes liver and kidney problems. As the need for these sensors increases, new techniques and compounds will be used in the chemical modification of electrodes. This research focused primarily on the chemical modification of platinum electrode surfaces via electropolymerization of a ruthenium complex, [Ru(5-phenNH2)](PF6)2, which is known to detect hydrazine. The characterization of this multilayered film is accomplished with cyclic voltammetry and Rutherford backscattering spectrometry (RBS); the thickness of the Ru thin film was determined using RBS. It was found that the thickness of the film and the amount of material immobilized on the electrode surface was directly dependent on the concentration of the ruthenium complex as well as the number of cycles of electropolymerization undergone. The RBS method has proven to be a very useful and effective means of determining thin film thickness.

Testing the Predicted Enhancement in DNA Sequence Specificity and Binding Affinity of Formamido-pentaamides over their Formamido-triamide Counterparts

Matt Gregory and Mia Savagian
Mentors: Drs. Moses Lee, Balaji Babu, Sameer Chavda and Vijay Satam
Department of Chemistry

Polyamides that contain imidazole and pyrrole heterocycles are known to target the minor groove of DNA in sequence specific interactions. Such molecules have the ability to alter gene expression. Analogs of the naturally occurring product distamycin have been developed and shown to bind in stacked anti-parallel dimers, but range in their affinity and specificity towards their target sequences. Although the formamido group is usually omitted from these analogs, it has been found to be important in increasing affinity and binding site size. Various formamido triamides have been synthesized, with f-ImPyIm showing the greatest affinity in targeting its cognate DNA sequence, 5'-d(ACGCGT)-3'. The established pairing rules for minor groove recognition indicate that the formamido-pentaamide, f-ImPyImPyIm, should bind with greater specificity to its cognate sequence without sacrificing affinity. This also calls for the synthesis of f-PyPyPyPyPy, which would target the control sequence 5'-d(AAATTT)-3'. The focus of this research is directed towards the synthesis of f-ImPyImPyIm and f-PyPyPyPyPy and testing their affinity and specificity in comparison with their triamide counterparts.

The authors thank NSF for support.

CHEMISTRY

Introducing Inquiry-Based Computational Science and Modeling to High School Students and Teachers

Cortney J. Kimmel and Catherine L. Ellis
Mentor: Dr. Brent P. Krueger
Department of Chemistry

Computational science and modeling (CSM) has become an integral part of modern research fields. But many high school students (future scientific researchers) are not given adequate exposure to this primary mode of investigation. Therefore, a one week workshop for high school science teachers was held at Hope College to introduce a large number of students to CSM before they reach the undergraduate level. During this workshop the teachers were trained in using WebMO, a research tool which creates input files from a menu-driven interface and organizes complex output files from computational engines. The workshop also included instruction on building inquiry-based lessons, which engage students in forming their own questions and making their own discoveries. Each teacher developed a WebMO-based inquiry lesson appropriate for high school students. Workshop participants completed pre, mid, and post-workshop assessments to determine gains in their CSM proficiency as well as the modifications needed to improve the effectiveness of the training and the overall experience of the workshop. After each teacher implements a WebMO lesson, students were assessed to determine their confidence in defining and recognizing CSM, as well as its impact on their understanding of the chemistry content.

This research was supported by the Michigan Space Grant Consortium, the Howard Hughes Medical Institute, and Hope College.

Lauren Moak prepares a dry ice-acetone bath

CHEMISTRY

Rate Performance of Three Dimensionally Ordered Macroporous Carbon Based Electrodes in Aqueous K3Fe(CN)6

Bruce Kraay and Ana Ortega
Mentor: Dr. Kenneth Brown
Department of Chemistry

For the improvement of rate performance of carbon electrodes, new electrode surfaces, such as Three-Dimensionally Ordered Macroporous (3DOM) carbon electrodes, are being studied in order to understand their electrochemical properties. The 3DOM carbon electrodes have a greater surface area that allows more charge-transfer reactions to take place and have high energy density. These characteristics should be useful in the development of sensors/biosensors with enhanced rates of electron transfer. In order to use the electrodes for aqueous solutions, an acid pretreatment was used to help create more "oxide defects" on the surface, therefore making the surface more hydrophilic to allow metal complexes to have better contact with the surface. This results in better electron transfer between the electrode surface and 3DOM electrode. Based on the Randles-Sevcik equation (derived from the Nernst-Plank equation), the 3DOM electrodes have shown results similar to that of results with glassy carbon electrodes, but with enhanced electron transfer rates.

Mechanistic Studies of C-C Bond Activation in Quinolinyl Ketones

J. Patrick Lutz
Mentor: Dr. Jeffrey B. Johnson
Department of Chemistry

Carbon-carbon single bonds form the framework for many organic molecules, but in most cases, they cannot be functionalized. Dreis and Douglas have reported the rhodium (I)-catalyzed isomerization of a quinolinyl ketone with an alkene tail to form a cyclized product, in a reaction that *does* involve carbon-carbon single bond activation (*J. Am. Chem. Soc.*, **2009**, *131*, 412-413.). The Johnson lab hopes to understand the mechanism of this reaction in order to be better able to use C-C activation in organic synthesis.

Currently, competition reactions are being used to study the relative rates of this reaction among substrates with electron-donating and electron-withdrawing groups substituted around the phenyl ring. From these experiments, inferences can be made about the reaction mechanism, specifically in relation to the rate-limiting step. Initial results suggest that the oxidative addition of the rhodium catalyst into the C-C bond is the slow step. Efforts are underway to prepare and cyclize an alkene-substituted substrate to further strengthen the mechanistic hypothesis.

This work is supported by the Research Corporation.

CHEMISTRY

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Abstract restricted

[redacted]

Rhodium-Catalyzed Carboacylation with Quinolinyl Ketones: Evidence for Rate-Limiting C-C Bond Activation

Colin M. Rathbun
Mentor: Dr. Jeffrey B. Johnson
Department of Chemistry

Carbon-carbon single bond activation reactions promise to revolutionize organic synthesis by opening the doors to new, more efficient synthetic methods. The rhodium-catalyzed intramolecular carboacylation of quinolinyl ketones serves as an ideal subject for the mechanistic study of carbon-carbon bond activation. Combined kinetic and NMR studies of this reaction allowed the identification of the catalytic resting state and determination of the rate law, $^{12}C/^{13}C$ kinetic isotope effects, and activation parameters. These results have identified the activation of a ketone-arene carbon-carbon single bond as the turnover limiting step of catalysis and provided quantitative detail into this process.

This work is supported by the Research Corporation.

CHEMISTRY

Quantification of Aldehydes in Water and Blood by SPME/GC/HRMS as a Method of Detection of Aldehyde Exposure and Disease

Grace Osborne
Mentors: Drs. Lalith K. Silva and Benjamin B. Blount, National Center for Environmental Health at the Centers for Disease Control and Prevention, Atlanta GA
Department of Chemistry

Aldehydes are readily found in the environment, formed from the burning of organic matter such as tobacco, and lipids such as gasoline, oil, and fats, as well as byproducts in the ozonation of water. Exposure to aldehydes is known to have adverse health effects. Aldehydes have also been associated with diseases such as breast cancer, lung cancer, and liver disease. The analysis of trace levels of aldehydes in biological matrices is difficult because they are highly reactive, water soluble and volatile. During the summer of 2010, we developed an accurate, solvent free analytical method to detect trace levels (parts-per-trillion) of ten aldehyes in human blood, plasma, and serum: acetaldehyde, acrolein, butanal, isopentanal, pentanal, hexanal, heptanal, furaldehyde, benzaldehyde, and o-tolualdehyde. Analytes were extracted from the headspace of the biological sample, desorbed into a heat injector and resolved using a gas chromatograph. A high-resolution mass spectrometer detected analytes with multiple ion monitoring. Analytes were quantified against a known amount of stable isotope-labeled internal standard. Quantitatively analyzing levels of lipid oxidation byproducts in whole blood, plasma, and serum can be used as an early indicator of oxidative stress and to prevent the progression of disease, particularly lung and liver cancer, which are difficult to detect in early stages. Upon returning to the CDC during summer 2011, I will verify results and conclusions in preparation for publication.

This research was supported by the Oak Ridge Institute for Science and Education and the Centers for Disease Control and Prevention.

Amanda Witte works to set-up
a reaction using air sensitive materials

CHEMISTRY

Exploring New Routes Toward Carbonyl-substituted Perimidinespirohexadienone Photochromes as Potential "Photochromic Photooxidants"

Luke J. Peterson and Kathryn A. Lindberg
Mentor: Dr. Jason G. Gillmore
Department of Chemistry

Photoinduced charge transfer (PICT) is a useful means of generating organic ion radicals. Cation radicals generated by PICT have relevance in a variety of applications of materials science interest, including new approaches to volume holographic data storage and 3D microfabrication. However, a limitation to the use of PICT-initiated cation radical reactions is the persistence of photooxidant in the material subsequent to completion of the desired reaction. For instance, in data storage, this prohibits the use of the writing laser to read out the data without a "fixing" step that may alter the material. We are therefore attempting to develop a reversible "pro-photooxidant" system to gate sensitivity to PICT, in essence only having a photooxidant present when it is desired.

Organic photochromes have long been used to "gate" optical properties, specifically color (absorbance)—in essence, Transitions® lenses "gate" the presence of sunglasses. The increase in conjugation that underlies the change in absorbance upon isomerization of a photochrome also has significant impact on electronic properties. This phenomenon has received much less attention.

In keeping with our group's ongoing development of the perimidinespirohexadienone (PSHD) family of photochromes as potential "photochromic photooxidants," in which one isomer is a good photooxidant, while the other isomer is not, we have explored a variety of routes to PSHDs bearing carbonyl substituents, which calculations predict to our most potent "photochromic photooxidant" candidates yet. Mechanistic lessons learned from several failed synthetic routes will be described, along with our current approaches in which the carbonyls are to be installed after coupling to form an initial photochrome without carbonyl substituents.

This material is based upon work supported by the National Science Foundation under grants CHE-0952768 (CAREER), CHE-0629174 (URC), and DUE-0728574 (S-STEM).

CHEMISTRY

Oxazinoquinolinespirohexadienones – Attempting to Create *N,O*-bridged Analogs of Quinazolinespirohexadienone Photochromes as Potential "Photochromic Photooxidants"

Benjamin J. Pollock
Mentors: Drs. Jason G. Gillmore and Daniel J. Stanford (Harper College, Palatine, IL)
Department of Chemistry

Photoinduced charge transfer (PICT) is a useful means of generating organic ion radicals. Cation radicals generated by PICT have relevance in a variety of applications of materials science interest, including new approaches to volume holographic data storage and 3D microfabrication. However, a limitation to the use of PICT-initiated cation radical reactions is the persistence of photooxidant in the material subsequent to completion of the desired reaction. For instance, in data storage, this prohibits the use of the writing laser to read out the data without a "fixing" step that may alter the material. We are therefore attempting to develop a reversible "pro-photooxidant" system to gate sensitivity to PICT, in essence only having a photooxidant present when it is desired.

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Building on our recently reported work in which the naphthalene moiety in the perimidinespirohexadienone (PSHD) structure is replaced with a quinoline moiety to give a quinazolinespirohexadienone (QSHD), we are now working to substitute an oxygen for one of the bridging nitrogens, to study the corresponding oxazinoquinolinespirohexadienones (OSHD). Synthesis, photochemistry, and experimental as well as computationally predicted electrochemical results will be presented on both the QSHD and OSHD photochromes.

This material is based upon work supported by the National Science Foundation under grants CHE-0952768 (CAREER), CHE-0629174 (URC), and DUE-0728574 (S-STEM).

CHEMISTRY

Synthesis of 1-(3-Chloropropyl)-4-nitroimidazole-2-carboxylic acid and N-Aminoalkylimidazole Containing Polyamides

Alex Porte
Mentors: Drs. Moses Lee, Balaji Babu and Sameer Chavda
Department of Chemistry

One of the primary endeavors in modern medicinal chemistry is the development of drugs that can control specific gene expression. The naturally occurring polyamide distamycin is one such molecule that binds to A/T-rich sequences of DNA in the minor groove. By altering the number and arrangement of pyrrole and imidazole heterocycles in analogous polyamides, specific sequences can be targeted. The polyamides exhibit a wide range of binding affinities to their complementary DNA sequences. By adding amino pendants to the nitrogen atom of pyrrole within the polyamide, it is known that binding affinity is improved. In order to determine the optimal DNA binding affinity of a particular polyamide, it is necessary to include amino pendants on imidazoles as well. The focus of this research is to synthesize polyamides which contain N-aminoalkylimidazole groups and to discover the optimal number of pendant amino groups and their location within the polyamide in regards to binding affinity.

The authors thank the NSF for support.

Modeling Fluorescently Tagged DNA and RNA Oligonucleotides for Direct Comparison to FRET Experiments

Alyssa A. Cassabaum, Andrew E. Cook, Christine A. Gobrogge, Alyssa M. Stevenson, Amy L. Speelman, Arcelia S. Ortega, David A. Paul and Bryan A. Leland
Mentor: Dr. Brent P. Krueger
Department of Chemistry

We are developing a method for studying the structural dynamics of biomolecules that couples fluorescence spectroscopy and computational modeling, providing a more complete understanding than is possible with either technique alone. Before beginning MD simulations, force field parameters were developed for the fluorescent probes to be used in experimental studies. This was carried out by first using quantum mechanical calculations to determine low-energy conformers of the probe molecules and calculate electrostatic potentials for these conformers. The RESP charge fitting procedure was then used to derive atomic charges; all other parameters were assigned by analogy to pre-existing force field parameters. Several DNA- and RNA-fluorescent probe systems were explicitly solvated in water and equilibrated before beginning production molecular dynamics simulations. These MD simulations will be used to generate simulated fluorescence data for direct comparison to experimental bulk and single-molecule FRET data.

This research was supported by the Howard Hughes Medical Institute, the ACS-Petroleum Research Fund, the National Science Foundation MRI, REU, & CIEG programs, the Midwest Undergraduate Computation Chemistry Consortium, and Teragrid Cyberinfastructure.

CHEMISTRY

Cathodoluminescent Signatures of Neutron Irradiation

Danielle Silletti, Sarah Brokus, Elly Earlywine and Joshua Borycz
Mentor: Dr. Graham F. Peaslee
Department of Chemistry

Nuclear proliferation and the potential threat to national security from unsecured special nuclear materials have renewed our national interest in not only detecting the presence of these materials, but also in detection of materials' pathways into this country. Currently, the only method to identify where special nuclear materials have been stored involves measuring induced radiation in adjacent materials, which is usually short-lived radiation. We have identified a permanent change to the luminescent properties of certain minerals that is due to neutron irradiation that could potentially be developed into a nuclear forensics tool. Feldspars and carbonates are common minerals that are known to luminesce under electron bombardment. The UV-Visible spectra of hundreds of individual potassium feldspar and calcite grains were measured with cathodoluminescence (CL) spectroscopy before and after neutron irradiation. CL excitation uses an electron beam to induce fluorescence in certain minerals due to their chemical composition and defects in their crystal lattice structure; the resultant emission spectrum is acquired with a UV-Visible spectrometer. The presence of ionizing radiation causes additional crystal lattice defects that leave a permanent CL signature. A spectroscopic signature is described that increases proportionately to neutron dose in both calcites and feldspars. Preliminary dose-response results from a neutron source study and a reactor study will be presented. There is also an orientation dependence in the luminescence measurement technique that complicates the analysis, but when fully understood, could allow not only the total dose to be estimated but also the direction of origin of the neutrons to be determined.

This research was supported by: Department of Homeland Security (2008-DN-077-ER0008) and National Science Foundation (PHY-0969058).

Monoubiquitylation of Histone H2B in *Giardia lamblia*

John Donkersloot and Brenna Lamphear
Mentors: Drs. Michael Pikaart, Aaron Best and Dereje Desta
Department of Chemistry

Covalent modifications of core histone proteins are essential to gene transcription. One such modification is the monoubiquitylation of H2B, a process which has been shown to occur in all tested eukaryotes. However, this process has not been studied in *Giardia lamblia*, which is thought to be the earliest-diverging eukaryote. To create gene constructs to test for the monoubiquitylation of histone H2B, histone H2B was amplified from Giardial genomic DNA. Antibody tags were attached to the gene through PCR primer design. After cloning the gene it was ligated into pNMyb, a plasmid containing a Giardial promoter and origin of replication. Subsequently the plasmid was introduced into *G. lamblia* through electroporation. Western blotting, RT-PCR, and Immunoflourescence assays have indicated low levels of HA-tagged H2B. The expression vector is being remade, and *G. lamblia* will be transfected with the new expression vector.

CHEMISTRY

Nickel-Mediated Decarbonylative Cross-Coupling of Cyclic Imides with Diorganozinc Reagents

Jessica M. Simmons and Valerie J. Winton
Mentor: Dr. Jeffrey B. Johnson
Department of Chemistry

Previous study of a nickel-catalyzed reaction on cyclic anhydrides demonstrated that desymmetrization of these compounds can be achieved with an $Ni(COD)_2$ bipyridyl system with diorgano zinc reagents to form β-ketoacids (*J. Am. Chem. Soc.* **2002**, *124*, 174-175). This poster outlines the study of a similar reaction on cyclic imides. Instead of forming β-ketoamides as predicted by this previous study, reaction of *N*-phenyl phthalimide with stoichiometric $Ni(COD)_2$ in the presence of Et_2Zn results in a decarbonylation followed by alkylation producing *o*-ethyl benzanilides. In addition to substitution on the nitrogen of the phthalimide, this reaction has been expanded to the use of diaryl zinc compounds synthesized *in situ*, along with commercially available diethyl and diphenyl zinc. The recent focus of this project has been to explore the substrate scope in the decarbonylative alkylation/arylation methodology. The scope of these aryl groups has grown to include *o*-, *m*-, and *p*- substituted aryl rings, di- and tri- substituted aryl rings, and substitutions containing electron withdrawing and electron donating groups.

This research was supported in part by the Camille and Henry Dreyfus Foundation.

Acetyl Analogs of the Anticancer Agent Combretastatin A4: Synthesis and Biological Evaluation

Robert Sjoholm, Megan Lee, Lauren Lee, Raymond Strobel, Olivia Brockway and Alexis Nickols
Mentors: Drs. Moses Lee, Greg Fraley, Balaji Babu, Dereje Desta and Sameer Chavda
Departments of Biology and Chemistry

Combretastatin A4 (CA-4) is a powerful agent that causes microtubule depolymerization in cells and is known to possess potent cytotoxic activity against the growth of cancer cells in culture. Due to its poor solubility in water, a phosphate-containing prodrug was developed, and it is presently undergoing phase II/III clinical trials for human cancer treatment. In this study, twenty new and theoretically more water-soluble acetyl analogs of CA-4 were designed and synthesized. Molecular modeling and single crystal x-ray crystallography studies showed that the acetyl-analogs have the same twisted conformation as the lead compound, CA-4. Cytotoxicity studies indicated that three analogs were particularly active, and a cell-based assay indicated that at least one of those has the same mechanism (microtubule depolymerization) as CA-4. Finally, *in vivo* mice studies demonstrated that the acetyl analog most similar to CA-4 demonstrated significant antitumor activity without showing any toxicity to healthy animals.

The authors thank Conjura Pharm, LLC, and The Arnold and Mabel Beckman Foundation (RS) for support.

CHEMISTRY

New GC/MS and Potentiostat and Their Application to Photochrome Research

Kyndra B. Sluiter, Jonathan P. Moerdyk and Amy L. Speelman
Mentor: Dr. Jason G. Gillmore
Department of Chemistry

Photoinduced charge transfer (PICT) is a useful means of generating organic ion radicals. Cation radicals generated by PICT have relevance in a variety of applications of materials science interest, including new approaches to volume holographic data storage and 3D microfabrication. However, a limitation to the use of PICT-initiated cation radical reactions is the persistence of photooxidant in the material subsequent to completion of the desired reaction. For instance, in data storage, this prohibits the use of the writing laser to read out the data without a "fixing" step that may alter the material. We are therefore attempting to develop a reversible "pro-photooxidant" system to gate sensitivity to PICT, in essence only having a photooxidant present when it is desired.

Organic photochromes have long been used to "gate" optical properties, specifically color (absorbance)—in essence, Transitions® lenses "gate" the presence of sunglasses. The increase in conjugation that underlies the change in absorbance upon isomerization of a photochrome also has significant impact on electronic properties. This phenomenon has received much less attention. Our group's emphasis continues to be on controlling and utilizing these electrochemical changes which occur concurrently with the photochromic rearrangement's shift in absorbance to create "photochromic photooxidants," in which one isomer of the photochrome is a good photooxidant while the other isomer is not.

An NSF CAREER grant was recently awarded to our group, enabling us to purchase new instrumentation. Two Agilent 6890 GC/FID's were upgraded, as was an Agilent 6890 GC with a 5973 MSD. A new Agilent 7890 GC with 5975C MSD was also purchased. A new potentiostat system was purchased from BASi, as well. Their application to our photochromic photooxidant research program will be discussed. In particular, results indicating differential electrochromic vs. photochromic ring opening of quinazolinespirohexadienones will be described.

This material is based upon work supported by the National Science Foundation under grant CHE-0952768 and by the Hope College Chemistry Department Undergraduate Research Fund.

CHEMISTRY

A Mechanistic Inquiry into Rhodium-Catalyzed C-C Single Bond Activation in Quinolinyl Ketones

Susan M. Stevenson
Mentor: Dr. Jeffrey B. Johnson
Department of Chemistry

Carbon-carbon single bonds are highly stable and inert under most reaction conditions but can be made to break and form using a rhodium catalyst. The purpose of this research project is to determine the mechanism for the rhodium-catalyzed activation of C-C single bonds in quinolinyl ketones with appended alkenes (*JACS*, **2009**, *131*, 412). Competition reactions were run between differentially substituted quinolinyl ketones to see how the substrate affected the reaction rate. Using $\{RhCl(C_2H_4)_2\}_2$, it was observed that differing the alkene substrate changed the reaction rate greatly, while substitution around the benzene ring had a much smaller effect. From these results, we were able to narrow down where the rate-limiting step of the proposed mechanism occurred. These results are in contrast, however, to the results obtained using $RhCl(PPh_3)_3$, suggesting different mechanistic behaviors for these two rhodium catalysts.

This work is supported by the Research Corporation.

Determining DNA Binding Selectivity and Affinity of the Tetraamide Phenyl Imidazole Pyrrole Imidazole

Samuel Tzou and Olivia Brockway
Mentors: Drs. Moses Lee, Balaji Babu and Sameer Chavda
Department of Chemistry

DNA minor groove sequence binding polyamides consist of Imidazole (Im) and Pyrrole (P) recognition units. The polyamide f-IPI [f (formyl), Im (imidazole) and Py (pyrrole)] is known to have the greatest binding affinity and selectivity among all formyl-triamides. Targeting the DNA sequence 5'-ACGCGT-3', the polyamide has a binding affinity of 10^8 M^{-1}. While studies have shown P-IPI shows better binding selectivity for one turn of the minor groove (10 base pairs), this tetraamide is not synthetically favorable. This paper reports the binding selectivity and affinity testing of the tetraamide Ph-IPI, a tetraamide with a phenyl group acting as a substitute for pyrrole in the tetraamide P-IPI. Ph-IPI's binding affinity to its cognate sequence 5'-ACGCGT-3' was compared to the related formyl-triamides and tetraamides binding to four non-cognate sequences. We have studied the biophysical/characteristics of Ph-IPI utilizing thermal denaturation (T_M), circular dichroism (CD) and isothermal titration microcalorimetry (ITC). In addition, further biological/biophysical characterization in progress includes the use of DNA footprinting and surface plasmon resonance (SPR) performed by research collaborators to determine the tetraamide's DNA binding selectivity and affinity.

The authors thank NSF for support.

CHEMISTRY

The Stereoselective Addition of a Gilman Reagent to an α,ß-Unsaturated Ester

David P. Todd and Thomas B. D. Endean
Mentor: Dr. Jeffrey Johnson
Department of Chemistry

The addition of a Gilman reagent to an α,ß-unsaturated ester is normally a non-stereoselective process. When a methyl-substituted Gilman reagent reacts with an α,ß-unsaturated ester, it adds to either face of the alkene, giving two enantiomers. In the reaction reported by Kuwahara (*J. Org. Chem.* **2008**, *73*, 6913-6915), the addition of a Gilman reagent to an α,ß-unsaturated ester with a pendant alkene showed a complete stereoselectivity that Kuwahara explains using the Felkin-Anh Model. The complete stereoselectivity is unusual for Felkin-Anh, suggesting that other factors are involved, such as an intermediate where the copper ion of the Gilman reagent complexes with the two alkenes. To test this hypothesis, we have synthesized a saturated analog of the precedent compound for comparison of stereoselectivities in the Gilman reaction.

This work is supported in part by Eli Lilly.

CHEMISTRY

Use of Site-Directed Mutagenesis to Examine Structure-function Properties of VACM-1/Cul5

David Grossens
Mentor: Dr. Maria Burnatowska-Hledin
Department of Chemistry

The expression of the VACM-1/Cul5 gene decreases cellular growth. Factors that regulate expression of VACM-1 have not been studied. VACM-1 sequence analysis revealed a putative binding site for peptide hormone vasopressin (AVP). Further, we have reported that AVP binds to VACM-1 but its effects on cell proliferation have not been studied. The purpose of this research was to study whether the mutation in the binding site for AVP in VACM-1 sequence will affect ifs function. Site-directed mutagenesis in the proposed AVP-binding region (R212A) was performed and COS-1 cells were stably transfected with the R212AVACM-1 mutant. Cells expressing mutated VACM-1 were selected using an antibiotic and cell growth, structure, and morphology were monitored. Cells were visually analyzed by phase contrast while protein localization within the cell was monitored through fluorescence microscopy using immunocytochemistry. To date we have successfully isolated a cell line expressing the mutated construct of VACM-1. The studies examining its effect on growth are in progress.

Mutation Analysis of VACM-1/cul5 Exons in T47D Cancer Cell Line

Angelica Willis, Steven Lewis, Alyssa Johnson and James Resau
Mentor: Dr. Maria Burnatowska-Hledin
Department of Chemistry

The VACM-1 protein is a cul-5 gene product which functions via an E3 ligase complex and has an antiproliferative effect on many cell types. Structure-function analysis of the VACM-1/cul5 protein sequence identified consensus sites specific for phosphorylation by protein kinases PKA and PKC and a Nedd8 modification site. We showed previously that mutation in the PKAspecific phosphorylation site at Serine 730 reverses the phenotype and negates the antiproliferative effect of VACM-1/cul5. This effect was associated with the appearance of larger Mr species when Western blots were probed with anti-VACM-1 specific antibody. Since T47D breast cancer cells express a modified form of the VACM-1/cul5 protein, we hypothesized that this modified form results from mutations at one of the sites described above. We used genomic DNA and mRNA isolation methods to amplify both genomic DNA and mRNA through PCR and RT-PCR, respectively. We have sequenced the genomic DNA of the VACM-1/cul5 gene in four cancer cell lines. Our work suggests that VACM-1/cul5 is modified posttranslationally in T47D cancer cells.

COMPUTER SCIENCE

The Model SEED Plug-In for Viewing and Editing Metabolic Models

Benjamin Bockstege and Nicholas Hazekamp
Mentor: Dr. Matthew DeJongh
Department of Computer Science

The goal of our research is to develop a plug-in for Cytoscape that will be used in tandem with the Model SEED Viewer to help biologists better understand and visualize the metabolic pathways of bacteria. The Model SEED is an online resource at www.theseed.org/models that provides biologists with a static, but very detailed view of metabolic models. It uses KEGG (www.genome.jp) metabolic pathway maps which cannot be edited by users. This ability to edit metabolic pathways is one of our primary focuses in creating the plug-in—in particular, adding, removing, and moving reaction and compound nodes. Additionally, we want to fully integrate the plug-in with the Model SEED, including the ability to link back to the Model SEED via hyperlinks and laying out the model's maps as they are seen in the Model SEED viewer so that the user may easily recognize them and quickly find what they are looking for. To get the KEGG representation of these maps, we use the KGML reader for Cytoscape, in addition to some of our own code, to read KGML files containing the positions of each node and edge of the map. Another priority has been to limit the amount of information displayed to the user to just those compounds and reactions represented in the current organism's metabolic model. Lastly, we have worked to implement a large variety of features aimed at improving the plug-in's user friendliness, such as loading and saving of user-defined metabolic pathway map layouts, showing the user which nodes are connected to a node and whether or not they are in the current map, and a large number of smaller additions that work to simplify navigation and the appearance of the user interface.

This material is based upon work supported by the National Science Foundation under grant No. MCB-0745100.

Testing Security Measures on Android Devices

Daniel Lee
Mentor: Dr. Michael Jipping
Department of Computer Science

Security on desktop computers has had much work done; security on smartphone or handheld devices still needs investigation. This project sought to test the boundaries of security on Android 2.1 systems. The phone systems were tested by attempting to load Trojan horses on them, by click-jacking them, and by taking control of them without the user's knowledge or permission. We also investigated systems that can be used to attack Android devices. These included simple cross-scripting and network management tools.

This work is supported by the IOMAXIS company.

COMPUTER SCIENCE

Lente: Stretching the Limits of Handheld Devices

Erik Westenbroek and Allison Hamann
Mentor: Dr. Michael Jipping
Department of Computer Science

There are approximately 400 million people in the world suffering from the challenges of visual impairment. There are 5 billion mobile phones in use in the world. This project worked to take advantage of this unique opportunity: to provide for computing assistance for visual impairment on a computing platform already accessible by many in the developing countries…the mobile phone. This project built software called "Lente" to use the technology of mobile phones to assist those with low vision. By making this technology work on phones already in use, this project seeks to provide this type of the assistance to those in developing countries free-of-charge, so that those that might not otherwise afford such technology would have access to it. This software was designed for and implemented on a Nokia N900 smartphone.

This work is supported by the National Science Foundation Research Experience for Undergraduates program.

Graph Games: A Human Computing Game Framework

Ryan Alfuth, Matt Jara, Jeff Largent, and Dan Simpson
Mentor: Dr. Charles Cusack
Department of Computer Science

Graph Games is a suite of online casual games that make use of human computation to help solve several NP-complete graph problems. These problems are very difficult for computers to solve efficiently because they rapidly become computationally infeasible as their size increases. However, humans possess intelligent decision-making abilities that computers do not, so they can solve these problems more resourcefully than computers.

Graph Games seeks to harness these abilities to increase the body of knowledge about solving NP-complete problems by presenting problems in the form of puzzle-like games. *Graph Games* currently consists of three families of games, each being comprised of several types of puzzles based on related problems. *Pebble It* helps solve graph pebbling problems. Graph pebbling problems involve the placement and/or movement of resources (called pebbles) under certain constraints. *Power Graph* puzzles are based on the vertex cover and dominating set problems. These problems require finding minimal subsets of the vertices of the graph that are adjacent to all edges or vertices in the graph. In these puzzles, players must activate as few power stations as possible to provide energy to an entire power grid. Finally, *Portal Lord* is based on the problem of graph bandwidth. In this game, players must build stabilizers on portals and assign addresses to them in such a way that the addresses of adjacent nodes are as close together as possible. We believe that by using this platform, ordinary gamers will contribute valuable insights to researchers working to solve NP-complete problems.

This work was supported by the National Science Foundation Research Experience for Undergraduates Program grant No. 0851293.

ENGINEERING

An Empirical Correction for Determining SRK and PR Vapor Pressures

Jonathan Boldt
Mentor: Dr. Michael Misovich
Department of Engineering

The Soave-Redlich-Kwong (SRK) and Peng-Robinson (PR) equations of state are commonly used methods for estimating vapor pressure of pure substances at any temperature, typically by a fugacity-based numerical algorithm. Recent work shows that a simple expression derived from a low temperature and pressure limit gives results within 35% of a standard fugacity algorithm for reduced temperatures below approximately 0.8. An empirical correction term for this simple expression was determined in this project, allowing estimation of vapor pressure with less than 0.1 percent deviation from the result given by a fugacity-based algorithm. Another empirical method was developed to estimate vapor pressure with similar accuracy for temperatures up to the critical point. Both empirical corrections were functions of a single variable combining temperature and acentric factor. Using these approaches, SRK and PR vapor pressures were accurately estimated at any temperature by a simple, non-iterative calculation.

This material is based upon work supported by Hope College and the Hope College Engineering Department.

Response of Plate Structures to Close-Range Blast Loading

Benjamin Barkel and Benjamin Bjerke
Mentor: Dr. Roger Veldman
Department of Engineering

Since 2008, the Department of Homeland Security has been investigating the failure patterns of thin aluminum structures from close-range blasts (<10in). In order to improve Finite Element models, a parametric study of various simulation techniques using LS-DYNA was done and the results compared to physical testing data from the Aberdeen Test Center. Variations included element sizes, use of solid versus shell elements, variably concentrated mesh densities, and plastic-kinematic versus Johnson-Cook material models. While results were reasonably close to physical data, the study showed an overall lack of sensitivity to these changes, suggesting a purely Lagrangian simulation method may not be as ideal for this type of analysis as a coupled fluid-structure interaction model such as Arbitrary Lagrangian Eulerian (ALE).

This material is based upon work supported by the United States Department of Homeland Security.

ENGINEERING

Stress Analysis of Artificial Shoulder Joints

Christian Calyore
Mentor: Dr. Roger Veldman
Department of Engineering

The best design for an artificial shoulder joint is not fully known, so the objective of this project was to determine the best design of the socket portion of the shoulder, know as the glenoid, through the comparison of several different design parameters. These parameters included the glenoid's radius of curvature, as well as the glenoid's method of fixation. This comparison was done through the use of the commercial software program ANSYS, which used finite element analysis to simulate the effects of various forces on the different glenoid designs. The results from the FEA were analyzed to determine stresses and deformations in each glenoid arising from the predetermined load positions and load values. These load values included forces on the shoulder typically expected from everyday activities along with some extreme load situations. The results indicated that having a larger radius of curvature glenoid and insetting the glenoid in the bone presented the least amount of stress and deformation due to any applied load.

This material is based upon work supported by Shoulder Innovations, LLC and Transcorp, Inc.

Design and Implementation of an 8-Tetrahedral Robot

James Dratz and Cornelius Smits
Mentor: Dr. Miguel Abrahantes
Department of Engineering

In recent years, NASA has been exploring the possibility of using tetrahedral- (TET) shaped robots to improve or replace existing Mars wheeled units. The current project NASA is undertaking is the implementation of a 12-TET design. As part of this effort, Hope College has researched, for several years, modeling and implementing more simple designs for a solid fundamental understanding of how these types of robots behave. As of this point, Hope's research group has modeled and built the 4-TET prototype and has created a computer model for a more advanced 8-TET configuration. From computer models, it was determined that the 8-TET will be able to roll smoothly instead of tumbling, and the strut extension rations needed to roll were much less extreme than other designs. This summer, the 8-TET was implemented by incorporating power antennas as the extendable struts and used PWM for motor control. Thenodes were machined from aluminum and attached to the struts using eyebolts. Each outer node also contained a ball-and-socket, connected to a pyramid-shaped foot, which prevented any binding during the robot's gait. The combination of these innovations and the 8-TET design make this the most advanced rover built by Hope College for this research group.

This material is based upon work supported by a grant from MSGC and the Hope College Engineering Department.

ENGINEERING

Refining Finite Element Analysis Material Models Through Dynamic Testing

Eric Dulmes
Mentor: Dr. Roger Veldman
Department of Engineering

The results of Finite Element Analysis (FEA) rely on the material model used in the computations. Current material models are mostly based on quasi-static tensile testing. Because materials can behave differently at different strain rates, higher strain-rate situations require dynamically-tested material properties for an accurate result. Concurrent research projects require a way to test various materials at medium to high strain rates (>1000 s^{-1}). A compressed air cannon was constructed to perform G.I. Taylor's test of impacting cylinders against a rigid boundary. By measuring the plastic deformation of the cylinders after impact, the dynamic yield strength can be calculated and used in FEA models to predict deformation to an explosive blast. This air cannon is a good step toward measuring the yield strength of various materials, but more work needs to be done to refine the projectile's flight to attain repeatable, reliable results.

This material is based upon work supported by the United States Department of Homeland Security.

Developing a Standard Test Method for Overlap Shear Splices for Wet-Layup FRP Samples

Benjamin Fineout
Mentor: Dr. Jeffrey Brown
Department of Engineering

The objective of this research was to develop a standard test method for evaluating overlap splices in wet-layup FRP samples. Using Infrared-thermography IRT, high temperature variations during tests could indicate high stress levels, allowing IRT to be used as a potential analysis tool. Fiber-reinforced polymer (FRP) composites are commonly used to support civil structures that are in need of strengthening and support. Overlap splices become necessary when the span of rehabilitation is too large. Carbon fiber was used with Type A and B Tyfo® S Epoxy to develop overlap coupons that were applied to cyclic load tests. To analyze the temperature variation of the coupon samples, a FLIR® A325 infrared camera was used. The camera recorded 900-1800 frames at 30fps for each test. A sinusoidal curve was fitted to the temperature variations at a frequency of 1 Hz. This allowed the images to be developed into a single amplitude image using a Fourier transform. With the amplitude image, samples could be evaluated to determine where the high stresses occurred. Results showed that large temperature variation occurred at the kink of the overlap samples, indicating higher stress. In the future, more samples will be tested to support current results.

This material is based upon work supported by the Hope College Engineering Department.

ENGINEERING

Modeling Biological and Chemical Processes in Slow Sand Filtration

Tabatha Hipshear
Mentor: Dr. Michael Misovich
Department of Engineering

The goal of this project was to quantitatively model biological and chemical processes in Manz intermittently operated biosand water filters. Velocity within filter zones was successfully modeled by the Kozeny-Carman packed bed flow equation, accounting for resistance and permeability. Biological and chemical process models focused on steady-state cell growth, using the Monod equation with stoichiometric yield coefficients describing consumption of nutrients and oxygen and production of waste products. Difficulties were encountered in finding appropriate values of model parameters, since most biochemical process models focus on conversion of substrate to product at relatively high concentrations, whereas models for drinking water systems focus on addition of chemicals to minimize microorganism growth. Future work will include better estimation of model parameters, modeling of diffusion phenomena and of the biolayer as a separate phase, and unsteady-state modeling of intermittent operation used in practice.

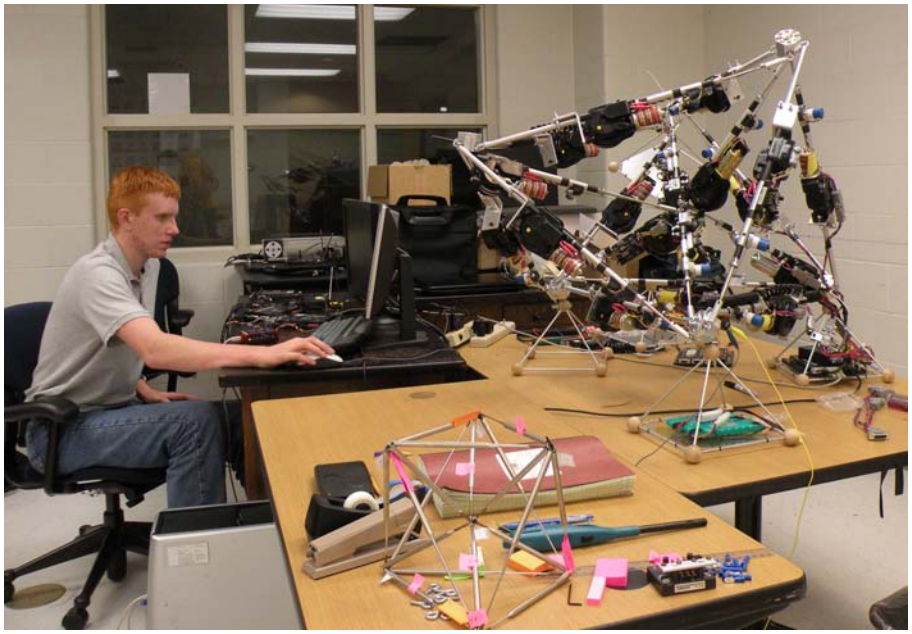
This material is based upon work supported by the Howard Hughes Medical Institute and the Hope College Department of Engineering.

Characterization of Truncation Error Using PRSV Series Method

Brett Kopinski
Mentor: Dr. Michael Misovich
Department of Engineering

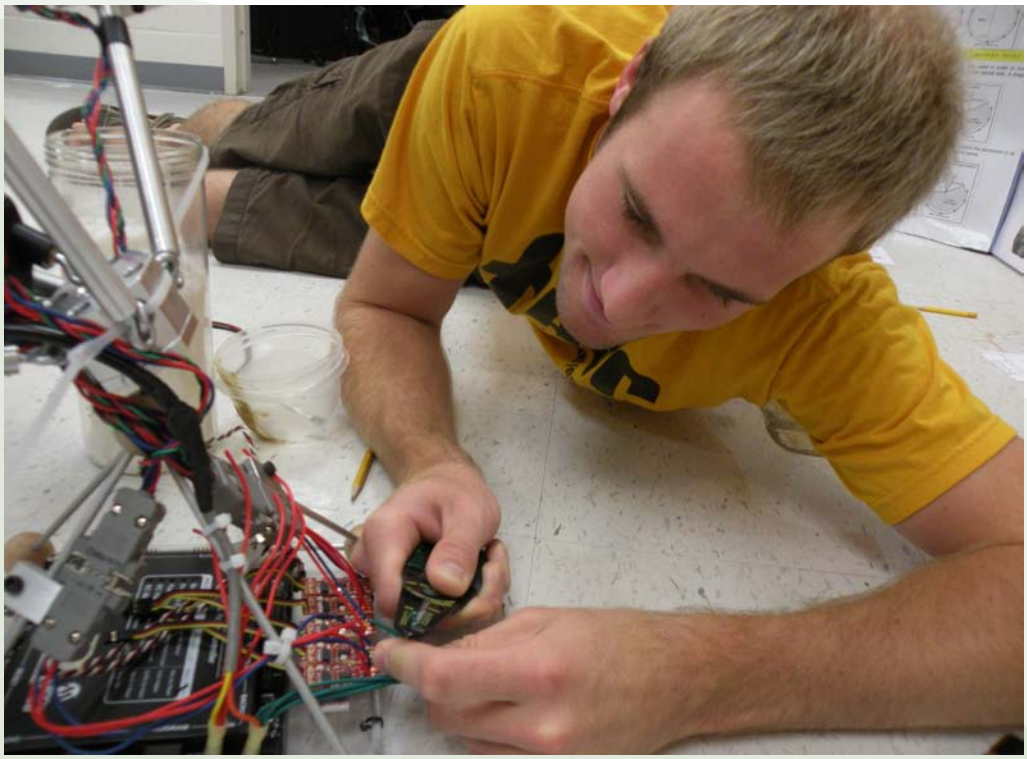
The Peng-Robinson-Stryjek-Vera equation (PRSV) is a versatile PVT equation of state (EOS) that can also be applied to determine equilibrium properties such as vapor pressure. Approximate results from a truncated series expansion method were compared to exact results from a numerical fugacity algorithm. Results were generated for reduced vapor pressure versus reduced temperature dependent upon the acentric factor parameter ω and an additional substance-specific parameter κ1. Plots of truncation error versus a reduced temperature expression were constructed to verify whether the truncation error function behaved as expected for a Taylor series expansion remainder term. Results were inconclusive, as certain tests showed the correct remainder term dependence but others did not. Future work is recommended to determine whether there is some inconsistency among the programs used to produce the exact and approximate solutions or whether the series coefficients themselves are incorrect.

This material is based upon work supported by Hope College and the Hope College Engineering Department.



Right: Cornelius Smits programming the controllers and calibrating the strut position sensors

Below: Jim Dratz wiring power cables to the PWM motor controllers for the 8-TET robot



GEOLOGICAL & ENVIRONMENTAL SCIENCE

Crossing the Moat: the REACH II Allegan County Bog Survey Project

Joshua Cooper
Mentors: Dr. Edward Hansen and Professor Suzanne DeVries-Zimmerman
Department of Geological and Environmental Sciences

The Research Experience Across Cultures at Hope (REACH) is a six-week summer program in which high school students and teachers work alongside undergraduate students and mentoring professors to conduct scientific research. The program's goal is to provide scientific research opportunities for area high school students and teachers, including members of underrepresented populations. This year, two pilot REACH II projects, a team-based research approach, were added to the program. One of these teams, consisting of four high school students, one high school teacher, and an undergraduate student, conducted a survey of bogs in Allegan County, Michigan. The goal of this project was to develop the stratigraphy and geologic history for four area bogs. The research group collected cores from each bog, then made and described smear slides at selected intervals along each core. The smear slide data were analyzed by the team to develop geologic histories and stratigraphic cross-sections for each of the sampled bogs. Lastly, each team member prepared a poster summarizing the results for one of the studied bogs and presented it at the final research celebration. The students stated that exposure to a real world research setting and interacting with other students and faculty members were among the most valuable aspects of the REACH program. They learned how to work as a team while overcoming the challenges and problems of fieldwork, and a close camaraderie developed within the group as a result of this fieldwork. Additionally, students said that they gained many new skills, including working with scientific instruments, developing a work ethic, and learning how to ask scientific questions and to read scientific papers. The hands-on experience of this research provided the participants with a valuable understanding of the scientific process from beginning to end.

This research was supported by funding from DTE Energy, the Howard Hughes Medical Institute, and Hope College.

GEOLOGICAL & ENVIRONMENTAL SCIENCE

Mineralogical, Textural, and Infiltration Capacity Analysis of Athletic Field Soils: a Metadisciplinary Study for Turf Management at Hope College

Katherine G. Garcia and Leah Marie Peterson
Mentor: Dr. Jonathan W. Peterson
Department of Geological and Environmental Sciences

Collaborative research occurs in many forms. While interdisciplinary projects are common, this presentation reports on a metadisciplinary collaboration at Hope College. Work involves horizontal integration of subject matter, generating data of interest to geologists, chemists, environmental scientists, and engineers. Research also involves horizontal and vertical integration of personnel with different educational experience and occupational roles. For example, a rising high school senior worked under the guidance of a rising college senior. Both students collaborated with an assistant professor and a full professor, as well as staff from the Grounds Department.

Healthy turf is an essential requirement for a safe and effective natural athletic field. Optimized irrigation is a necessary part of field management. To that end, the team collected and analyzed soil data including infiltration capacity, grain size distribution, fine particle distribution, mineralogy, and bulk adsorption behavior for pharmaceuticals and personal care products (PPCPs). Several techniques were used including soil boring, sieving, XRD, double-ring infiltrometer tests, laser particle counting, column and batch experiments, and subsequent LC/MS analysis of attendant solutions. The study included 10 different turf fields representing a range of manicuring.

Some results, for example, show that standard uniformity coefficients and porosities do not adequately predict infiltration capacity; but rather, particle size distribution of the very fine materials (<37μm), is more important to infiltration behavior. Also, preliminary XRD data indicate that specific mineralogical differences of the clay-size fraction between the most manicured and least manicured turfs may play a key role in PPCP transport.

This project is characterized by different outcomes for different end-users. Infiltration capacity and textural data are useful for the Grounds Department. As the use of treated wastewater for irrigation of turf areas becomes a reality, mineralogical adsorption data on PPCPs in soils will be essential for scientists and engineers engaged in environmental policy making.

This research was supported by the Hope College Grounds Department and the Department of Geological and Environmental Sciences (GES).

GEOLOGICAL & ENVIRONMENTAL SCIENCE

Fire History Reconstructed from Charcoal Abundance in a Peat Bog from Allegan County, Southwest Michigan

Dean Hazle
Mentors: Dr. Ed Hansen and Professor Suzanne DeVries-Zimmerman
Department of Geological and Environmental Sciences

Detailed analysis of paleoenvironmental proxies have been completed for a sediment core taken in Allegan County, Michigan. Data interpretation from organic-bulk density, sand concentrations, plant macrofossils, siliceous microfossils and charcoal abundances develop an understanding of local environmental and ecological change for ~13,500 YBP. Charcoal abundances are usually interpreted as an indication of frequency and intensity of wildfires. In the upper section of core, changes in siliceous microfossil patterns indicate a period of time when the center of the bog was above water level. While the center of the bog is emergent, there is a rough correlation between charcoal abundances and sand concentrations. The correlation suggests that both windblown sand into the bog and fires are influenced by some of the same environmental factors: possibly aridity. The lower section of core precedes emergence, and siliceous microfossil patterns indicate the bog was completely below water level. During this time, peaks in the charcoal record are spaced closer together, and sand concentrations are generally higher. Before, emergence material may have been washed into the bog by water as well as blown in by wind. Additional pathways for material into the bog may partially account for difference in sand and charcoal patterns.

This work was supported by the Michigan Space Grant Consortium Fellowship Program.

Caleb Nyboer and Rachel Medina surveying a steep, eroding dune surface July, 2010

GEOLOGICAL & ENVIRONMENTAL SCIENCE

An Assessment of 3D Computer Models of Sand Dune Surfaces Using Close Range Digital Photogrammetry

Rachel A. Medina and Caleb C. Nyboer
Mentor: Dr. Brian Bodenbender
Department of Geological and Environmental Sciences

We have been trying to determine the usefulness of close-range digital photogrammetry for building three-dimensional models of sand dune surfaces at scales from 5 to 100 meters. Sand dunes are ever-changing environments that show both strengths and weaknesses of digital photogrammetry. In gathering data to create three-dimensional models, we have found that limitations include the fact that sand dunes frequently look homogeneous at our scale of observation, providing few uniquely recognizable points needed to make models. Also, since photogrammetry is a line-of-sight method, foreground vegetation or topographic irregularities can obscure background features. Furthermore, photogrammetry works best with views normal to the surface being modeled, but 3-D dune modeling may be limited by relatively low angles, creating less-accurate models. Finally, the moving landscape requires extra effort to establish stationary control points for time series comparisons. Strengths include that points are measured remotely, in contrast to GPS and some laser survey methods, therefore leaving the surface undisturbed. Also, data gathering is more rapid than in laser survey methods, and compared to laser scanning, photogrammetry requires less and lighter equipment that is easier to hike through remote dune locations. Of the limitations, the homogeneity of dune surfaces at a distance appears to be the most serious difficulty. A future partial solution to the homogeneity of dunes is to place targets on the dune to improve the density of uniquely recognizable points. Collecting enough data at a high enough resolution to compare different time periods and storm events is difficult over large areas, but the method can still be useful to monitor changes in dune vegetation, or to measure sand movement in smaller views where individual sand grains provide distinct markers for matching points when making models.

GEOLOGICAL & ENVIRONMENTAL SCIENCE

Nanoparticle-enhanced Breakdown of Penicillin Antibiotic in Water: Implications for Fate of Drugs in the Environment

Laura J. Petrasky
Mentors: Drs. Jonathan W. Peterson and Michael D. Seymour
Departments of Geological & Environmental Sciences and Chemistry

Extensive use of pharmaceuticals in human and animal medicine has resulted in antibiotic contamination of natural waters. Nanoparticles (10^{-9} m) are found in natural soil-water environments and have the ability to adsorb contaminants due to the large surface to volume ratio. Though adsorption to nanosurfaces likely plays a significant role in reducing aqueous concentrations of drugs, nanoparticle-mediated degradation of organic compounds may also be a significant mechanism. This was investigated by exposing ampicillin (AMP), a common penicillin antibiotic, to nanoparticles of Fe_2O_3, TiO_2, Al_2O_3, and SiO_2 in separate timed batch experiments. AMP adsorption and degradation were measured by HPLC analysis of solutions and breakdown products were identified by LC/MS analysis.

Degradation of zwitterionic AMP (pKa_1 = 2.5, pKa_2 = 7.3) was observed in timed mixing experiments with 25nm- TiO_2 (anatase) at pH 6.2 over 48 hours. TiO_2 has a net positive surface charge at pH < 7.2 (pzc). Significant degradation of AMP (m/z = 350) was measured in mixed samples relative to controls, with initial parent AMP of 553 µmol/L dropping to 1 µmol/L within 48 hours. Decrease in AMP concentration was accompanied by an increase in the concentrations of two products, isomers of penicilloic acid (P1 and P2, at m/z = 368-369), likely formed by the hydrolysis of the beta-lactam ring of AMP. Formation of the P2 penicilloic acid isomer can be described by a logarithmic function of ln [P2] = 0.965 (ln(time)) + 5.02 (R^2 > 0.98). Comparison of adsorption isotherm and timed experiment data are in progress to quantify the actual extent of, and relationships between adsorption and degradation mechanisms. Similar trends were observed in experiments with nano-Fe_2O_3 and Al_2O_3, but no significant enhancement was observed in SiO_2 data experiments.

The research was funded in part by the NASA-Michigan Space Grant Consortium Seed Grant Program, Howard Hughes Medical Institute, the Hope College Department of Geological & Environmental Sciences, and the Hope College Chemistry Department. Many thanks to team members Nicholas Powers, Emily Van Wieren and Jeffrey Wilcox. Conversations with Kenneth Brown and Jason Gilmore were very helpful.

GEOLOGICAL & ENVIRONMENTAL SCIENCE

Experiments on the Adsorption of Pharmaceuticals and Personal Care Products (PPCPs) to Nano-Scale Oxides

Nicholas S. Powers
Mentors: Drs. Jeffrey D. Wilcox, Michael D. Seymour, and J.W. Peterson,
Dept. of Environmental Studies, University of North Carolina at Asheville, and
Departments of Chemistry and Geological & Environmental Sciences at Hope College

Pharmaceuticals and personal care products (PPCPs) have been detected in sediment-freshwater systems, where nanometer-size (10^{-9} m) oxides are important in contaminant transport. To investigate interactions between PPCPs and oxide nanoparticles (NPs), experiments were performed using six NPs (TiO_2, Fe_2O_3, MgO, SiO_2, Al_2O_3, and CaO) and seven PPCPs: salicylic acid, propanolol, carbamazepine, bisphenol-a, diclofenac, caffeine, and ibuprofen. Composite PPCP solutions (1-10ppm) were batched with 50 mg of each NP. Aqueous concentrations were determined by LC/MS after mixing, and sorption was quantified by comparison to control samples.

Results illustrate how sorption can be controlled by the surface charge of the NP and the overall charge on the PPCPs. Over the pH range investigated (~6-8), PPCPs are either cationic, neutral, or anionic, and the net surface charge of NPs depends on their PZC (point of zero charge; the pH value below which the NP has a net positive surface charge). For example, sorption of anionic ibuprofen and diclofenac to negatively-charged SiO_2 (PZC=2) was negligible (K_d <0.1 L/kg), while sorption coefficients for these compounds to positively-charged MgO (PZC=12) were 43±8 L/kg and 394±66 L/kg, respectively.

Results also demonstrate that compound charge and NP PZC are not the only parameters controlling sorption. For example, the cationic propanolol was the only compound with significant sorption to SiO_2 (K_d=10±6 L/kg), but its sorption to positively-charged MgO was greater (67±33 L/kg). Diclofenac was highly sorbed to Fe_2O_3 (PZC=~7; K_d=361±80 L/kg) and MgO (PZC=12; K_d=394±66 L/kg) compared to TiO_2 (PZC=7.2; K_d=4.4±0.7 L/kg), CaO (PZC=~8; K_d=9.5±1.0), and Al_2O_3 (PZC= 9.1; K_d=9.6±0.9). Bisphenol-A exhibited greater sorption to MgO (K_d=119±9 L/kg) than the other five NP (1.6 to 11 L/kg). Sorption coefficients for carbamazepine (<0.1 to 6.0 L/kg) and caffeine (0.6 to 2.9 L/kg) were consistent for all six NP. Future work will investigate nonlinear or competitive sorption, PPCP complexation, and NP aggregation.

This project was funded, in part, by the Howard Hughes Medical Institute, and the Hope College Departments of Chemistry, and Geological & Environmental Sciences. Thanks are in order to team members Laura Petrasky, Emily Van Wieren and Katherine Kerr.

GEOLOGICAL & ENVIRONMENTAL SCIENCE

Experiments on the Interactions Between a Fluoroquinolone Antibiotic and Nanometer-Size Soil Oxide Particles: Adsorption and Breakdown

Emily M. Van Wieren
Mentors: Drs. Michael D. Seymour and Jonathan W. Peterson
Departments of Chemistry and Geological and Environmental Sciences

Antibiotic contamination is a concern in soil-water systems because of the potential for promoting antibiotic resistance. Mobility of drugs may involve nanometer (nm)-size particles, so there is a need for data on both adsorption to nanoparticle surfaces and the fate of drugs after adsorption. To address this, batch experiments were done with ofloxacin (OFX), a common veterinary antibiotic, and nm-size particles of Al_2O_3, SiO_2, Fe_2O_3, and TiO_2. Sorption and breakdown were quantified and identified by HPLC and LC/MS analysis.

OFX sorption to Al_2O_3 generates linear isotherms of mass sorbed/mass nano vs. liquid concentration ($R^2 > .96$), with a K_d of 441 L/kg (± 35). OFX sorption to SiO_2, TiO_2 and Fe_2O_3 is logarithmic, such that: SiO_2 Ln K_f = 3.0 (± .52), n = .57 (± .10); TiO_2. Ln K_f = 8.6 (± 3.5), n = .82 (± .51); Fe_2O_3 Ln K_f = 5.5 (± 1.2), n = .89 (± .17). Maximum OFX sorbed was 10 mmol/kg to SiO_2, 370 mmol/kg to TiO_2, and 11 mmol/kg to Fe_2O_3. Substrates with sorbed OFX were rinsed with OFX-free solutions in desorption experiments to remove weakly-attached molecules. Results show ~ 7% of the OFX could be removed from Al_2O_3, 89% from SiO_2, < 1% from TiO_2, and 27% from Fe_2O_3. Smaller percentages indicate stronger adsorption mechanisms.

Breakdown of zwitterionic OFX was observed in 80-hour timed mixing experiments with 25nm-TiO_2. Decrease in OFX was accompanied by an increase in at least 2 product compounds. Mass spectral data suggest these breakdown reactions may involve the N-methyl, carbonyl, and carboxyl groups. Concentrations of the two products (m/z = 336-337 and m/z = 348-349) increase at a linear rate of ~ 1.5%/hr. Comparison of data from isotherm and timed experiments will quantify the amount of sorption vs. breakdown. Preliminary results from SiO_2, Fe_2O_3 and Al_2O_3 timed experiments indicate less breakdown of OFX compared to the effects of TiO_2.

The research was funded in part by the NASA-Michigan Space Grant Consortium Seed Grant Program, Howard Hughes Medical Institute, and the Hope College Departments of Geological and Environmental Sciences, and Chemistry. Many thanks to team members Laura Petrasky, Nicholas Powers, and Jeffrey Wilcox. Conversations with Kenneth Brown and Jason Gilmore were very helpful.

MATHEMATICS

Non-real Zeros of Derivatives of a Class of Real Entire Functions

Jessalyn Bolkema, David Gansen, Nathan Graber and Hannah Stanton
Mentors: Drs. Jennifer Halfpap, University of Montana, and Stephanie Edwards
Department of Mathematics

In 1943, G. Polya conjectured that the number of non-real zeros the kth derivative of a real entire function of order greater than 2, with finitely many non-real zeros, tends to infinity as k goes to infinity. This was verified in 2005 by A. Eremenko and W. Bergweiler. A natural extension is whether the number of non-real zeros of the kth derivative increases monotonically as k goes to infinity. We show that the number of non-real zeros of the kth derivative of a function f increases monotonically with differentiation when f(z)=z^me^{K(z)}, where m is a natural number and K is in one of several special classes of real polynomials.

Modeling Aeolian Sand Dune Morphology

Matthew Eiles, Daniel Waldo, Robert Nash, Diane Hyzer and Elizabeth Heines
Mentors: Drs. Timothy Pennings and Brian Yurk
Department of Mathematics

Saltation is the process by which wind transports sand grains over sand dunes, resulting in dune formation and migration. Numerous saltation models have been developed in the past, but few focus on the actual deposition of saltating sand grains on the front slope of a sand dune. We developed a model combining single grain trajectory functions with distribution models to describe this process and make predictions about the characteristics of the shape of deposition. Experimental techniques were devised to adequately verify this model's predicted power. These included applying surveying techniques to create three-dimensional topographic maps in MATLAB and engineering a sediment trap variation suited to dune terrain.

MATHEMATICS

Data-Driven Intervention: a Minor Tweak, a Major Revelation, Correcting Mathematic Students' Misconceptions, not Mistakes.

Lindsay Nieuwkoop
Mentor: Dr. Vicki-Lynn Holmes
Departments of Mathematics and Education

In a standard-based reform age where "research driven instruction" is the dictum of the day, this mixed-methods study investigated how Algebra I teachers analyzed and corrected student function family errors. Research reveals that by learning to correct mathematics students' misconceptions rather than their mistakes, teachers are able to target more students and increase their conceptual understanding of the topic at hand. This presentation highlights the results found from 36 Algebra I teachers' use of this pedagogical skill after a three-day workshop entitled "Teaching Algebra Concepts through Technology ($TACT^2$)." Pre and post Common/Habitual Algebra Student Misconceptions assessments were given to assess teachers' function family content knowledge and pedagogical content knowledge at the beginning and end of the workshop. These assessments were comprised of a series of example student problems that contained common function family misconceptions that (a) research showed students habitually made when working with linear and quadratic equations and interpreting exponential and polynomial graphs; and (b) aligned with the National Common Core Standards. The post tests revealed that the Algebra I teachers averaged a 43% improvement in their ability to identify the common misconception present in several students' example problems and in creating suitable interventions for that misconception. As one teacher commented, "A minor tweak resulted in a major revelation." A secondary, but no less important result from the workshop was a shift in the way we classify misconceptions. Two patterns of common misconception types emerged: computational (which is comprised of vocabulary), and computation; and conceptual errors of erroneous belief. In doing so, a new vein of pedagogical research emerged: matching Algebra teacher intervention to these types of misconceptions.

This material is based upon work supported by the Howard Hughes Medical Institute, Michigan Space Grant Consortium, The Carl Frost Center for Social Science Research, and Ottawa Area

NEUROSCIENCE

Resveratrol Ameliorates Brain Damage Induced By Surgical Cannulae: Potential For Treatment Of Parkinson's Disease

Julia Becker and Kelsey Castillo
Mentors: Drs. Gregory Fraley and German Torres (New York College of Osteopathic Medicine)
Neuroscience Program

During advanced-stage Parkinson's disease (PD), many patients resort to deep brain stimulation (DBS), a treatment in which electrodes are implanted into the brain. Even though this treatment has proven highly effective for many PD patients, the main side effects are due to a 1 mm3 area of cell death around the electrode. The lesions are due to the physical presence of the electrodes and eventually lead to an ineffectiveness of DBS to ameliorate the signs of PD. Resveratrol (RESV), a plant derivative and antioxidant found in grape skins (specifically in red wine), has shown to have protective effects against cellular degeneration. We previously found that RESV has neuroprotective effects to prevent brain lesions associated with the physical presence of cannulas in the brains of rats. Because of RESV's estrogenic structure, we decided to test the non-classical estrogen receptor GPR30 as a possible mechanism of action of RESV. We used estriol, a known antagonist for GPR30. Peripheral treatments of RESV, RESV/estriol, and blank capsules were implanted prior to surgery. All animals received a unilateral cannula into the subthalamic nucleus (STN), which is the target site in humans undergoing DBS. A rotorod test was used to quantify motor coordination following injections. All rats that received blank or RESV/estriol treatments showed significant ($p < 0.01$) motor-deficits post-surgery. Neuronal damage was assessed using Nissl stain, GFAP immunocytochemistry (to measure gliosis), and Fluoro-Jade stain for neuronal degeneration. Histology demonstrated that estriol inhibited the neuroprotective effects of RESV. The control and RESV/estriol treatments showed increased gliosis, necrosis, and neuronal degeneration compared to RESV treatment. Qualitative assessments suggest that RESV-treatment attenuated all of these effects, thus preventing much of the damage associated with cannula placement. Our studies suggest that resveratrol may have neuroprotective effects, and that it may in fact be acting through the GPR30 receptor.

NEUROSCIENCE

System x_c^- is Regulated by Multiple Mechanisms in U-138 MG Cells

Christina Bowles and Annalise Almdale
Mentor: Dr. Leah Chase
Departments of Biology, Chemistry and Neuroscience

System x_c^- is a transporter located on the plasma membrane of many cell types, including glioma cells, neurons, fibroblasts, activated macrophages, microglia, and vascular endothelial cells. This transporter is thought to be involved in alleviating oxidative stress in those cell types. An important question that had remained unanswered has been the time course of System x_c^- activation and subsequent localization to the membrane of the cell following exposure to hydrogen peroxide. Through experiments such as biotinylations and cystine uptake assays, a time course of approximately two hours has been proposed, in which System x_c^- is trafficked to the membrane and remains there for nearly two hours following hydrogen peroxide exposure. In the process of completing these experiments, a new mechanism of regulation of System x_c^- was discovered. We demonstrated that washing the cells with new media causes a nearly ten-fold increase in transporter activity, without a change in membrane localization. We hypothesize that the activity of the transporter may be influenced by the glutathione concentration of the cell. Further study is ongoing to understand this novel mechanism of regulation of System x_c^-.

This material is based upon work supported by the NSF under grant No. RUI-0843564.

Oxidative Stress Causes Modifications and Decreased Function of System x_c^-

Matt Hartwell
Mentor: Dr. Leah Chase
Departments of Biology, Chemistry and Neuroscience

Oxidative stress represents an imbalance between the production of reactive oxygen species, and their removal by antioxidants. System x_c^- is a plasma membrane transport system that exchanges intracellular glutamate for extracellular cystine, a precursor to cysteine, the limiting reagent for glutathione production. As glutathione is an endogeneous antioxidant, system x_c^- plays a role in combating oxidative stress. Previously, our lab has observed using western blot analysis that a fraction of xCT shifts to a higher molecular weight form after hydrogen peroxide exposure. As hydrogen peroxide produces free radicals, we believe xCT is oxidized, therefore decreasing its function. Two methods are being taken to observe oxidation, biochemical strategies in our lab and mass spectroscopy done at Michigan State. Biochemical strategies include DNPH assays to detect the presence of carbonyls after oxidative stress. Results indicate that xCT is oxidized. In addition to oxidation, proteins may also be glutathionylated on cysteine residues and/or form high molecular weight multimers as a result of cross-linking by reactive cyteine residues. Mass spectroscopy will help identify specific locations of oxidation. Once targets are identified, a combination of site-directed mutagenesis and mass spectroscopy will be used to identify critical residues that are modified post oxidative stress.

This material is based upon work supported by the NSF under grant No. RUI-0843564 and HHMI Research Scholars Program.

NEUROSCIENCE

Real Time Analysis of System x_c^- Trafficking in U138MG cells

Cassie Cramer and Anne Georges
Mentor: Dr. Leah Chase
Departments of Neuroscience, Biology and Chemistry

The membrane transporter System x_c^- catalyzes the exchange of cystine and glutamate across the membrane of many cell types. As such, this transporter plays significant roles in controlling intracellular cysteine levels and ultimately, the synthesis of glutathione and regulating extracellular levels of glutamate, the primary excitatory neurotransmitter in various areas of the brain. Previous studies in our lab have demonstrated that hydrogen peroxide (whether added exogenously or produced endogenously) regulates the trafficking of System x_c^- to the plasma in cultured human glioma cells (U138MG) or PC 2 cells, and that this process is responsible for maintenance of glutathione levels under conditions of oxidative stress. The objective of this study was to develop an inherently fluorescent form of System x_c^- (GFP-xCT chimera), so that we can study the trafficking of the transporter in response to oxidants in real time. The xCT-GFP construct was prepared previously by Matthew Wixson in the lab, and we developed the transfection protocol to express this protein in U138MG cells. Using this technique, we were able to achieve a 10-15% transfection rate. We are currently in the process of developing a stable cell line expressing the GFP-xCT construct and completing the necessary controls to confirm that the chimeric protein traffics to the plasma membrane in response to hydrogen peroxide like the wild-type transporter. Once these controls have been completed, we will begin our real-time analysis of xCT trafficking.

This material is based upon work supported by the NSF under grant No. RUI-0843564.

NEUROSCIENCE

Inducing Schizophrenia-like Symptoms in Rats

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The hypo-NMDA receptor function hypothesis for schizophrenia is a model that is currently receiving considerable attention. This hypothesis states that decreased NMDA receptor activity in GABAergic interneurons leads to disinhibition of multiple neuronal pathways within the central nervous system, including the corticolimbic pathway. If NMDA receptor function on inhibitory neurons (GABAergic) diminishes, this leads to decreased GABA release and improper signaling in downstream neurons. This process is proposed to lead to the behaviors associated with schizophrenia. The primary objective of this pilot research project was to determine if ablation of GABAergic interneurons (via bilateral intracerebroventricular (i.c.v.) injection of the neurotoxin and NMDA receptor agonist homocysteic acid) in the brain of rats leads to a schizophrenia-like phenotype. To test this hypothesis, ten Sprague Dawley rats were injected with HCA (6 mg) in each lateral ventricle, and ten rats were injected with the same volume of CSF in both ventricles. Following injection, the rats were assessed for their spatial learning ability (Morris Water Maze), motor function (rotorod), hedonistic-like/reward-seeking behavior (saccharine preference test), risk-taking behavior (open field test and elevated plus maze), and social behavior (social interaction test) several times over the course of 5 months. We have demonstrated that HCA treatment leads to changes in social interaction such that the HCA treated animals spend more time interacting with the same rat that has been introduced several times compared to control rats. In addition, HCA treatment leads to a reduction in pleasure-seeking behavior, specifically HCA-treated animals drink less sucrose solution than control rats. Finally, HCA rats fall off the rotorod more frequently than control rats. These behaviors are consistent with a schizophrenia phenotype demonstrated in NMDA-receptor knock-down mice. Since HCA is endogenous within the brain, these data suggest further studies of its effect on behavior should be completed.

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NEUROSCIENCE

Long Term Effects of the Administration of Quisqualic Acid into the Substantia Nigra of Rats

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Previous *in vitro* studies in rat hippocampal slices have demonstrated that the non-NMDA receptor and mGluR agonist, quisqualic acid (QUIS), causes sensitization of pyramidal cell neurons which persists for hours following the removal of QUIS from the extracellular medium. This effect is not blocked by antagonists of either non-NMDA receptors but is blocked by non-transportable inhibitors of the cystine/glutamate exchanger, System x_c^-. Based on these studies, we hypothesized that QUIS may trigger a slowly developing neurodegeneration. In this study, QUIS and/or *S*-4-carboxyphenylglycine (CPG), a non-transportable inhibitor of system x_c^-, was injected into the substantia nigra of rats. The rats' motor performance, anxiety, and spatial learning were tested for 25 weeks post-injection. QUIS injections into the substantia nigra led to changes in performance in the Morris Water Maze five months following injection. QUIS-treated rats traveled a greater distance and took longer to find a hidden platform than did rats not treated with QUIS. However, there were no other motor effects observed as a result of QUIS treatment. QUIS had no effect on performance on the Rotarod task or the hanging wire task. There also was no reliable effect of QUIS on gate or risk taking behavior. These results indicate that central administration of QUIS into the substantia nigra has minimal effects on the behavior of rats. Previous studies in which QUIS was injected into the hippocampus led to changes in spatial learning ability, as predicted, five months following QUIS injection. However, the results from the substantia nigra-injected rats suggest there may be fewer neurons in this region of the brain, unlike the hippocampus, which are susceptible to QUIS excitotoxicity.

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NEUROSCIENCE

β-Integrins Traffic with System x_c^- in Confluent and Non-confluent Cultures of Human Glioma (U138MG) Cells

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Department of Neuroscience

System x_c^- is a plasma membrane transport system that is comprised of two proteins, xCT and 4F2HC. The transporter catalyzes the exchange of cystine and glutamate across the membrane glia and some neurons. Previous research in the Chase lab demonstrated that differences in basal transporter activity in confluent and non-confluent cultured human glioma (U138-MG) cells are a result of differential membrane localization of xCT. We hypothesized that the changes in membrane localization of the transporter is mediated by its association with cell-surface adhesion molecules β1-integrins, as one of the protein components of System x_c^-, 4F2HC, forms a dimer with b1-integrins. Specifically, we hypothesized that the decrease in transporter activity observed with increased cell density is a result of internalization of a 4F2HC: xCT: β1-integrin complex. To test this hypothesis, we measured relative membrane expression and internalization of xCT, CD98, and β-integrin in cultures that were 95% confluent compared with cultures that were 50% confluent. We first confirmed that xCT and 4F2HC form complexes with β1-Integrins in both confluent and non-confluent cultures. In addition, we confirmed that the localization of β1-Integrins on the plasma membrane decreases with increased cell culture density. We also explored the functional implications of these findings. We hypothesized that the differences in membrane trafficking of System x_c^- in confluent and non-confluent cultures would result in a difference in theirsusceptibility to H_2O_2 –mediated damage. Using a trypan blue cell death assay, we demonstrated that confluent cultures were less susceptible to H_2O_2 –mediated cell death in comparison to non-confluent cell cultures ($p < 0.01$). These data provide further evidence that the trafficking of System x_c^- plays an important role in the acute antioxidant defense pathway of glioma cells.

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NEUROSCIENCE

Activation of System x_c^- Trafficking Via an Akt-dependent Signal Transduction Pathway

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System x_c^- is a heterodimeric plasma membrane transporter involved in the exchange of intracellular glutamate for extracellular cystine—a critical step in the production of the antioxidant glutathione. Previous studies in our lab have demonstrated that within ten minutes of exposure to H_2O_2, the percent of xCT protein localized to the plasma membrane of cells increases. The study described herein sought to establish a link between a putative "oxidative-stress activation" of Akt and trafficking of System x_c^-. To date, the role of Akt in mediating xCT trafficking has not been confirmed, due primarily to a lack of experimental replicates. Activation of Akt was seen in U138MG cells following ten-minute exposure to 3mM H_2O_2, and cells treated with the Akt inhibitor 10-DEBC (2.5μM) showed decreased phosphorylation of Akt at Ser473. Similar inhibition of Akt phosphorylation at Thr308 was observed following treatment of cells with 1.0μM API-2. Stimulation of cell cultures with H_2O_2 following one-hour exposure to 10-DEBC did not result in increased phosphorylation of Akt at Ser473, but similar treatment of cells with H_2O_2 following exposure to API-2 did show increased levels of phosphorylation at Thr308. These results indicate that 10-DEBC might be a more effective inhibitor of Akt activation in response to oxidative stress than API-2. Future experiments will seek to confirm the putative role of Akt in the activation of System x_c^- trafficking during periods of oxidative stress.

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NURSING

Exercise, Cardiac Rehabilitation Participation, and Their Relationship with Hopelessness and Depression in Individuals with Cardiac Disease

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Department of Nursing

State and trait hopelessness describes acute hopelessness experienced by coronary heart disease patients in response to a sudden heart event, or a chronic tendency for hopelessness present for years. Hopelessness is associated with an increased risk of fatal and non-fatal CHD. The purpose of this study is to describe the frequency and severity of hopelessness (state and trait) and depression over time, and the relationship of state and trait hopelessness and depression to exercise level and participation in a hospital-based CR program. The project is based on Abramson's Theory of Hopelessness Depression. The research design is non-experimental and descriptive. The survey includes demographic data and a questionnaire assessing state and trait hopelessness testing, CR exercise participation, activity status index and patient health. Select participants completed the Beck Hopelessness Scale. A convenient sample of 500 participants was taken from a large West Michigan hospital. Participants were identified based on the diagnosis of myocardial infarction, unstable angina, coronary artery angioplasty, stent, bypass surgery, or cardiac valve surgery. Participant hopelessness, depression, and exercise adherence was monitored for a year after discharge with three follow-up periods at 3 months, 8 months, and one year. Data analysis includes descriptive, correlation, and t-test statistics using SPSS software. Conclusions and results are pending. Limitations include one hospital site for data collection and a convenient sample, decreasing generalizability. Implications may lead to future research of interventions to prevent, decrease, or resolve hopelessness.

NURSING

Acculturation and Childhood Obesity Within the Latino Population

Mallory Fox
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Department of Nursing

The prevalence of childhood overweight and obesity has reached epidemic proportions and affects the Latino population more than any other ethnic group in the United States. The Latino paradox gives explanation to the fact that Latinos' health tends to worsen after immigration to the United States. The purpose of this study was to gain a better understanding of acculturation within the Mexican-American population and its effect on childhood obesity. This study followed the theoretical framework of Virginia Henderson, which addresses the importance of nurses helping individuals in performing activities that lead to better health. Literature review of several nursing and professional journals was conducted with extensive focus on questions asked, possible factors, and tools used. This literature review yielded nine articles. To date, literature review has revealed that those considered less acculturated have a greater risk of becoming overweight or obese. The tool being used to measure acculturation throughout the previous research is the Acculturation Rating Scale for Mexican Americans (ARSMA-II). Limitations to previous studies revealed that authors have looked only at adults and not at children. An implication related to practice is that only nine articles reviewed thus far have been done on Latino children. Research questions thus far have examined contributing factors that may increase the risk of childhood obesity within the Latino population. A potential research question that could be explored is what affect acculturation has on the increasing rate of childhood obesity within the Latino population in order to help nurses educate and prevent this growing epidemic.

Michelle Zeitter '11
in the Hope College
Nursing Skills Lab

NURSING

Relationship of Childhood Body Mass Index and Parent's Activity Preferences

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Departments of Psychology and Nursing

Little nursing research has been done on the relationship between a child's health and activity preferences of his/her parents. As childhood obesity is a growing problem in the United States, the purpose of this research is to study the relationship between a child's Body Mass Index (BMI) and their parent's activity preferences. Pender's (1987) Health Model was used to explore this relationship. Activity preference surveys, established by Jane Leary (2008) and adapted by Trent-Brown, et al. (2010), were returned by the parents of 38 West Michigan area preschoolers (ages 3-5.5), selected through a convenience sample. Children were measured and weighed at the preschool sites. From this data the child's BMI by age percentile was calculated. The parent surveys, available in Spanish and English, established whether a parent was sedentary or active in their pastimes. Statistical analyses on PASW-17 included bivariate correlations and multivariate analysis of variance. It was found that when a father preferred physical activities, the child was increasingly likely to have an elevated BMI [$r(28)=.445$, $p=.014$, $r^2=.198$]. The highest mean maternal BMI measures were positively correlated with the obese classification for child participants [$r(34)=.382$, $p=.022$, $r^2=.146$]. Limitations of this project include the survey nature of the parent test, which is subject to biases, the lack of knowledge about the children's nutritional habits, and the nonrandomized selection process. Implications of these results are applicable for nursing education programs with young children and to promote a higher level of activity among parents and schools with young children, helping to increase a child's activity level.

NURSING

Avoiding the Next "Great Plague"

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Illness outbreaks on college campuses are common occurrences that affect a large number of students populating those campuses. These outbreaks, if not controlled adequately, can become a public health issue affecting large numbers of students and eventually members of the community. The focus of this research is to gain a better understanding of the thoughts and feelings students had concerning their health safety and perceived control of the situation during a specific outbreak in the fall of 2008 on the campus of a small mid-western college. The study is based on the nursing framework of Florence Nightingale and her theory that utilizes environmental changes to provide care. This qualitative project will be carried out in the form of focus groups of 6-10 participants. Discussion will take place in a "conversation friendly" setting and be led by a peer to the participants. A student recorder will note what the participants say as well as their body language and tone to better understand their perceptions of the event. Data will be analyzed using qualitative methods to discover emerging themes. Results and conclusions are pending. The study is limited in that subjects were from only one college campus and were limited to only those students that were actually on campus during the outbreak. The future implication for this study is to develop a protocol for college campuses to use that may potentially decrease the number of students affected by future outbreaks on campus, as well as members within the neighboring communities.

The Impact of Consistent and Accurate Wound Care Documentation on Home Health Care Outcomes and Appropriate Reimbursement

Lindsay Zeller
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Department of Nursing

Wound care continues to be among the most prevalent and costly services provided by home healthcare agencies. Consistent and accurate documentation of wound care is essential in demonstrating patient progress and in receiving appropriate reimbursement from insurance companies. The framework for this study is based on Patricia Benner's Novice to Expert Model. The purpose of this study is to examine the consistency of current wound care documentation practices by a small home healthcare agency in western Michigan. Using retrospective chart review, this descriptive, longitudinal study examines the consistency of specific aspects of wound care, including consistent photographs, measurements, and appropriate naming of the wounds. The sample included 14 clients with surgically-dehisced wounds receiving in-home wound care, and the data was analyzed using PASW 17.0. The results of the study found that wound care documentation was most consistent in the categories of measurements and photographs being taken. The findings of this study reinforce the importance and value of consistent wound care documentation. Limitations of the study include a small sample size and a narrow focus, including only clients with surgical wound dehiscence. Consistent documentation among home health nurses is critical to ensure optimal patient outcomes and to receive necessary reimbursement for the services provided.

NURSING

Comparison of Teaching Methods on the Use of Incentive Spirometry in Pediatric Trauma Patients

Laura Nyitray
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Department of Nursing

Incentive spirometry is a common nursing intervention taught to patients. Little information exists regarding incentive spirometry or best methods to provide this teaching to pediatric patients. The purpose of this study is to compare the usual method (one-on-one verbal) for teaching hospitalized pediatric trauma patients how to use their incentive spirometers to one-on-one verbal teaching supplemented by the use of a videotape/CD-ROM (alternate method). Betty Neuman's Systems Theory focuses nursing care on helping the client stay stable through use of prevention measures. This experimental, randomized, controlled study seeks to promote incentive spirometry to prevent respiratory complications by comparing patient education techniques. Dependent variables are compliance with incentive spirometry use and inspiratory capacity. A random sample will consist of 78 pediatric trauma patients between the ages of 5 and 17 in a large, Midwestern children's hospital. Data will be entered into an Excel spreadsheet and uploaded into PASW-17. Statistical tests will include descriptive statistics and t-tests. Results and conclusions are pending. Current limitations are that not all participants completed the full 48 hours due to early discharge and researchers did not reassess client performance as stated in the protocol. Specific implications for nursing depend on results. The results will hopefully provide nurses with evidence on education strategies that maximize pediatric patient learning in regards to incentive spirometry.

Nursing students Grace Olamijulo, Nicole Bennett and Jeana Longoria in the Hope College Nursing Skills Lab

NURSING

Evaluation of Health Literacy Screening Questions for Use in the Acute Care Setting

Anna Nieboer
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Department of Nursing

Despite advances in medical treatment, patients continue to experience poor health outcomes due to limited health literacy. Nurses have an obligation to ensure patient understanding but often lack the tools to accurately assess their patient's level of health literacy. The purpose of this research project is to identify valid, reliable, and feasible health literacy screening questions for use in the acute care setting. It is based on the Health Literacy Framework (Institute of Medicine, 2004) which proposes that health literacy acts as the mediator between individuals and health contexts. The prospective, descriptive study will evaluate the reliability of three health literacy assessment questions when compared to the Newest Vital Sign and the Short Test of Functional Health Literacy in Adults, which have both been deemed valid and reliable tools to assess health literacy. Data collection will involve the administration of all three assessment tools to each subject at one point in time. The study will recruit 300 selected adult, English speaking inpatients at a level 1 hospital in West Michigan. A kappa statistic will be used in SPSS to determine if there is a relationship between the scoring of the health literacy assessment questions, NVS, and S-TOFHLA. Results and conclusions are pending for the project. A potential limitation of the study may be subject withdrawal before data collection is complete. Future implications for nursing practice include improved health assessment tools and identification of individual patient education needs in the acute care setting.

Heather Fuglseth
working in the Hope College
Nursing Skills Lab

NURSING

Effects of a Preschool Intervention Using Nature-based Activities on Children's Self–Efficacy and Preferences for Outdoor Activity: How Activity Preferences Relates to Childhood Body Mass Index

Amanda Schab
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Departments of Psychology and Nursing

Childhood obesity has become a growing problem in the United States. According to the Center for Disease Control, obesity rates for children ages 6-11 have increased. This problem may lead to other health complications that could threaten the overall quality of life of young individuals. The major concern of this epidemic is what can be done to promote better lifestyle habits. This controlled study (N=155) examined preschool-aged children (ages 3-5) and the relationship between activity preference (outdoor vs. indoor) and Body Mass Index (BMI). The comparison is designed to determine whether preference for indoor or outdoor activity correlates with Body Mass Index. The body mass index will be reported as normal, overweight, or obese by percentiles for age. Pender's (1987) Health Promotion Model provided the framework for this study. Data was collected at preschools in the Holland/Zeeland, Michigan area by measuring height and weight of children, as well as administering a modified version of Janie Leary's (2008) Activity Preference instrument, adapted by Trent-Brown, et al. (2010). Statistical analysis included multivariate analysis of variance and bi-variate correlational analysis. Results showed significant relationships between increased activity preference and height ($p=.029$), as well as trending for weight ($p=.054$). Other findings that showed trends were that between women and increased BMI ($p=.062$). Limitations of the study include language barriers, regional specificity due to examining a small geographical area, and child understanding of the testing procedures. Results show that increased physical activity should be encouraged in smaller children as well as young girls.

NURSING

Laying the Foundation for a Nursing Research Partnership Between a University in Querétaro, Mexico and a College in West Michigan, United States

Grace B. Olamijulo
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Department of Nursing

There is an increased need for nursing practice to be adapted to fit the needs of a globalized society. For nurses to effectively practice in a global society, they must possess competency in cultural care and research. It is therefore important to explore how nursing schools can strengthen cultural competency and research skills of undergraduate students. The establishment of an international collaborative nursing research program was proposed in order to meet this goal. The purpose of this investigation was to examine the potential for forming a collaborative nursing research program between a large university in Querétaro, Mexico and a small liberal arts college in west Michigan. Using a descriptive qualitative design, data was collected through interviews, focus group sessions, and clinical observations in Querétaro, Mexico and west Michigan. The perceptions of ten nursing professors, nine nursing students, and four practicing nurses were acquired during data collection. Responses were collected until saturation was met and then categorized into five themes. The meanings of the themes were extracted and then described. Findings revealed that the identification of a common research topic of interest between both schools of nursing would be helpful in developing a collaborative nursing research program. A program proposal focusing on a research topic of common interest was then created. This study confirmed a common interest in a collaborative research program by nursing faculty and students at the university in Querétaro and the college in west Michigan. Other commonalities between the two nursing schools were identified in addition to potential challenges to forming a collaborative research program. Limitations to the study included differences in technological capabilities of the two campuses, language barriers, and some cultural differences.

NURSING

Happiest Baby on the Block: A Descriptive Study

Kristin Stefan
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Department of Nursing

Crying is very common among infants but should not last for extended periods of time. Inconsolable crying is very stressful for parents and is one of the leading causes of shaken baby syndrome and other child abuse. The purpose of this study it to evaluate the efficacy of The Happiest Baby (THB) program to help reduce parent stress and inconsolable infant crying through the use of calming strategies. The nursing framework that shaped this study was Kolcaba's comfort theory. Her theory focuses on the importance of nursing interventions to enhance comfort in patients of all ages in order to produce better overall outcomes. This study is a retrospective, descriptive study of parental response to THB nursing interventions. The convenience sample size is 25 babies and their parents who have been referred for a fussy baby consultation in the clinical setting. Results and conclusions for this study are pending. The use of one agency for this project and the lack of time allotted for educating the staff at the clinic about this project are limitations of this study. More research is needed to assess the effectiveness of calming techniques and the change in length and frequency of the infant's crying following implementation of these interventions.

Effective/Efficient Scheduling Processes for Private Duty Care

Margaret Jipping
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Department of Nursing

The effective scheduling of home health nurses and aides has always been a difficult task. The natural ebb and flow of patients due to recovery, requiring more care such as a nursing home, or even death, makes scheduling of hours for nurses and aides a complicated assignment. The purpose of this research is to investigate whether other agencies have developed a system that satisfies health care workers while maintaining a consistently high standard of care. The framework of this research is based on the structural contingency theory. Anticipated data will be collected through phone interview with agency directors. The study will be descriptive, including open-ended and closed-ended questions, and the anticipated data will be analyzed using PAWS 17.0. Five agencies in the western Michigan area will be invited to participate. Results and conclusions of this study are pending. Limitations of the project include a small sample size and a lack of geographical diversity. The topic of scheduling is often paired with factors that are meaningful to private duty workers and their satisfaction level; this study will provide useful information about worker retention and satisfaction.

NURSING

Duration of Breastfeeding After Discharge from a Midwestern United States Community Hospital

Bethany VanderLaan
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Department of Nursing

Breastfeeding has been shown to provide a number of health benefits for infants and their mothers. The longer an infant continues to breastfeed, the longer these benefits last. Since there are national breastfeeding duration goals set by *Healthy People 2020*, it is the desire of outstanding healthcare facilities to meet these goals. The purposes of this study were to evaluate breastfeeding duration, compare local statistics to national standards, and determine barriers causing early cessation of breastfeeding at a Midwestern community hospital. The framework utilized for this study was Nola Pender's Health Promotion Model because of its recognition of the many different types of influences and perceived benefits/barriers involved with promoting optimal health of the patient. The study was descriptive and retrospective in design and involved data collected via written patient questionnaires. Participants included women ages 18 and older who gave birth between March 1, 2008 and February 28, 2009 in a Midwestern community hospital and were listed as breastfeeding upon discharge. This convenience sample included 403 women, which was a 34.4% return rate. Results and conclusions are currently pending. Data will be analyzed using SPSS software for descriptive statistics and correlations. Limitations of the project include convenience sampling, biased return of surveys, biased recall of information from 6-12 months prior, and only one hospital included. The implications of the results will include staff adaptation towards increasing the duration of breastfeeding after patient discharge.

NURSING

Demographic Factors and Differences in Physical Functioning Levels in Patients with Coronary Heart Disease

Amanda Meekhof
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Nursing Department

Physical functioning levels can vary among patients with coronary heart disease (CHD) based on a number of demographic variables. Physical functioning capacity prior to hospitalization can affect participation in cardiac rehabilitation following a CHD even. The purpose of this study was to examine which demographic factors are correlated with higher levels of physical functioning in patients who experienced a CHD event. The conceptual framework used was Parse's Human Becoming Theory because it explains that all parts of a human (in this case demographic variables) affect the human's behavior and development. The study was a non-experimental,descriptive research design. The Duke Activity Status Index questionnaire was used to measure physical functioning and a demographic questionnaire developed for the study was used to measure demographic variables. The target sample was 30 patients from two cardiac units at a large Western Michigan hospital. Patients were enrolled during the months of November and December 2010. Patients included in this study were age 21 years or older and had a diagnosis of myocardial infarction; unstable angina; or coronary artery angioplasty, stent, or bypass surgery. Data will be analyzed using descriptive statistics, correlations and independent t-tests in PASW statistical software. Statistical analyses will focus on mean physical functioning levels among different demographic groups. Results and conclusions are pending. A study limitation is that data collection occurred at only one hospital, limiting generalizability of results. Findings may increase nurses' understanding of physical functioning in patients with CHD and could help nurses better promote physical activity in this population.

Professor Vicki Voskuil with nursing students Lauren Dice and Amanda Meekhof performing a physical assessment

NURSING

The West Michigan New Graduate Nursing Practice Readiness Assessment

Nicole Spagnuolo
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Department of Nursing

Transition for a new graduate of nursing school into the work setting can be challenging. Research has shown that hospital leaders perceive new graduates' inexperience leads to a gap in nursing competencies such as critical thinking, prioritization and adjustment to workload. The purpose of this descriptive study is to confirm those competency areas by replicating the Nursing Executive Study (nationally based) in West Michigan new graduates. Patricia Benner's Novice to Expert is the framework used as a foundation for this study because nurses develop their skills and ability to provide optimal care over time. An electronic survey was sent out to 370 new graduates, nurse preceptors, educators and managers located throughout four hospitals. Qualitative data was collected through focus groups. Data was analyzed for patterns and frequencies to rank the West Michigan results with the Nursing Executive Study. Results and conclusions are pending. A limitation of the study was a lack of participation in the new graduate focus group and unequal representation among units. In the future, this study suggests specific areas the academic curriculum and hospital orientation can address to promote development of the less proficient clinical competencies in new graduates. This will help create a smoother transition for new graduates throughout their first year of work.

Evaluating Nurses' Perceptions on the Effectiveness and Usefulness of the Pediatric Pressure Ulcer Risk Assessment Tool (PURAT)

Allison Reynolds
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Department of Nursing

Though often contrary to popular belief, the hospitalized pediatric population is at risk of acquiring pressure-related injuries similar to those of the adult population. The purpose of this study is to determine how nurses perceive the effectiveness and usefulness of the Pediatric Pressure Ulcer Risk Assessment Tool (PURAT). The desire to determine the effectiveness of the assessment tool is founded on the work of Dr. Nola Pender, who, in her health promotion model, stressed the importance of viewing health as not only the treatment of disease but also the promotion of a client's overall wellbeing as a direct effect of nurses' actions. This project is a quantitative and qualitative, non-experimental, cross-sectional survey of the 219 registered nurses on the impatient pediatric floors at a Level I pediatric hospital. Descriptive statistics and correlations of data using PASW-17 will be conducted to determine the relationships between the data collected. Specific results and conclusions of these data are pending. Limitations of this study include a low survey response rate, the lack of attention to the nurses' experience, and the bias of self-report. Through the conclusions made from these surveys, the PURAT will be modified to better suit the needs of nurses and to improve the overall effectiveness of the tool at preventing pressure-related injuries in the pediatric population.

NURSING

Evaluation of Complications Post Peripheral Vascular Intervention at Site of Femoral Arteriotomy Using Manual Pressure with Surface Pad vs. Intra-Arterial Closure Devices

Janette Zandstra
Mentors: Dr. Paulette Chaponniere, Kara Heck, BSN, RN-BC and Adam March BSN, RN, CCRN (Holland Hospital)
Department of Nursing

The site of femoral arteriotomy post peripheral vascular intervention has the potential to develop many complications. In order to prevent complications, such as bleeding, manual pressure is applied by the nurse above the femoral site. The purpose of this study is to determine whether manual pressure with a surface pad or an intra-arterial closure device produces better outcomes post peripheral vascular intervention at the femoral site. Betty Neuman's Systems Model was selected for this project since the stressors that the client encounters before the peripheral vascular accident, such as co-morbidities or as a result of the peripheral vascular intervention, can affect the effectiveness of manual pressure or intra-arterial devices. The project is a descriptive, non-experimental, retrospective study of a convenience sample of 23 patients undergoing a peripheral vascular intervention in a small community hospital in Western Michigan. Data was collected using the ICU/TU/Cath Lab Data Collection Tool, which looks at multiple contributions to complications post sheath removal. The results were analyzed using PASW Statistics 17.0, with tests including frequencies, means, and correlations. This study found that there was a significant relationship between the use of manual pressure and the occurrence of a post-procedure re-bleed. No other significant relationships were found between the closure method used and the development of complications. The limitations for this study include multiple researchers collecting data at many different times and incomplete documentation of data. This project has the potential to introduce new nursing interventions that may prevent complications post femoral sheath removal. More research may need to be done using a more ethnically-diverse sample in order to determine if the results encompass all ethnicities.

PHYSICS

Characterizing the Present-Day Spatial Distribution of Nearby Neutron Stars

Caleb Billman
Mentor: Dr. Peter Gonthier
Department of Physics

We developed a model describing the present-day spatial distribution of nearby neutron stars as part of a larger project aimed at replacing our Monte Carlo-based pulsar simulation with one implementing the Maximum Likelihood Method. This new program will enable us to produce confidence regions on the parameter space of a model of the population statistics of radio and gamma-ray pulsars, which we will use to study different high energy emission beam geometry and luminosity models. Our project supports the team efforts of NASA's Fermi Gamma-ray Space Telescope, launched in 2008, which has discovered about 80 new gamma-ray pulsars and almost 2000 new radio pulsars. We assume in our Monte Carlo program a recently improved surface density distribution of neutron stars born in the Galaxy with an empirical supernova kick-velocity model. Using Monte Carlo techniques, we seed the Galaxy assuming a constant birth rate during the past billion years, and evolve the neutron star trajectories from their birth location to present. Having generated a large sample of simulated neutron stars within 12 kiloparsecs from the sun, we explore spatial distribution models using nonlinear least squares fitting procedures. We present some preliminary results from our efforts this past summer, and our future plans to characterize the likelihood function to be maximized.

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Ion Beam Analysis of Metalloprotein Stoichiometry

Andrew McCubbin
Mentors: Drs. Paul DeYoung and Graham Peaslee
Department of Physics

Particle Induced X-ray Emission (PIXE) spectroscopy is a non-destructive ion beam analysis technique well suited to determine the concentrations of heavy elements. Particle elastic scattering analysis (PESA) is a similar technique which measures the areal density of a thin target by quantifying the energy loss of the transmitted ions. A combination of PESA and PIXE has been developed to provide a quantitative technique for the determination of stoichiometric metal ion ratios in metalloproteins. About a third of all proteins are metalloproteins, and most do not have known stoichiometric compositions for the metals they contain. Current work focuses on establishing a standard method in which to prepare protein samples. Two methods of preparation are currently being investigated. The first involves spotting protein solutions on aluminized polyethylene terephthalate and allowing them to dry. The second uses the process of native polyacrylamide gel electrophoresis in order to separate proteins, and then drying them to provide adequately thin samples. These methods are compared for several proteins to determine their respective effectiveness and to develop a standard model for running ion beam analysis of metalloproteins.

This material is based upon work supported by the Howard Hughes Medical Institute and by the National Science Foundation under NSF-PHY Grant No. 0969058.

PHYSICS

Process for Die Attach and Electronic Testing of High Temperature Superconducting Chips

V. Andrew Bunnell
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Department of Physics

A procedure for the attachment of superconducting electronic chip devices to their housing was needed for experiments on the nonlinear response of superconducting devices to high frequency currents. Candidate methods include atmospheric gas low temperature indium soldering, inert gas indium soldering, and conductive epoxy film. All three processes were developed using visual quality and procedural complexity as the basis for judging process quality. Epoxy film is the simplest and resulted in the most uniform attachment. Low temperature solder is more complicated, especially in an inert gas, but the chips are re-usable and may experience less contamination. Currently, evaluation is focusing on device performance. To evaluate the electrical performance of attached chips, nonlinearity is induced inside the passband of $Tl_2Ba_2CaCu_2O_8$ and $YBa_2Cu_3O_7$ superconducting resonators. Nonlinear emission is stimulated locally in the vicinity of a probe by off-resonance, low frequency signals. By mixing of two very low frequency local currents and of one current in the passband, second and third order intermodulation distortion is generated around the resonant frequency, permitting the quantitative determination of the currents associated with each order of nonlinearity. This technique is also being used to perform spatially resolved nonlinearity studies, to examine the effect of doping on nonlinearity in $Tl_2Ba_2CaCu_2O_8$, and to search for a correlation between lithographic edge quality and second and third order nonlinearity.

This material is based upon work supported by the National Science Foundation under NSF-REU Grant No. PHY/DMR-1004811, a Cottrell College Science Award from the Research Corporation, and an R&D contract from Mesaplexx, pty, ltd.

PHYSICS

Doping Dependent Microwave Nonlinearity of Tl2Ba2CaCu2O8-x Superconductor

Candace Goodson
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Department of Physics

The carrier doping of the $Tl_2Ba_2CaCu_2O_{8-x}$ superconductor is a potential tool for modifying the nonlinearity of the superconductor's microwave response. The properties that respond to carrier doping level include the surface resistance (R_s) and the critical temperature (T_c) of the superconductor. Nitrogen annealing was used to modify carrier doping, and its effect on the samples was studied by using a sapphire/superconducting dielectric resonator to measure R_s and T_c. The influence of the induced surface current on surface resistance, R_s, called nonlinearity, was found to depend on the doping level, as was the critical temperature, T_c. This, in turn, provides a useful correlation of doping level to the temperature of the nitrogen anneal. Nitrogen annealing has thus been shown to provide a calibrated method to select a nonlinearity regime of the superconductor. A series of nitrogen anneals were also performed with 15 samples to show the effects of annealing on the T_c. Samples that had been annealed in nitrogen at 250°C, 300°C, 350°C, 375°C, and 400°C, as well as three unannealed samples, were tested. Those that were unannealed were then annealed and re-tested at different temperatures, resulting in 18 unique measurements. The average T_c was taken from the three samples at each temperature. N_2 annealing was found to decrease the T_c, however, 250°C resulted in almost no change in T_c. 300°C resulted in a variety of changes ranging from a small decrease to no change. Significant changes became evident when the annealing temperature exceeded 300°C. Because nitrogen annealing has been found to change the doping level as shown by the T_c shift, it can then be concluded that nonlinearity depends on the doping level and can also be controlled through doping.

Material is based upon work supported by the National Science Foundation under NSF-REU Grant No. PHY-0452206, a grant from Michigan Space Grant Consortium, and support from Mesaplexx, Ltd, Pty. of Eight Mile Plains, QLD, Australia.

PHYSICS

Development of the Exact Relativistic Compton Scattering Cross Section in Strong Magnetic Fields

Caitlin Taylor
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Department of Physics

Resonant Compton scattering with relativistic electrons in the strong magnetic fields is an efficient mechanism to explain the recently discovered rapid rise above 10 keV in the X-ray spectra of Anomalous X-ray Pulsars (AXPs) and Soft Gamma-ray Repeaters (SGRs). Currently, the scattering cross section being used within the community incorporates the relativistic effects of strong magnetic fields with the average relativistic width of the resonance. This average width does not provide an accurate depiction of the scattering as it ignores the spin effects present in the virtual intermediate state. The current cross section displays the magnetic suppression of the cross section below the Thomson limit. Our team has recently suggested the development of an exact QED cross section that incorporates the spin dependence of resonance width with the correct treatment using the required Sokolov & Ternov basis states, as shown in Baring, Gonthier and Harding (2007). In addition to numerical checks, this project explores these spin effects both near and far from resonance. This correct and exact treatment will be cast in compact and accurate analytical expressions for the astrophysics community to utilize. In addition, we will develop the specific analytics for the resonant scattering as well as asymptotic forms. The objective is to develop numerical methods to support collaborators at Rice University, and eventually, the development of a Monte Carlo simulation code to describe the full magnetospheric scattering that produce the spectra observed in AXPs and SGRs. The expressions developed support data collected by various observatories, including RXTE, INTEGRAL, XMM and BeppoSAX.

This material is based upon work supported by the National Science Foundation under NSF-REU Grant No. PHY/DMR-1004811, and by Physics Department endowed funds including the Guess Fund.

PHYSICS

A Study of the Uniformity of NiFe Electrodeposition on a Au Substrate

Daniel McNeel
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Department of Physics

The layered deposition of magnetic metals on non-magnetic metals creates materials with giant magnetoresistance. Controlled electrodeposition may produce these materials more easily and affordably than current techniques. This research used three different techniques to analyze our control over the deposition process for NiFe alloys. The three techniques were: current data during deposition, the Scanning Electron Microscope (SEM) at Hope College, and the Atomic Force Microscope (AFM) at Calvin College. The effects of varying the initial potential and the deposition time were studied. The effects of using an initial potential of 0 mV versus an open circuit initial potential were studied using current data and SEM images. Electrochemical data showed that the deposit varied more due to change in solution than due to the variation in initial potential. The effects of changing the duration of deposition were studied using SEM and AFM. SEM images were used for visual comparisons of sample uniformity. The AFM data were analyzed for height scaling properties.

Material based upon work supported by the National Science Foundation under Grant Nos. REU-PHY/DMR-1004811, and MRI-0959282, Hope College Dean for the Natural and Applied Sciences, and Hope College Physics Department Frissel Fund.

Construction of the Large multi-Institutional Scintillator Array

Tim Nagi
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Department of Physics

The Large multi-Institutional Scintillator Array (LISA) was constructed in the summer of 2010. LISA will be used to detect neutrons in the range of 0-100 MeV at the National Superconducting Cyclotron Laboratory (NSCL) in combination with the Modular Neutron Array (MoNA) and sweeper dipole superconducting magnet. With only MoNA, there is low detection efficiency when decay energy is greater than 1.5 MeV, and one of the improvements that LISA will grant is more efficient detection of neutrons from decays of greater energies, allowing new physics to be explored. LISA modules consist of a photomultiplier tube (PMT) and voltage divider assembly to both ends of 2 meter organic plastic scintillator acrylic bars. Nine different institutions each constructed sixteen bars, resulting in a total of 144 bars that together make up LISA. Undergraduates at each of these institutions will be conducting small scale experiments with their bars before shipping them to the NSCL in January.

This material is based upon work supported by the National Science Foundation under grant No. PHY0922794.

PHYSICS

PIXE Spectroscopy for Lake Macatawa Watershed Sediment Characterization

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Departments of Chemistry and Physics

This research project focuses on the non-point source sedimentation and hypereutrophication problems plaguing Lake Macatawa. Excess nutrients, such as phosphates and the sediment particles to which they are attached, flow into the lake from the surrounding watershed, increasing both the lake's turbidity and its nutrient imbalance. The goal of this study is to identify sediment signatures representative of unique locations within the watershed by analyzing the elemental composition of the sediment that is present in the Lake Macatawa watershed. This analysis would aid in the determination of sediment provenance, and effectively allow for the modeling of this non-point source pollution as multiple point sources of the sediments and their adsorbed nutrients. This is accomplished partly by characterizing dried, homogenized sediment samples by Particle Induced X-Ray Emission (PIXE) spectrometry. A method has been developed to measure 18 different elemental concentrations in sediment samples collected from a variety of sampling sites. These concentrations are compared site to site and rain event to rain event to find trends in the changes of concentrations of the metals that will help characterize the sediment source. When the sediment elemental composition is compared with other analytical methods such as phosphate analysis, the ability to discriminate between different locations is enhanced.

This work supported by the National Science Foundation under NSF-REU PHY/DMR-1004811 and the National Science Foundation under NSF-RUI PHY0969058.

Analysis of Data from Neutron Detectors

Eric Lunderberg
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Accurate simulation of 1-100 MeV neutrons is essential for interpretation of data taken from scintillator arrays such as the Modular Neutron Array (MoNA). Since neutrons are uncharged, they interact with MoNA only in nucleon-nucleon scattering, and are indirectly detected by the presence of charged byproducts of these interactions. The neutron retains a portion of its initial energy and can therefore interact elsewhere in the detector. These multiple detections make it difficult to determine the number of neutrons present in MoNA, and must therefore be reproduced with simulation to interpret data from MoNA. Geant4, a high-energy physics simulation, is capable of simulating the passage of particles through matter, but is designed for energies of several GeV and must therefore be modified to model accurately the actions of neutrons in this lower energy regime.

This material is based upon work supported by the National Science Foundation under Grant No. PHY0969058.

PHYSICS

Trace Elements of Honey Using PIXE

Sarah Prill
Mentors: Drs. Paul DeYoung and Graham Peaslee
Department of Physics

Honeybees only travel about 2 km from their hive, collecting water and pollinating plants. Because of the small area they cover, honey could be a good indicator of environmental threats. Nine different honeys were collected from local honey farms, Meijer, and a honey farm in Indiana, and samples were prepared by burning honey at 550° C for one hour. To analyze the honey ash, samples were hydraulically pressed into self-supporting targets for ion beam analysis. Proton Induced X-ray emission (PIXE) was used to find the trace elements present. The particle accelerator accelerates protons which excite electrons from the core shells of the target atoms. When these electrons fall back into their core states, x-rays of a particular energy that are characteristic of a particular element are emitted. These x-rays are detected, and using their energy, the quantity of elements present in honey can be found in parts per million (ppm). It was found that these honey samples contain mostly aluminum, chlorine, potassium, manganese, iron, copper, and calcium, although the concentrations of these elements vary greatly, and hopefully can be used to distinguish them and their environmental sources.

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Microwave Electric Field Dependent Visible Emission Spectra in a Collisional N_2 Plasma

Cameron Recknagel
Mentor: Dr. Stephen Remillard
Department of Physics

The visible line spectra for nitrogen plasma in the collisional regime (20Torr) was investigated for electric field influence. Nitrogen plasma was induced in the capacitive gap of a microwave resonator at 1.46 GHz, and the emission spectra were compared over a range of electric fields. Measurements were made with an astronomical grade spectrometer, and the spectra were recorded by a CCD camera and then converted from pixels to wavelengths using imaging software. Only within low wavelength (370nm-450nm range) are transitions in the 2nd positive system ($C^3\Pi_u - B^3\Pi_g$) observed. Electronic bandheads from the 1st positive system ($B^3\Pi_g - A^3\Sigma_u^+$) and rotationally degraded wavelength emissions in the medium wavelength (570 nm to 650 nm) range are seen at high and medium electric field, but not at low electric field. This corresponds to the observed color change of the plasma. At low electric field, N_2 exhibits blue plasma, whereas at high electric field orange plasma is resultant. This can be observed visibly with the naked eye as the electric field strength is varied.

This material is based upon work supported by the National Science Foundation under NSF-REU Grant No. PHY/DMR-1004811.

PHYSICS

Characterization of Electrodeposited Thin Films Created for Giant Magnetoresistance

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The phenomenon of giant magnetoresistance (GMR) occurs when a non-magnetic thin film is sandwiched between two magnetic films. In the presence of an external magnetic field, the magnetic films align, allowing increased current flow. Electrodeposition was used to create these films necessary for GMR. The magnetic films were composed of nickel and iron while the non-magnetic films were composed of copper. These films were deposited from sulfate solutions containing nickel (100mM), iron (10mM), and copper (1mM or 2mM) onto uniformly gold-plated silicon wafers. Scanning Electron Microscopy (SEM), simultaneous Particle Induced X-ray Emission (PIXE), and proton Rutherford Back Scattering (RBS) were used to study how the deposition time (6 or 60 minutes), deposition potential (-500mV to -1200mV vs. Ag/AgCl), and copper concentration (1mM or 2mM) affect the composition and surface structure of the deposits. The composition of samples deposited from solutions containing 1mM copper and 2 mM copper were compared. The variability in each sample and between samples was also studied. The amount of deposited material was measured in three different ways: amount of charge deposited, ratio of deposit counts to gold counts found using PIXE, and layer thicknesses found using proton RBS. The three ways were found to be consistent measures of thickness.

This material is based upon work supported by the National Science Foundation under NSF-REU Grant No. PHY/DMR-1004811 and Grant No. PHY-0969058, and the Hope College Dean for the Natural and Applied Sciences Office.

PIXE Analysis of Automobile Paint Layers

Kiley Spirito
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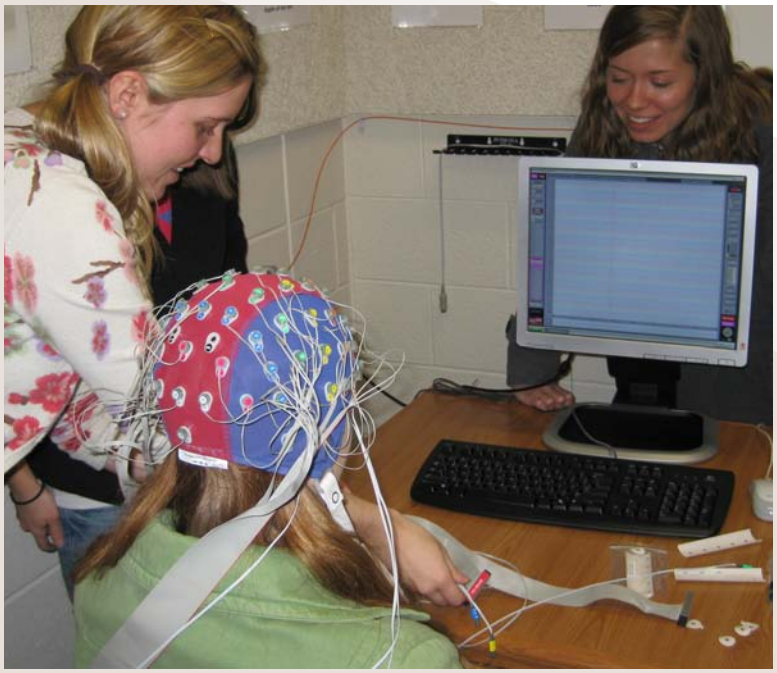
Department of Physics

The current process for elemental analysis of multi-layered paint samples is both destructive and very time-consuming. The layers must be mechanically separated and then chemically dissolved, destroying the sample in the process. Particle Induced X-ray Emission (PIXE) uses a particle accelerator to analyze the composition of a sample based on emitted x-rays. Differential PIXE is a technique used to analyze multi-layered samples without destroying them. Differential PIXE varies the incident beam energy to penetrate into selective layers of the sample, thus only emitting x-rays from the layers that the beam passes through. However, depending on the thickness of the layers, the beam may not penetrate all of the paint layers. The use of a microtome is a semi-destructive method for analysis of the paint layers. Post-separation, the layers would be run in PIXE, and no more damage would be done to the sample. The peak-fitting program GeoPIXE allows for analysis of multi-layered samples while accounting for the thickness of the layers, a factor that other programs do not consider. Analysis of the paint layers and perfection of the methods for preparation of the samples is still ongoing.

This material is based upon work supported by the National Science Foundation under grant No. PHY-0969058.



Above: Lindsey Boeve presenting her research "The Milk and Medicine Program" in Zambia, Africa

Left: Elizabeth Miller and Elizabeth Burks applying an EEG electrode cap to a participant

COMMUNICATION

The Effects of Religious Involvement on Hope College Freshmen's Sense of Connection to the College Community

Kylen Blom, Christopher McGann and Sarah Jones
Mentor: Dr. J. Roselyn Lee
Department of Communication

For incoming freshmen, friends, extra-curricular activities, and habits are all set in place within their first few months of college, which has critical influence on their college career. Considering this, colleges make efforts to make freshmen feel more connected to their community by offering various activities in which their freshmen can participate. At Hope College, the College Campus Ministries have made a significant amount of efforts to provide students with opportunities to engage themselves in campus-organized religious activities as a way to fulfill the college's mission "to promote faithful leadership and grateful service as manifestations of Christian commitment." In the present study, we investigate the effects of freshmen's involvement in campus-organized religious activities on their feelings of connection to Hope College. In particular, we focus on the following three aspects: (1) sense of connection to upperclassmen, (2) sense of connection to campus ministry staff, and (3) overall satisfaction with Hope College. Our data collected from an online survey with 210 freshmen (59 males, 151 females) at Hope show that freshmen's involvement with campus-organized religious activities has positive associations with their sense of connection to upperclassmen and campus ministry staff. The data further reveal that religious involvement also has a positive association with freshmen's overall satisfaction with the college. Our research suggests that participation in campus-organized religious activities may be beneficial to freshmen as the involvement could help them establish sense of connection to the college community through strengthening ties with upperclassmen and campus ministry staff members. In addition, the positive association between freshmen's religious involvement and overall satisfaction with the college points to the vital role played by campus-organized religious activities in students' subjective well-being.

Disregard for Rules: A Cultural Study of a Student Newspaper Group

Holly J. Evenhouse
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Department of Communication

This study researched the organizational culture of a student-run newspaper at a small, Christian, liberal arts college. Aspects that were studied include the student involvement and commitment, interaction with each other, documents pertaining to the newspaper, and interviews with current staff, former staff, and the current faculty advisor in order to discover the real, working culture of the organization. Many of the staff hold similar views to each other, and are willing to comply with the restrictions that college administration puts on the paper. Members differ, however, in their regard for the rules and roles within the culture. The transient population leads to high turnover rates. Thus, implications for developing culture within a short-term work group are discussed.

COMMUNICATION

Dancing with Advisors: The Co-cultural Experience of a Collegiate Religious Dance Group

Sarah A. Fraser
Mentor: Professor Isolde Anderson
Department of Communication

Previous organizational analyses have focused principally on organizations in the business world. This study gathered ethnographic data of Sacred Dance, a Hope College organization, by observing organization meetings and rehearsals, leadership meetings, and interviews with participants of the organization. This analysis focuses on the culture of a college organization that has strong values of community and Christianity. Differences in group behavior between the presence and absence of a faculty advisor are examined for their impacts on the group's culture. Examining the effect of faculty advisors on group culture can aid future collegiate organizations by identifying potential hurdles they may have to conquer. This study also provides a model for performing an organizational analysis in the new arena of collegiate organizations.

The Faces Behind the Furniture: Herman Miller Design Yard Cultural Analysis

Casey S. Dawson
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Department of Communication

In this study, interviews were used to analyze employees' sense of culture at Herman Miller's Design Yard facilities. Twelve employees were interviewed (out of 300 total employees) that work at the Design Yard, including a customer experience manager, design facilitation employee, corporate workplace strategist, corporate communications consultant, concierge work team member, workplace knowledge consultant, environmental health and safety specialist, writer/editor of brand marketing, and two interns. Patterns within the interview data suggest that the culture of Herman Miller functions as a root metaphor. Themes of innovative design, strong historical foundation and shared values, both written and unwritten, make Herman Miller's culture unique. Previous studies of Herman Miller have focused on the founders' perspectives of the organization's culture, but this analysis provides insight from employees who have worked at the company from a range of thirty years to five months. Understanding what these employees agree on and where the ambiguity resides will provide great insight for Herman Miller.

COMMUNICATION

A Potluck of Personality: Culture of the Distributed Team at a College

Heather A. Gill
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Department of Communication

This ethnographic study explores the style of communication in an office that receives its information in a central location but does its work outside of that location. Because the work of Hope College's physical plant is done through distributed teams, alternate communication patterns are used to compensate for face-to-face interactions between departments. Shared identity, a sense of participating in the "in-group" of an organization; shared context, an equal share of access to similar resources and work structures; and spontaneous communication, or informal, unplanned interactions experiences among team members, are used to form the culture of the physical plant and help to manage conflict that arises. These patterns were identified through participant observation, formal and informal interviews, and document analysis. The culture can be captured by the root metaphor of a potluck dinner: everyone brings something different to the table, and while there may be confusion and repetition among dishes, the focus of the event is on providing a good meal and building relationships. The data from this study could be used to develop other research on culture in distributed teams that are not separated through large geographical distances.

Mountain Men: An Analysis of the Modern Day Mountain Man and Tough Guy TV

Michelle Goris
Mentor: Dr. Teresa Heinz Housel
Department of Communication

One popular program genre on educational-entertainment cable channels such as the Discovery Channel is a type of show that this paper calls "Tough Guy TV." This paper examines how "Tough Guy TV" is a new way for today's men to reconnect with their masculinity through television. "Tough Guy TV" focuses on one notorious masculine image: the Mountain Man, which appeals to both genders. Men want to be them and women find themselves attracted to them. Mountain Men represent adventure, courage, and pure masculinity. Through a combined historical and textual analysis of television programs (Discovery Channel's "Survivorman" and "Man vs. Wild"), this paper examines the historical origins of the Mountain Man and why this figure continues to be popular on television and among audiences. The research found that the Mountain Man image that emerged in the nineteenth century has been manipulated to fit current television portrayals. Both programs' hosts also share similar racial, personality, and socio-economic characteristics. Finally, both "Survivorman" and "Man vs. Wild" reflect traditional images of "Tough Guy" masculinity that men are socially expected to fit.

COMMUNICATION

When the Mindset Matters: A Quantitative Study on Hope College Students' Recycling Behaviors

Bonnie Jansma, Brittany Konfara and Alyssa Austin
Mentor: Dr. J. Roselyn Lee
Department of Communication

In the past 20 years, great attention has been given to the issue of recycling, particularly with respect to economic benefits and corporate responsibility. Recently here at Hope College, there has been increased interest in students' recycling efforts and economic sustainability. Evidence of these efforts are apparent across campus: reducing the amount of paper usage, new measures of eco-consumption in dining areas, and buildings with several bins for recycling items such as batteries, newspapers and various plastics. Based on existing literature, we examined how various individual and structural factors affect college students' recycling behaviors: altruism, spirituality, perceived importance of recycling in the day-to-day mindset, and accessibility to recycling systems. We hypothesized that these four factors would have positive associations with actual recycling behavior. Using an online survey tool, we collected data from Hope College students to test our hypotheses. Our data revealed that the only factor found to have a significant association with actual recycling behaviors was perceived importance of recycling. No other individual or structural factors showed a significant relationship with recycling behaviors.

You Are In My Space, But That's Okay: Sustaining an Innovative Culture in the Workplace

Ayanfeoluwa Olonade
Mentor: Professor Isolde Anderson
Department of Communication

This study explores the group culture of the Global Design team of Haworth Inc. Haworth Inc is a global leader in the design and manufacturing of organic workspaces, including raised floors, movable walls, systems furniture, seating, storage, and wood and case goods. Previous studies on creativity and innovation in organizations primarily focused on identification of factors affecting innovation within an organization as a whole. This study uses ethnographic methods to examine how elements within the Global Design team keep them and their products innovative. Data include observer's participation, formal and informal interviews, meeting notes, and document analysis. Two main contributors were found to group culture development: workspace characteristics (proximity to team members, multi-functionality, and advanced technology), and interpersonal and computer-mediated interactions. As companies strive to make profits through harsh economic times, the results of this study provide suggestions on how to sustain innovativeness as a group and through products or services.

COMMUNICATION

An Established Culture in a Vibrant Industry

Bryce C. Melchiori
Mentor: Professor Isolde Anderson
Department of Communication

Why should organizational culture matter? What if the culture embedded within an organization actually fabricates success? Could the culture of an organization help avert conflict, or is it the culprit? Many aspects of corporate culture have the ability to create organizational internal themes that many organizations don't notice or take advantage of. This project examined what cultural aspects within Creative Dining Services help to shape the company, the culture, and its employees to what it is today. I analyzed the following sources: 1) office artifacts, structure and layout, 2) original Creative Dining Services written documents, 3) on site observation, and 4) individual interviews with company employees. Initial observation indicates cultural themes of: 1) a strict emphasis on timeliness, 2) a clash between creative thinking and solidified structure, and 3) a deeply rooted sense of respectfulness towards coworkers and facilities. A clear picture of Creative Dining Services culture can assist small to medium sized, multifaceted corporations in understanding how their unique culture can affect employee training, communication patterns, working conditions and ultimately, company success.

Coaching Communication: Effects of Different Coaching Styles on Athletes

Lindy Melville, Patrick Robey, Kenichiro Kawakami and Ben Lemmen
Mentor: Dr. Teresa Heinz Housel
Department of Communication

Because every person communicates differently, no one person responds to messages the same exact way as someone else. Communication is especially important in the world of sports. Athletes need to talk and relate to their teammates both on and off the court. It is also very important for athletes to respect and connect to their coach. However, establishing a productive athlete-coach relationship is not always easy, because there are many different coaching styles across sports. Many times, coaching techniques can strongly impact the team's chemistry. Some coaches shout at their team using a command speaking style, while other coaches have a cooperative communication style. With this background in mind, this project examined what Hope College student athletes believe is the best coaching communication style. The research group interviewed athletes from almost every Hope male and female team, asking their opinions about coaching styles and the styles' impact on team chemistry, cohesion, and performance. The qualitative interview analysis revealed two findings: Cooperative coaching is the most common coaching style at Hope, and student athletes had very different responses to coaching styles. Finally, the study found that it is difficult to predict which coaching style will be more productive because it depends on the athletes and how they respond to their leader.

COMMUNICATION

Communicating Culture: Perceptions of Global Communication

Julia Peterson and Alison Bernard
Mentors: Dr. Deirdre Johnston and Professor Rebecca DeVries
Department of Communication

The hypothesis of this study is that high levels of global exposure (measured by international internet, media, and travel experience) in college-age students will be related to positive beliefs regarding global communication (the intercultural diffusion of ideas and values). Internet survey data was collected from college-age students from China, Korea, Mexico, and the United States. Surveys were conducted in the language of the countries surveyed and administered by local college faculty in each country. A 21-item global exposure scale indicates that global exposure varies significantly by country with Korea featuring the highest level of global exposure followed by the United States, Mexico, and China, respectively. Factor analysis revealed four dimensions of global perceptions: National Progress (belief that global communication leads to government accountability, effects global politics, promotes scientific and technological development), Cooperation (belief that global communication promotes peace and solutions to world problems), Fear (belief that global communication threatens the traditions and morals of one's culture), and Pro-West (belief that global communication promotes democratic values). The beliefs of Mexican college students were consistent with the hypothesis of the study in that comparatively lower level of global exposure was associated with high fear of global communication, cynicism that global communication leads to national progress and promotes change and accountability in world politics. However, inconsistent with the hypothesized relationship, Koreans who had the highest level of global exposure also had the highest Fear beliefs scores of the nations surveyed. Further, mean scores for Pro-West beliefs were highest for China despite low global exposure scores overall. These preliminary results reveal a more complex relationship between global exposure and the four identified dimensions of global perception than originally hypothesized. It is anticipated that ongoing data collection in Holland, Japan, and other countries will further explore the complexities present within these findings.

COMMUNICATION

What Determines Classroom Participation? Effects of Gender, Class Rank, Class Structure, and Personality

Erica Toren, Kellie Cochrane and Robert "Cody" Ells
Mentor: Dr. J. Roselyn Lee
Department of Communication

Classroom discussion is a fundamental part of the learning process. To better understand the material, a student must ask questions, give opinions, and exchange ideas with the professor and other students. It is important to be able to understand and learn from alternate views an individual might miss, but another student might see. However, in order for classroom discussion to serve its purpose, students must actively participate. Professors must look at several factors in order to get the optimal discussion from their class. Students also must be conscious of these factors to receive optimal learning. With a Hope College student sample (N = 75), we conducted a survey study to investigate how various individual and structural factors affected a student's level of participation. In particular, we examined the effects of students' gender as well as class rank, factors related to class structure (class size and grading based on participation), and students' personality in regards to shyness. We found that males and females did not show a significant difference in their participation levels, which, interestingly, contradicted the findings of previous research. We also found that students tend to participate less in larger classes, which tells us that class size matters. Class rank revealed a significant difference, showing that juniors are the most active participators, freshmen are the second most active, and seniors are the least active participators. Lastly, our data showed that students' shyness had a significant negative association with class participation levels, indicating that the shyer students are, the less likely they are to engage in class participation.

Kerry Smith and Lauren Shira

COMMUNICATION

The Role of Communication Technology in Patient-Physician Relationships: Technology Violating Immediacy Expectations

Kevin Watson
Mentor: Professor Rebecca DeVries
Department of Communication

Ongoing research indicates that there are numerous benefits to patient-centered care (Beck & Gordon, 2010). Patient-centered care involves physicians treating patients as co-experts in their own health care (Epstien, Franks, Fiscella, Shields, Meldrum, Kravits, & Duberstein, 2005). Much of the communication involved in satisfying patient-centered care, among other factors, relies heavily on a physician's ability to create nonverbal immediacy with a patient (Wanzer, Booth-Butterfield, & Gruber, 2004). Since nonverbal immediacy is built through smooth, open, and warm interpersonal behaviors (Richmond, Smith, Heisel, & McCroskey, 2001), the introduction of communication technology during a medical examination has the potential to affect behaviors, thus affecting the interaction. To test this, a 2 by 2 factorial design is utilized, looking at the interactions between high or low nonverbal immediacy behaviors and the presence or absence of communication technology in a standard medical examination. Participants are randomly assigned to one of the four conditions for this internet video experiment. After viewing the video, participants are asked to complete a survey that measures beliefs about patient-centered communication, participants' technological readiness, and overall satisfaction with perceived care. Depending on how technologically ready the participants are and whether or not they buy into a collaborative mindset for patient-physician interactions, they will evaluate the physician's use of communication technology (in this case, a computerized tablet) as enhancing or minimizing patient-centered communication and overall satisfaction. According to Roger's model of Diffusion of Innovation (1995) and Burgoon's Expectancy Violation Theory (1993), this study predicts that participants who are early-adopters of technology and believe in a collaborative (patient-centered) interaction will evaluate the non-seamless (low nonverbal immediacy) use of communication technology during the patient-physician interaction as a violation of their expectations, therefore lowering the participants' level of satisfaction with perceived care.

ECONOMICS, MANAGEMENT & ACCOUNTING

The Effect of Per Pupil Expenditure on ACT Scores

Michael Bazydlo
Mentor: Dr. John E. Lunn
Department of Economics, Management, and Accounting

The average state expenditure on education has increased by 100% from 1995 to 2008. Regression results using state-level data from the U.S. Census Bureau, National Center of Education Statistics, and the ACT, show that a state's total expenditure does not have a significant effect on average composite ACT scores when controlling for race, median household income, the percentage of population living in poverty, and the pupil per teacher ratio for each state. Although the results do not show a correlation between education expenditure and ACT scores, the results show that the poverty level does have a significant negative effect on test scores. This suggests that more research be done on the effects of socioeconomic status on academic performance.

A Look at Contributing Factors to Delaying Early, Normal, and Late Retirement

Kelsey Bos
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With the past economic depression there has been a sense of anxiety about the effects it will have on retirement plans. The results of three regressions, from a University of Michigan Health and Retirement Study, indicate significant differences between the contributing factors to the probability of one continuing to work through early, normal, and late retirement ages. The difference within the significances of the models shows that finances are only one aspect of the key contributing factors in the choice to retire. Financial security is the greatest concern for early retirees; however, throughout the normal retirement age, factors contributing to satisfaction with life, ranging from health to finances, are valued more. The late retirement model resembles the early model but with a stronger focus on health and the physical ability to continue working. Thus, one's financial situation is only one of multiple significant factors effecting retirement; the others should be explored to a greater extent as to enhance understanding of the different retirement plans.

ECONOMICS, MANAGEMENT & ACCOUNTING

Volumes and Volatilities: A Study on the Transition from Open-Outcry to Electronic Trading in CME Live Cattle Futures

Tyler Busdicker
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Department of Economics, Management, and Accounting

The Chicago Mercantile Exchange is experiencing a transition from open-outcry trading in trading pits to electronic trading in trading platforms (Globex). This paper concludes that as Globex gains market share, its liquidity costs and higher volatility will be reflected throughout the entire market. Regression results, statistics, and correlations indicate that the days in which Globex has higher than normal daily volumes, the volatilities of both trading platforms will increase. From these relationships I can hypothesize that as the transition from open-outcry trading to electronic trading continues, volatilities in both trading platforms will increase until all trading is executed through Globex.

Entrepreneurial Business Creation Response to Monetary Policy

Kevin Hagan
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Department of Economics, Management, and Accounting

Recent peaks in the unemployment rate are cause for concern, with annual unemployment rates in the United States approaching ten percent, creating a trend of the lowest employment rates since the Great Depression. Finding ways to increase the number of entrepreneurs and thus, the creation of new businesses, would allow for sustainable job creation and could jump-start the struggling economy. One such option to solve these economic struggles is to spur an increase in the number of businesses, something which requires investigation into the behavior of entrepreneurs. This study attempts to examine the response of entrepreneurs in relation to changes in the monetary policy. Regression analysis is used to determine the effect of the interest rate upon the start-up rate of businesses in the United States. The expectation was that a lower prime rate would, in turn, increase the incentives of borrowing capital, and thus would increase the likelihood of business creation. The results of this study show no clear relationship between the current year's prime rate and the start-up rate. However, when looking at specific sectors of industry, there are several significant, although small, negative relationships between the prime rate and the business start-up rate. Additionally, there was a particularly strong inverse relationship between the previous year's prime rate and the overall business start-up rate.

ECONOMICS, MANAGEMENT & ACCOUNTING

An Empirical Investigation on the Effect of Long Term Debt on Country Bond Yields

Jonathan Herrman
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Department of Economics, Management, and Accounting

Investors take into account many different types of data when determining what interest rates they will pay on bonds of a given country, including the absolute level of debt. Regression results using debt as a percentage of GDP and other variables necessary to estimate interest rates for a country showed that total debt is significant. However, the coefficient was negative, indicating that countries with higher levels of debt tend to pay lower interest rates for other reasons.

U.S. Manufacturers Diminishing Demand for Labor

Drew Klooster
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Department of Economics, Management, and Accounting

The manufacturing sector is dwindling in its ability to create and sustain jobs within the United States' economy. By looking at time series data representing factors such as changes in the flow of investment capital, productivity growth within the manufacturing industry, as well as increasing international competition in the market of manufactured goods and their relationship with the dissipating labor demand by the manufacturing sector, there is reason to believe that this is part of a structural change within our economy with some indicators appearing as early as 30 years ago. In light of numerous studies suggesting that the reduction in the manufacturing sector's overall employment involves a shift in demand that favors skilled relative to unskilled labor, I'd argue that it would be more beneficial for the government to acknowledge this structural change and therefore endorse policies that support the education and training of the unskilled workforce displaced by this transformation, rather than look for quick fixes through the use of stimulus spending.

ECONOMICS, MANAGEMENT & ACCOUNTING

The College Town: An Economic Analysis of a College's Effect on Its Environment

Jordan Richardson
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Department of Economics, Management, and Accounting

There is something unique and different about college towns. This difference can be found in the types of stores that line Main Street, the nightlife, and the sorts of people one would find on the sidewalk at any given time of day (or night). Towns like Oxford, Ohio or Chapel Hill, North Carolina, surely have something the standard city lacks, but is that difference economic? This paper will seek to answer that question. It will explain what it takes to be classified as a college town, find the relationship between college student population and per capital income, and differentiate between the value of an undergraduate student and a graduate student.

Can Benefits Sometimes Hurt? A Look at the Relationship Between Unemployment Insurance and the Unemployment Rate

Matthew Witt
Mentor: Dr. John E. Lunn
Department of Economics, Management, and Accounting

This paper tries to establish if unemployment insurance (UI) has any type of effect on the unemployment rate. Many have suggested that extending UI to those out of work will have no adverse effect on the unemployment rate, while the exact opposite has also been claimed many times. For this project, I decided to see if I could establish if there was indeed any relationship between UI and the unemployment rate. I ended up using a regression analysis using the 50 different states plus District of Columbia as my observations. I used two separate independent variables to measure the amount of benefits given out. These two variables were used because they differentiate from state to state and because their quantities were not caused by the unemployment rate. My findings show that while there is not enough evidence to conclude that the amount paid out to those eligible for benefits affects the unemployment rate, the number of weeks a state allows you to collect the insurance does show a statistically significant correlation, although we cannot deem there to be a causation effect.

ECONOMICS, MANAGEMENT & ACCOUNTING

Effects of Size, Industry, and Type of Ownership on Business Firm Longevity

Katelyn Rumsey
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Department of Economics, Management and Accounting

Some companies have managed to overcome economic challenges, massive changes in technology, globalization and other socio-cultural transformations to not only survive, but thrive over an extended period of time. Does private ownership or firm size make a difference in a business's ability to survive over the long term? Are there certain industries to which these companies belong that are more conducive to long-term survival?

It was hypothesized that the percentage of companies over 100 years old that were privately held would be higher than the overall U.S. business population, since private ownership was mentioned in several case studies as a method of survival. Other hypotheses included the belief that businesses that have survived over the long term would be smaller than average U.S. firms, and that they would cluster into certain industries.

Company websites and academic databases were used to gather detailed information of U.S. companies over 100 years old. The authors of this study analyzed over 400 companies. After compilation, the data was compared to the overall U.S. business population statistics provided by the U.S. Census data.

The authors found that the percentage of old companies that were public was significantly larger than that of the general U.S. business population. After analyzing company size, a vast majority of the companies examined had well over 500 employees. A discussion is provided which highlights the specific industries that were most represented in our study. Among the eighteen industries, the manufacturing industry had the most representation among the old companies.

This material is based upon work supported by the Frost Research Center and the Japanese Small Business Research Institute.

EDUCATION

Perceptions of Michigan Educators Concerning the Michigan Merit Curriculum

Marcy Blowers and Nydia Chavarria
Mentors: Drs. Vicki-Lynn Holmes and Jane Finn
Departments of Education and Mathematics

The Michigan School Board recommended new graduation requirements using the Michigan Merit Curriculum (MMC) for school children starting with the graduating class of 2011. The new MMC mathematics changes include four years of math consisting of Algebra I, Algebra II, Geometry and one other final year of high school math credit. These new graduation requirements focus on (a) preparing upcoming Michigan high school graduates for the 21st century job market; and (b) decreasing the drop-out rate due to low expectations of school staff. In the spring of 2010, 462 Michigan educators were surveyed on their perceptions of the success of the MMC for all students including children identified as special education and "at risk". Of those educators surveyed, about 1/3 each were Algebra instructors, special education teachers, and secondary principals /special education directors). Results of this quantitative research show that 65% of the teachers could articulate a new curriculum plan in place and alternative methods for completing the Algebra I graduation requirement for students who were indentified "at risk" and special needs. Approximately 25% of the Algebra teachers did not feel qualified to teach special education students and desired more professional development in this area; 100% of the special education teachers felt that the Algebra teachers were ill-prepared to teach children in special education. Ironically, 80% of the teachers as opposed to 16% of the administrators feel that the drop-out rate will increase as a result of these new curriculum changes.

This research was supported by a grant from The Carl Frost Center for Social Science Research.

What Is the Impact of CASA (Children's After School Achievement) on Student Achievement?

Jori Niemann
Mentor: Dr. Laura Pardo
Department of Education

This project researched the effectiveness of CASA on elementary students' academic achievement. CASA is an after school tutoring program for at-risk elementary students in the Holland area. Tutors are Hope students who volunteer their time and come from a variety of majors. CASA's stated outcomes are for CASA students to: maintain a high rate of attendance, receive high performance scores on daily work, improve annual reading test scores, move up to the next grade in school, do better in school, and graduate from high school. Data collected and analyzed included: attendance records, student's pre and post reading level scores, teacher surveys, parent surveys, tutor focus groups, standardized test scores, and demographic data from the Holland Public Schools. Early analysis indicates that both teachers and mentors value the mentoring relationship because it provides stability and one-on-one guidance. Additional evidence suggests CASA students maintain high attendance and improve their annual reading test scores. Research is still under way and further conclusions are yet to be determined.

This research was supported by The Carl Frost Center for Social Science Research.

EDUCATION

The Friendship House: A Three Year Longitudinal Study

Alex Harsay and Jill Valentino
Mentor: Dr. Jane Finn
Department of Education

How can we facilitate the functional independence of individuals with cognitive disabilities in our own community? Throughout the world, housing shortages for individuals with disabilities abound. Due to this lack of appropriate residential housing, a unique living arrangement named the Friendship House was created. The Friendship House is an establishment in which college and seminary students live side by side with people with cognitive impairments in a small dormitory setting on the seminary campus. Each young adult with a disability shares a suite with three college or seminary students. We conducted a qualitative research study by interviewing the (a) roommates without disabilities, (b) roommates with disabilities, and (c) the parents of the roommates with disabilities. Our research will discuss the longitudinal findings of this study, which includes suggestions on how to improve this type of housing as well as information regarding the replication of this type of housing option on other college campuses. We have noted several general trends and themes that are also addressed in our research. The ultimate goal of the Friendship House is to provide young adults with cognitive impairments an opportunity to live independently and actively contribute to society. Using the results from this study, similar housing opportunities can be pursued for young adults with disabilities throughout the United States.

This research was supported by a grant from the Eugene and Mary Heideman Fund.

Mathematics Literacy: Using Technology to Improve Student's Conceptual Understanding of Mathematics

Jonathan Wielenga, Brittany Holloway and Sarah Lohman
Mentors: Drs. Vicki-Lynn Holmes and Kimberly Kotkowicz
Departments of Mathematics and Education

The purpose of this year-long qualitative case study was to determine the effect of technology on the metacognitive processes of elementary mathematics students on mathematics content knowledge. Specifically, we were searching for a method for turning rote procedural or algorithmic activities (ranging from multiplying two digit numbers to two binomials) into conceptual ones by developing students' mathematical reasoning skills through metacognition. Two Hope College intern teachers were selected to weekly incorporate Livescribe, an interactive digital pen that records and allows the sharing of audio visual files, with the pedagogy of "think alouds," where students orally talk through the "how to" and "why" of each activity in their mathematics classrooms. Other students were given the opportunity to analyze their peers' oral recordings. Teachers also kept a journal chronicling the critical reflection of the metacognitive process that was occurring in the classroom. While this project is ongoing, preliminary results after one semester indicated students' engagement levels increased. Students' responses became more critical, going from explanation of "what" to "why." Additionally, the teachers' mathematics pedagogy improved as they became more adept at using errors as opportunities to provide scaffolding for further conceptual understanding. It is clear that metacognition helps provide a deeper conceptual understanding of procedural activities for these elementary mathematics students.

KINESIOLOGY

The Effectiveness of the ShakeWeight as a Means of Muscle Strength, Endurance, Hypertrophy and Tone in the Upper Body

Sarah Anthony, Ryan Cotter, Adam Diver and Kristen Schwenk
Mentor: Dr. Maureen Dunn
Department of Kinesiology

The purpose of this study was to test the effectiveness of the ShakeWeight as a tool to improve muscle hypertrophy and tone compared to a traditional upper body workout. Fifteen previously sedentary participants (8 male, 7 female) were assigned to either the ShakeWeight group (n=7) or the traditional weight-training group (n=8); groups were matched based on gender and strength. The ShakeWeight group trained for 6 minutes at a time, 3 times per week for the 6-week period. The traditional weight-training group also trained 3 times per week for 42 minutes each session, performing two 21-minute circuits composed of exercises that trained the same muscle groups as the ShakeWeight. These included: push-ups, bicep curls, lateral pull-downs, sit-ups and triceps curls. Baseline testing for body composition, muscle tone, muscle endurance and muscle strength were performed. Progress testing was performed at the conclusion of the third week, and post testing was performed at the end of the 6-week program. Improvements were seen in 1 RM bicep strength ($p=.032$), 1 RM lateral pull down strength ($p=0.00$), and pushups ($p=0.00$) for both groups following the 6-week period, with no difference between groups. Other tested areas remained stable for both groups over time. The study confirmed our hypothesis that the ShakeWeight training program produced similar results in muscle strength, tone, endurance and hypertrophy, compared to a traditional weight-training program, in one-seventh of the time. Results indicate that the ShakeWeight appears to be an effective means of increasing muscle strength, endurance, tone and hypertrophy in sedentary individuals.

Haleigh Gokey performing a balance rehabilitation research project with an elderly woman using Nintendo® Wii Fit™ balance games

KINESIOLOGY

Comparison of High Intensity Interval Training and Moderate Intensity Training on Aerobic Capacity of College Students.

Kate Brundige, Katie Oosting, Elizabeth Barnes and Katie Blodgett
Mentor: Dr. Maureen Dunn
Department of Kinesiology

Research suggests that high intensity interval training is more effective at improving maximum oxygen uptake (Vo_2 max) than moderate intensity endurance exercise. This study was designed to test the hypothesis that high intensity interval training will produce greater improvements in aerobic capacity when compared to moderate endurance exercise. Fourteen healthy, college-age students were assigned to comparable training groups: a high intensity interval training group (HIIT) or a moderate intensity training group (MIT). HIIT consisted of 10 x 1-minute stationary cycling intervals at 90-100% age-predicted max heart rate (%HR max), each followed by one minute of active rest. MIT consisted of continuous stationary cycling at 75% age- predicted heart rate max. Twelve 20-minute sessions were completed by both groups over a 6-week period. Responses in VO_2 max, heart rate, and body composition were examined. Training group assignment resulted in a significant difference in average heart rate ($p = 0.000$) and %HR max ($p = 0.000$) between training groups. Training did not have a significant effect on changes in body composition for either group, yet the HIIT group trended toward decreases in percent body fat. A trend suggested VO_2 max improvements in both training groups, with the HIIT group appearing to have greater improvement; yet these differences were not significant. These trends suggest the possibility of HIIT training to provide superior improvements in aerobic capacity and body composition when compared to MIT training, yet they indicate that further research on the subject is needed to determine the proper protocol.

Effects of Caffeine on Repeated Sprint Performance in Male Swimmers

Alicia Tuuk, Ashley Olney and Emily Fischer
Mentor: Dr. Maureen Dunn
Department of Kinesiology

The aim of this study was to examine the effects of various doses of caffeine on repeated sprint performance in collegiate male swimmers (n=10). Each participant completed six 100-yard sprints on 3 separate test dates. On each occasion, athletes ingested either 3 or 6 mg/kg caffeine or placebo one hour prior to exercise in a counterbalanced, double-blind manner. Sprint time, lactate level, and rate of perceived exertion (RPE) were assessed on each test date. Mean sprint time for all 6 sprints decreased from the first testing day compared to the third testing day ($p > 0.01$). There was no effect of caffeine on mean sprint time or RPE, although there was a trend for decreased RPE in the 6 mg/kg caffeine trial compared to placebo and 3 mg/kg caffeine ($P=0.09$). Lactate production following sprinting was significantly increased during caffeine trials compared to placebo ($p < 0.01$). There was no difference between caffeine doses on lactate production. Results indicate that the use of caffeine as an ergogenic aid is neither detrimental nor enhancing to performance.

KINESIOLOGY

Effectiveness of Creatine as a Supplement for Enhancing Power and Endurance in Male Collegiate Basketball Players

Kelvin Carter, Kurtis Carroll, Andy Schuldt and Colin Bilodeau
Mentor: Dr. Maureen Dunn
Department of Kinesiology

The purpose of this experiment was to examine the effects of four weeks of creatine supplementation compared to placebo on endurance, body composition, and flexibility in male collegiate basketball players during a pre-season training regimen. The tests conducted before and after supplementation included a mile run, 40-meter dash, beep test, vertical jump, bench press, sit-and-reach, body composition, and VO_2 max. Participants were matched into two groups (creatine supplementation and placebo) based on VO_2 max values in a double-blind manner. The creatine supplementation protocol consisted of a five-day loading phase in which athletes ingested 10 grams of creatine twice per day, followed by a maintenance phase in which athletes ingested 2 grams of creatine per day for the remaining 23 days of the study. Placebo was ingested in a similar manner. Workouts were designed and carried out by the Hope men's basketball coaching staff and included various combinations of endurance training, plyometrics, and resistance training. Overall, both the experimental and the control group showed significant improvements in mile run time, 40-meter dash time, vertical jump height, beep test level, and lean muscle mass over the 4-week trial period. No significant differences in improvement between groups existed; however, the vertical jump test yielded a trend of superior improvement for the experimental group compared to the control group. This study offers no significant evidence that creatine supplementation improves endurance, reduces body fat, or improves flexibility.

Kinesiology student David DeBoer increases physical activity using Wii™ videogame "Mole Stomper" which is part of the "Active Life: Outdoor Challenge" software package for Nintendo® Wii™

KINESIOLOGY

Is Chocolate Milk as Effective as a Protein Supplement for Enhancing Strength Following Resistance Training?

Courtney Cook, Christopher Feys, Stephen Hazekamp and Daniel Karam
Mentor: Dr. Maureen Dunn
Department of Kinesiology

The present study was designed to compare strength gains between two groups of collegiate baseball players during their 6-week off-season training program. One group (n=5) ingested chocolate milk following their workout, while another (n=5) ingested a protein supplement (Nutrilite whey protein shake). All athletes performed similar weight-training exercises, with the only difference between groups being the post-exercise beverage consumed. One repetition maximum (1RM) strength was assessed in both groups for bench press, squat, leg curl, triceps extension, hammer row and biceps curl prior to and following training. Following the 6-week period, both groups increased strength in all muscle groups with the exception of hammer row and triceps extension. There were no differences in strength gains between groups. Interestingly, both groups increased body mass and body fat percentage following training. The only significant difference between groups was a greater increase in body mass in the protein compared to the chocolate milk group (p=0.05). Results indicate that chocolate milk is as effective as a more expensive protein drink for enhancing strength in collegiate baseball players.

Athletic Pubalgia: Diagnostic Difficulties and Treatment Options

Brian Wiese
Mentor: Dr. Kirk Brumels
Department of Kinesiology

Athletic pubalgia is a disruption of the connective tissue located near and around the pubic symphsis region that creates diagnostic and treatment difficulties for health care professionals. Many times confused for a hernia or muscle strain; athletic pubalgia (also known as Gilmore's Groin or sports hernia) is a debilitating condition which can severely affect an individuals ability to perform high level athletics and in some cases activities of daily living. Although, athletic pubalgia is actually a herniation of connective tissue, the diagnostic difficulties arise due to athletic pubalgia not clinically presenting as a typical inguinal or femoral hernia. In addition current diagnostic tools are unable to produce images that confirm athletic pubalgia and often lend to misdiagnosis of muscle strains in the pelvic region. Treatment and rehabilitative activities that are typically effective for musculotendinous pathologies are often ineffective in athletic pubalgia cases thus causing athletic pubalgia to become a diagnosis of exclusion. These diagnostic and treatment difficulties lends to a long process with longstanding pain and decreased function, which can only be corrected through surgical intervention. This case study will explore the presentation of symptoms, the difficulties of diagnosis, and the surgical interventions required to manage a case of athletic pubalgia in an athletic male patient. It is our hope that this case will serve to educate health care professionals, as well as the common public, in the nuances of athletic pubalgia presentation and treatment.

KINESIOLOGY

The Effects of Strength Training Set Configurations for Improving Muscular Strength in Collegiate Baseball Players

Sara DeWeerdt, Kate Glomski, Katie Sawyer and Brandon Siakel
Mentor: Dr. Maureen Dunn
Department of Kinesiology

This study compared the effect of three different strength training set configurations on 1-RM bench press, leg press, and leg curl strength. Fifteen Division III collegiate baseball players were randomly assigned to 1 of 3 weight training protocols: single-set to failure (SSF), 3 sets not to failure (NF), and 3 clustered sets not to failure (CNF). All subjects performed the same strength training exercises 3 days per week for 6 weeks, emphasizing the major muscle groups. A double-progressive overload system was implemented to allow for muscular adaptation. 1-RM pre-tests and post-tests were compared before and after 6 weeks of training and showed no significant differences [p = 0.155 (BP), p = 0.147 (LP), p = 0.158 (LC)] between groups. Overall strength gains, however, were observed in all groups for all muscles studied over time (p < 0.0001). Results suggest that the 3 clustered sets not to failure (CNF) protocol may produce greater strength gains in a short-term training program. Further research is necessary to substantiate this claim.

The Effect of the Power Balance Bracelet on Balance, Flexibility, and Strength

Dillon Fink, Nicholas Goulooze and Nicholas McBride
Mentor: Dr. Maureen Dunn
Department of Kinesiology

The Power Balance bracelet is a growing phenomenon in the athletic community because of its proposed effects on athletic performance. A Mylar holographic disc in the bracelet supposedly improves flexibility, balance, and strength in its users. This study was performed to test the efficacy of the Power Balance bracelet in a variety of physical tests that assessed flexibility, balance, and strength. Fifteen healthy Hope College males were recruited from the club lacrosse team and the Emersonian fraternity to participate in the study. Participants were tested in pre-determined tests once a week for four weeks. The first week was used for baseline measurements to familiarize the subjects with testing procedures and limit practice effects. Each participant was then tested once a week for a total of three weeks in a counterbalanced manner: one week with no bracelet, one week with a placebo bracelet (a Power Balance bracelet with the hologram removed), and one week with an actual Power Balance bracelet. To assess balance, participants were scored using the Balance Error Scoring System while standing on a force plate. Flexibility was determined using the sit and reach test along with goniometer measurements (shoulder flexion and hip extension). One repetition max tests on bench press and leg press and grip strength were used to measure strength. Results showed no significant differences in performance between the three conditions. However, improvements in leg press and sit and reach performance occurred over the course of the four-week study regardless of whether participants wore the placebo bracelet, no bracelet, or the actual Power Balance bracelet. Overall, data suggested that any improvement in performance in balance, flexibility or strength was not based on the claims of the Power Balance bracelet and the proposed effects of its embedded Mylar holographic disc.

KINESIOLOGY

Pre-Exercise Ingestion of High- vs. Low-Glycemic Index Food: Effects on Cycle Time Trial Performance

Carmen Hirsch, Becky Van Kammen, Allyson Wehrly and Derek Bradley
Mentor: Dr. Maureen Dunn
Department of Kinesiology

The purpose of this study was to determine whether the administration of a high-GI food immediately prior to exercise had the same effect on cycle time trial performance as a low-GI food administered 45 minutes before exercise. Nine volunteers (males, n=5; females, n=4) recruited from a Hope College Health Dynamics class completed three 20km cycle time trial rides (70% VO_2max), one week apart in a counterbalanced manner. One trial included the ingestion of a high-GI snack immediately prior to exercise, another trial included the ingestion of a low-GI snack 45 minutes before exercise, while a third trial served as a control with no food. Time trial performance did not improve significantly in any of the three trials (C=37.472 ± 1.704min, H=38.657 ± 1.625min, L=37.493 ± 1.622min, P>0.05). Blood glucose (C=93.56 ± 16.37 mg/dL, H=99.67 ± 24.59 mg/dL, L=96.44 ± 20.13 mg/dL) and lactate (C=9.50 ± 2.94 mmol/L, H=9.91 ± 3.97 mmol/L, L=8.72 ± 4.54 mmol/L) concentrations were not significantly different between groups; however, there was a significant difference in perceived stomach fullness between the high-GI and the low-GI groups (p=.043), as well as between the High-GI and control groups (p=.008). Results indicate that the composition of a pre-exercise meal will not affect performance in 20 km time trial performance.

Pedagogical Approaches to Teaching Motor Skill Stages of Development Using Video Presentation

Kelsey Reimink
Mentor: Dr. Steven Smith
Department of Kinesiology

This study examined the impact of two different pedagogical approaches to teaching stages of motor skill development to undergraduate students using digital video technology. It was hypothesized that using an electronic student response system during the learning phase would result in greater accuracy in identifying stages of fundamental motor skills in children, when compared to a group of students not using the electronic response system during the learning phase. Motor skills develop in a clear and identifiable sequence. Identifying these stages of learning in children is key to the education of kinesiology students in an undergraduate and graduate education. This research involved two phases. The first phase for the summer of 2010 was to develop high-quality digital video of children at various stages of motor skill ability for 11 fundamental motor skills. During this first phase, the video was developed into two different formats for presentation of the various stages of motor development. The second phase is occurring during the academic year 2010/2011. Comparison of two pedagogical approaches to presenting the video will be examined to help determine the best practices in video presentation and student learning of motor skill stage sequencing. The data will be analyzed during May and summer terms of 2011.

This research was supported by the Faculty Development Grant at Hope College.

KINESIOLOGY

Tarsal Coalition in a Female Collegiate Soccer Player

Molly Schab
Mentors: Margaret Frens, MS, AT, ATC and Dr. Kirk Brumels, PhD, AT, ATC
Department of Kinesiology

Tarsal coalition is an abnormal cartilage, fibrous, or osseous union of one or more of the tarsal bones in the foot. The incidence of this condition is very low, but when it does occur, it often causes significant functional and symptomatic difficulties for the affected individual including, but not limited to, gait pattern disruptions, range of movement discrepancies, and pain. This study examined a case of tarsal coalition in a Division III collegiate female soccer player. The presentation of her condition and functional ability were not consistent with what is considered normal for an individual with the condition. Due to this, the subsequent treatment and rehabilitation was also outside the norm. The examination of this case specifically emphasizes the significance of a proper evaluation and referral process, as well as the importance of having an athletic trainer and other health care professionals with a wide range of knowledge regarding musculoskeletal conditions, especially the more obscure ones.

Eye Pathologies in Sports

Emily Corstange
Mentor: Dr. Kirk Brumels
Department of Kinesiology

Injuries sustained while participating in collegiate athletics are not uncommon. Injuries are typically classified based on injury mechanism and are identified as acute or chronic in nature. Acute injuries are single episode injuries and are often times the direct result of the aggressive and competitive structure of sports. Chronic injuries have an insidious onset and are often the result of anatomical abnormalities, predisposing conditions, training errors, or repetitive microtrauma aggravated by athletic participation. In addition, injuries can further be classified as either orthopedic or non-orthopedic. Orthopedic injuries occur to the musculoskeletal system, whereas non-orthopedic conditions occur to anatomical structures in various other body systems. Non-orthopedic conditions must be recognized, managed, and treated quickly and appropriately to reduce the risk of long term disability. This specific study presents the case of a collegiate volleyball player who sustained an injury to the eye during a competitive match. It also investigates other common eye pathologies that can occur during participation in athletics. This presentation reviews the pertinent anatomy of the eye, common mechanisms of injury, management, and appropriate treatment needed to reduce or avoid long term disability.

KINESIOLOGY

Effect of Dietary Intake of n-6 and n-3 Polyunsaturated Fatty Acids on Speed and Power in Humans

Andrew Young
Mentor: Dr. Kevin J. Cole
Department of Kinesiology

While there is evidence that manipulation of dietary fats has an effect on endurance performance, there has been little research examining the effect on sprinting or muscle power. Most of the evidence for this possibility comes from studies demonstrating a strong relationship between n-6 polyunsaturated fatty acid (PUFA) content of various mammalian, reptilian, and fish muscles and maximum speed. The possibility of this relationship existing in humans is enticing, and warrants further study. Therefore, the purpose of this study was to compare the performance effects of ingesting a nutritional supplement containing a high percentage of n-6 PUFA to one containing a high percentage of n-3 PUFA, to determine if the type of fatty acid ingested has an effect on sprinting speed, leg power, and maximal aerobic capacity in humans. Eighteen fit, college-age students were recruited for the study. All subjects completed a battery of pre-test measurements to assess speed (40m dash), anaerobic power (vertical jump test and Wingate cycle test), and aerobic capacity (VO_2 max test). Subjects were randomly assigned to either a high n-6 PUFA supplement group or a high n-3 PUFA supplement group in a double blind manner. For three weeks, subjects ingested two capsules per day containing either 1000mg flaxseed oil (high n-3) or 1000mg borage oil (high n-6) and then repeated the pre-test measurements. There were no significant differences between the two groups for Wingate test peak power or mean power, vertical jump height, or 40m dash times. There was a significant interaction effect for VO_2 max ($p<0.05$), as the n-6 PUFA group improved while the n-3 PUFA group did not. These results suggest that supplementation with n-6 PUFA may improve maximal aerobic capacity but does not affect measures of anaerobic power in humans.

This research was supported by the Henderson Research Grant in Kinesiology.

POLITICAL SCIENCE

The Role of Civil Society in Developing Countries

Sarah Wenz
Mentor: Dr. Virginia Beard
Department of Political Science

Civil society organizations have long been heralded as essential players in fostering stable, sustainable democratic growth. More recently, however, evidence has emerged to dispute this as an unquestioned assumption. A growing body of literature suggests mixed or even negative impacts of NGOs in democratic development. This paper explores both negative and positive influences of NGOs, using the case study of Rwanda as a developing democratic state and burgeoning economy with a large presence of NGO activity. Using secondary data analysis as well as qualitative data gathered during a June 2010 scholarly trip in Rwanda, this paper explores the useful and less than-useful impacts of NGOs. Findings suggest that while NGOs are crucial in meeting basic needs, a significant number of negative effects result from NGO presence and activity. This paper therefore argues that when it comes to long-term development of a democratizing nation, the role of civil society must be re-evaluated and re-structured. Future research should warily view the influences of civil society organizations, questioning the currently posited theoretical benefits of civil society which do not seem to play out in the reality of developing African democracies.

Based on the theoretical literature and the case study of Rwanda, civil society, though often heralded as a magic bullet for positive political development, can also prevent such development or even contribute to the falling apart of seemingly stable and sustainable growing nation-states. This paper presents an analytical view on the factors that both foster and prevent development through civil society in Rwanda.

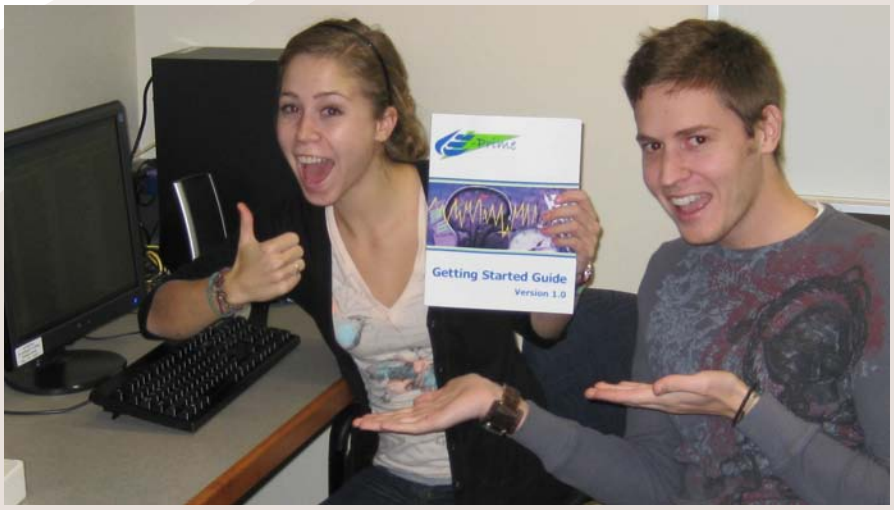
The student research was funded by an internal grant from the Hope College Political Science Department.

PSYCHOLOGY

Explicitness and Word Class as Factors Contributing to the Neural Basis of Metaphors

Elizabeth Fast, Alex Hughes, Lauren Schira, and Kerry Smith
Mentor: Dr. Gwenda Schmidt
Department of Psychology

This research project is based upon previous research on the neural basis of metaphor. There have been conflicting results regarding whether literal and figurative language have different neural bases. These inconsistencies are thought to be due to unknown confounds, and poorly controlled stimulus sets. More recent research has supported the idea that there is a different neural basis to nominal metaphors (metaphors that use nouns metaphorically) and predicate metaphors (metaphors that use verbs metaphorically). However, the difference may have been due to a confound concerning the explicitness of the sentences. For example, nominal sentences often take an explicit form such as "The boys eyes are saucers." But predicate metaphors such as "In the dean's office the student withered" are always of an implicit form. To deal with this confound, a stimulus set was created with factors of word class and explicitness. The stimulus set was then first characterized in a "cloze" probability study, which allowed us to calculate the predictability of the ending words. Participants filled in the last word of each sentence, so we could calculate the cloze probability for the items in the stimulus set. Secondly, a pilot study that recorded accuracy and reaction time was performed. Finally, a norming study was also completed, which looked at the familiarity, naturalness, and imageability of all the stimuli; participants rated each sentence on each of the factors. The factors from these three studies were then used to eliminate stimuli to result in a stimulus set balanced across conditions. The stimulus set will be used in electroencephalography (EEG) research to look at measures of semantic processing at the scalp. This will allow us to better understand if a predicate-nominal difference exists, or if the previous results were actually due to an implicit-explicit difference.



"Explicitness and Word Class as Factors Contributing to the Neural Basis of Metaphors" Elizabeth Fast and Alex Hughes

PSYCHOLOGY

Pro-social Tendencies in Adolescents: The Effects of Bilingualism, Bilingualism Attitudes, and Ethnicity

Ashley Garza, Stephen Agauas and Kyle Stufflebaum
Mentor: Dr. Lorna Hernandez Jarvis
Department of Psychology

This study investigated the effects of bilingualism and bilingualism attitudes on pro-social tendencies (PT) comparing Latino and Caucasian Adolescents. Middle school students (N=1311, 33% male) in grades six through eight were asked to complete a questionnaire in three consecutive years, 2005-2007. The questionnaires included measures of pro-social tendencies and attitudes toward bilingualism. There were no ethnic differences in pro-social tendencies. Contrary to the hypothesis, bilingualism (whether they spoke two languages) did not lead to higher pro-social tendencies. Analyses indicated that regardless of ethnicity, adolescents with higher pro-social tendencies were more likely to have positive attitudes toward bilingualism than adolescents with lower pro-social scores.

The Effects of Acculturative Stress and Ethnic Identity on Bilingualism and Bilingual Attitudes in Latino Adolescents

Chelsea E. Lynch, Trevor A. Coeling, Sarah D. Eklov and Kelly Raymond
Mentor: Dr. Lorna Hernandez Jarvis
Department of Psychology

This study examined the effects of acculturative stress and ethnic identity on Latino adolescents' (N=244) bilingual attitudes and bilingualism using cross-sectional questionnaire data. Stress was predicted to be negatively correlated with bilingual attitudes and bilingualism, while ethnic identity was predicted to be positively correlated with the bilingual measures. The questionnaire included demographic measures, the Multi-group Ethnic Identity Measure, the Acculturation Rating Scale for Mexican Americans II, Baker's (1992) Attitudes Toward Bilingualism Scale, Bilingualism Patterns Measure, and the Societal, Attitudinal, Familial, and Environmental Stress Scale for Children. The analyses indicated that adolescents with higher acculturative stress and ethnic identity reported more positive bilingual attitudes. Bilingual participants reported higher stress levels and higher ethnic identity than English monolinguals.

PSYCHOLOGY

The Role of Modality and Figurativeness on Semantic Processing: An N400 Study

Stephen Agauas and Elizabeth Miller
Mentor: Dr. Gwenda Schmidt
Department of Psychology

It has been observed that words depicting actions ("jump") produce activation of the primary motor cortex or motion processing regions of the brain, in addition to language areas. Thus, the first aim of current study was to investigate whether the modality of words (motion "skydive" versus auditory "babble") would have an effect on the brain processes underlying semantic processing. Secondly, some studies have observed that the neural substrate for the semantic processing of figurative language may be different than for literal language; however, results are conflicting. We suggest this is because of the many confounds in existing studies comparing literal and figurative language processing. When these confounds are accounted for, there may be no difference between literal and figurative language processing in the brain. The current study employed a 2x2x4 design with the factors of modality (auditory, motion), figurativeness (literal, metaphor), and scalp location (right anterior, left anterior, left posterior, right posterior). Stimuli were well controlled on numerous dimensions such as familiarity, naturalness, and imageability. Participants (N=16) were right handed, native English speakers. After presentation of each sentence, participants completed a comprehension task. The electrical activity at the scalp was measured with an electroencephalography system (EEG) during this task. This data was used to calculate the amplitude of the N400 (a negative waveform at 400ms post-stimulus that is an index of semantic processing) across the scalp. A 3-way MANOVA revealed a significant interaction between modality and scalp location, but no other significant effects or interactions. This suggests that the two modalities we looked at have different neural substrates, but that literal and figurative language share a common substrate.

Explaining Backyard Racism to Caucasians: Sympathy or Defensiveness?

Stephanie Kahn, Loan Nguyen, Ashley Garza and Paola Munoz
Mentor: Dr. Mary Inman
Department of Psychology

Colleges often report racial tensions and misunderstandings about college parties that hurt students of color (www.tolerance.org). What can researchers do to help Caucasians understand that a campus Ghetto party where Caucasian students acted like gang members reflects racism? We presented a news story describing an offensive Ghetto party. We manipulated the *location* of the party (own college or different college in another state), and whether Caucasians were given an *explanation of why* the party was offensive in order to test how location and explanations affected Caucasians' emotions, (sympathy for the offended students or defensiveness), and perception of whether the party reflected racism. Results showed that defensiveness occurred, especially when racism was explained. People who learned that the party was far away and were *not* given any explanation saw the party as racism much more than the other three conditions. Activists may want to first present ingroup offenses and then gradually provide the explanations and locations of such offenses.

PSYCHOLOGY

Effects of Listener Characteristics on Speaker Identification by European American Listeners

Jacqueline Canonaco, Chelsea Lynch, Ryan Tussey and Elizabeth Van Oss
Mentor: Dr. Sonja Trent-Brown
Department of Psychology

This study examined the contributions of listener characteristics to the perceptual identification of African American and Caucasian speakers. Undergraduate Caucasian listeners (N=281, 44% were male) responded to auditory stimuli presented in forward and reversed temporal conditions varying by level of phonetic complexity (sentences and monosyllabic words). It was hypothesized that listener characteristics would have significant effects on four dependent variable measures: listener accuracy of identification, identification reaction time, confidence ratings, and rating reaction time. Results of a multivariate analysis showed a significant main effect of listener gender for the accuracy measure such that female listeners made more accurate identifications than did males. Significant interactions for the accuracy measure included phonetic complexity X listener gender, speaker ethnicity X listener gender, and speaker gender X listener gender. Speaker gender X listener gender was also significant for identification reaction time. Listener characteristics appear to influence speaker identification. Implications of these findings are of interest for educational, forensic, and business applications with respect to perceptual stereotyping and linguistic profiling.

Preschool Children's Preferences for Outdoor versus Sedentary Activity

Ryan Cotter, Amanda Schab, Sara Dykstra, Ann Frisella, Kelsey Hawkins and Nathan Love
Mentor: Drs. Sonja Trent-Brown, Steven Smith, Mark Northuis and Professor Vicki Voskuil
Department of Psychology

Although the growing childhood obesity epidemic stems from various factors, one particular aspect that has been identified is that children are not as physically active as in previous decades. Currently, the average child spends less than 25 minutes per day outside, which speaks to the inactive lifestyle of today's youth. In the U.S. alone, there are over 9 million children over the age of 6 that are considered obese. This obesity trend has many negative health implications and costs this country over 98 billion dollars annually (Smith & Northuis, 2006). Physical activity has been cited as a way to improve not only health, but academic performance as well. Children who are physically active have experienced better cognitive functioning, overall health, academics, and self esteem (Hanson, Muller, Austin & Lee-Bayha 2004). This study investigates the activity preferences of preschool children to explore early tendencies toward sedentary versus physical activity.

This material is based upon work supported by the Hope College–Howard Hughes Medical Institute Faculty Development Grants for Interdisciplinary Research under grant No. G00024963.

PSYCHOLOGY

Metaphor Processing: Neural Responses to Figurativeness and Sensory Imagery

Ashley Drew, Audrey Weil, Elizabeth Burks and Rebecca Kresnak
Mentor: Dr. Gwenda L Schmidt
Department of Psychology

The distinction between metaphorical, literal, and anomalous language (called figurativeness) processing within the brain was investigated through the use of electroencephalography (EEG). In addition, neural distinctions of modality-specific language were examined by dividing the stimuli into auditory and motion modalities. In the auditory condition, sentences ended in nouns depicting sound ("clatter"), and in the motion condition, sentences ended in nouns depicting motion ("glide"). Therefore, the three figurativeness conditions (metaphor, literal, and anomalous) each included an equal amount of auditory and motion sentences. Before testing, sentences were matched on predictability, familiarity, naturalness, imageability, accuracy rates, and response times to eliminate confounding variables. Upperclass English majors (n = 11) were presented with 300 sentences. While the participants performed a semantic judgment task of categorizing the sentence as literal, metaphorical or anomalous, the neural activity within each brain quadrant (left anterior, right anterior, right posterior, left posterior) was recorded. The amplitude of the brain wave generated approximately 400 ms after the sentence presentation (called the N400) was the dependent variable used to examine differences in brain processing. A MANOVA revealed a main effect of modality on the N400 amplitudes, where the motion modality sentences produced greater amplitudes. There was also a significant interaction between figurativeness and the brain quadrants on the N400 amplitude. Lastly, there was a weak interaction effect between modality and figurativeness on the N400 amplitude. In conclusion, literal, metaphorical, and anomalous sentences produced different scalp distributions of neural activity implying different neural processes. Furthermore, modality along with the figurativeness of the sentences produced different mean N400 amplitudes. The neural differences due to modality are suggested to be related to the imageability of the sentences. As predicted, the figurativeness and modality of language affects the processing mechanisms within the brain.

PSYCHOLOGY

Health Indicators in Preschool Children

Sara Dykstra, Amanda Schab, Ann Frisella, Kelsey Hawkins, Ryan Cotter and Nathan Love
Mentor: Drs. Sonja Trent-Brown, Steven Smith, Mark Northuis and Professor Vicki Voskuil
Department of Psychology, Kinesiology, and Nursing

During the preschool years, children's development is especially vulnerable because their physical and mental health is easily shaped by outside factors such as activity and nutrition (Kaiser Family Foundation, 2005). In recent years, trends in the United States illustrate the rise of childhood obesity, with over 9 million cases in children greater than 6 years of age (Smith & Northuis, 2006). Screening a child's growth and other health measures at an early age is essential to promote physiological and psychological well-being in these critical years, which will help to identify precursors to obesity. As part of a nature-based enrichment program evaluation for preschoolers, children's height, weight, Body Mass Index (BMI), and blood pressure were examined in relation to the children's age and gender. These data provide the baseline for a pre-/post-test comparison following the enrichment program intervention.

This material is based upon work supported by the Hope College–Howard Hughes Medical Institute Faculty Development Grants for Interdisciplinary Research under grant No. G00024963.

Nurture for Nature: Physiological and Psychological Correlates in Preschool Children

Ann Frisella, Amanda Schab, Kelsey Hawkins, Sara Dykstra, Ryan Cotter and Nathan Love
Mentor: Drs. Sonja Trent-Brown, Steven Smith, Mark Northuis and Professor Vicki Voskuil
Department of Psychology, Kinesiology, and Nursing

Research has suggested that in addition to biosocial factors, children's affective, cognitive, and psychosocial development has begun to suffer because of the decrease in their direct experiences with nature. Multifactorial influences have given rise to this lack of natural contact. The numerous contributing dynamics cited include increased pollution, declining access to open, green spaces, reductions in biodiversity, the transformation of natural habitats to synthetic environments, urban sprawl, and the progressive movement of families and communities away from nature (Kellert, 2005). Further evidence suggests that children who spend at least one hour outdoors each week enjoy improved health, emotional wellbeing, and cognitive growth in comparison to peers who spend less time outside. This study presents findings detailing the relationship between measures of preschool children's physical health, cognitive processing, self-efficacy and activity preferences.

This material is based upon work supported by the Hope College–Howard Hughes Medical Institute Faculty Development Grants for Interdisciplinary Research under grant No. G00024963.

PSYCHOLOGY

Preschool Children's Self-Efficacy and Preferences for Outdoor Activity

Kelsey Hawkins, Amanda Schab, Ann Frisella, Ryan Cotter, Sara Dykstra, and Nathan Love
Mentor: Drs. Sonja Trent-Brown, Steven Smith, Mark Northuis and Professor Vicki Voskuil
Department of Psychology, Kinesiology, and Nursing

Evidence suggests that children who spend more time outdoors are healthier, happier, and smarter (Kellert, 2005; Wells, 2000). It is reasonable to consider that outdoor activity also influences the development of self-efficacy. Self-efficacy can be operationally defined as the children's perceptions of personal agency and their capability of operating at tasks. There is no widely accepted method or instrument for assessing self-efficacy in preschoolers. The Preschool Assessment of Self Efficacy Scale (PASES) was developed specifically for use with this project and target population. The instrument was developed in accordance with Bandura's (2006) guidelines for constructing self-efficacy measures for children. Outcomes for physical, cognitive, social, and self-help subscales are explored with respect to various demographic factors including age and gender. Self-efficacy scores are considered in relation to the children's activity preferences as assessed by a picture selection task based on an activity preference measure developed by Leary (2009).

This material is based upon work supported by the Hope College–Howard Hughes Medical Institute Faculty Development Grants for Interdisciplinary Research under grant No. G00024963.

Making Snap Judgments About a Stranger's Personality

Hannah Karaptian, Mickael Nunez, Kelsey-Jo Ritter and Philip Zuska
Mentor: Dr.Thomas Ludwig
Department of Psychology

How do people decide whether a stranger might be able to help them, or even whether it is safe to approach that person? Previous research has demonstrated that a brief glimpse of a face is enough for you to make a judgment about the trustworthiness, competence, and potential threat of a stranger. This study explored the role that the left and right brain hemispheres play in judging personality traits of individuals whose faces are presented very briefly on a computer screen. Participants rated the competence and aggressiveness of 100 faces, each presented for only one-tenth of a second. The faces had been carefully constructed so that the left and right halves of the face could display different levels of the emotional expressions related to dominance and threat. Of the 100 faces, 25 were HH (high level of dominance/threat on both sides), 25 were LL (low on both sides), 25 were HL (left half was high, right half was low) and 25 were LH (left half was low, right half was high). Current theories of face perception suggest that the features displayed in the left visual field of the viewer (projected to the right hemisphere of the viewer's brain) should have greater impact on the viewer's rating of each face, due to the right hemisphere's general dominance in processing emotion signals.

PSYCHOLOGY

Vive la Musique: The Relationship Between Music Experience and Phonological Accuracy in Second-Language Learners of French

Corinne Schild and Kirsten Peterson
Mentor: Dr. Sonja Trent-Brown
Department of Psychology

While it is obvious that music exposure trains the ear over time, the extent of this training is not fully understood. This study seeks to discover whether musical sensitivity of the ear correlates with phonetic sensitivity; that is, whether different frequency experiences of music correlate to tuning frequencies that specify vowels. Comparison of the French and English vowels produced by upper-level language learners will allow examination of the variables which might influence the production of native-sounding vowels. This study seeks to determine which variables influence the production of vowel sounds. It is hypothesized that musical background, both experience and aptitude, perceptual accuracy, and time spent in a French-speaking country will influence phonetic authenticity in the second language of French. Participants from French classes level 300 and above completed both a musical experience questionnaire and a language background questionnaire. Perceptual tasks were administered, including Gordon's (1989) test of music aptitude and a perceptual task requiring participants to identify whether vowel sounds produced by a native balanced bilingual speaker were produced in French or in English. Participants were also recorded speaking in both languages so that their utterances could be measured for target accuracy compared to the native speaker's productions. Results for the language perceptual listening task indicate that listeners were more accurate in their perception of French targets than for English. Music perception outcomes present a range of audiation performance scores from the 41st to 87th percentile for musical aptitude. Comparison of the perceptual data with acoustic analysis outcomes sheds light on a complex interaction of contributing influences.

PSYCHOLOGY

Out of the Mouths of Babes: Acoustic Variation in Child Speakers

Ryan Tussey, Jacqueline Canonaco, Chelsea Lynch and Elizabeth Van Oss
Mentor: Dr. Sonja Trent-Brown
Department of Psychology

In a classic study, Hillenbrand, et al. (1995) conducted an analysis of the acoustic features of American English vowels and published target acoustic descriptions of spectral (pitch) and temporal (duration) features for men, women, and children ages 10-12. Results were presented for "children" and were not broken down for gender, likely because children typically achieve their lower adult voice later in adolescence—age 14 for girls and age 15 for boys. However, there is a gradual lowering of the voice beginning with the onset of puberty, which can begin as early as age 10. As the lowering of the voice occurs, the fundamental frequency (F_0)—the characteristic resonance of the vocal tract—is lowered. F_0 influences the formant frequencies for the phonological space, which could produce differences across gender, especially for the 11 and 12-year-olds. In addition, no mention was made of speaker ethnic background for either adult or child speakers, and studies have suggested that there is evidence of both perceptual and acoustic variation with respect to speaker ethnicity (Trent-Brown, et al., 2009). Child speakers ages 8-12 were recorded producing words and sentences. Acoustic variation was measured in terms of differences in temporal and spectral acoustic features such as vowel duration, F_0, and formant resonance frequencies. A multivariate analysis of variance showed significant differences for both age and gender. For gender, there was a significant F_0 variation, with higher values for girls than for boys. For age, F_0 varied such that as age increased, fundamental frequency decreased. These findings are in the predicted direction, mirroring adult patterns, suggesting that gender and age are also acoustically important considerations for children.

Effects of Speaker Characteristics on Speaker Identification by European American Listeners

Chelsea Lynch, Ryan Tussey, Jacqueline Canonaco and Elizabeth Van Oss
Mentor: Dr. Sonja Trent-Brown
Department of Psychology

This study examined perceptual identification of African American and Caucasian speakers by undergraduate Caucasian listeners (N=281; 124 male, 157 female). Listeners responded to auditory stimuli presented in forward and reversed temporal conditions varying by level of phonetic complexity (sentences and monosyllabic words). It was predicted that speaker characteristics would have significant effects on measures of listener accuracy of identification, identification reaction time, confidence ratings, and rating reaction time. Results showed significant main and interaction effects with regard to manipulations of phonetic complexity and temporal condition, as well as speaker ethnicity and speaker gender across the four dependent measures. Speaker characteristics do, in fact, contribute to speaker identification. These findings suggest important implications for educational, forensic, and business applications with respect to linguistic profiling and perceptual stereotyping.

SOCIOLOGY & SOCIAL WORK

The Milk and Medicine Program Evaluation: Lusaka, Zambia

Lindsey Nicole Boeve
Mentor: Dr. Deborah Sturtevant
Department of Sociology and Social Work

The HIV and AIDS epidemic is sweeping through Zambia, Africa at an unsettling rate. This epidemic plays a dramatic part in the increase of orphans and vulnerable children. The Christian Alliance for Children in Zambia (CACZ), a faith-based, non-governmental organization, implemented its Milk and Medicine Program in 2004. CACZ's goal is "to improve child health and strengthen families to prevent child abandonment and institutionalization." The program distributes nutritional supplements and medicine and provides limited social work support for those involved in the program. It has served approximately 300 children since its inception. This research seeks to understand the efficacy of the Milk and Medicine Program.

The purpose of this ongoing research, conducted annually through 2012, is to provide an understanding of the aggregate data to enable CACZ to provide services to orphans and vulnerable children so that they may thrive. This particular study analyzed over ten variables that included weight and age comparisons to Zambian normal growth charts for a sample size of 118 children. It was found that upon admission to the program, 92 (78%) children were underweight. At the conclusion of the 2009 study period, 77 (65%) of the children remained underweight. Based on these findings, recommendations for improving the program included increasing the amount of formula based on weight and age, adding vitamin and mineral supplements, improving and standardizing record keeping, and adding distributing sites. The results demonstrated a strong relationship between length of time in program and weight gained, and supported the case for long-term infant feeding programs for orphaned and vulnerable children.

This research was supported by The Alliance for Children Everywhere.

SOCIOLOGY & SOCIAL WORK

Measuring Childhood Obesity and Wellness: A Pilot Study

Trevor Lake, Kaitlyn Leikert, Matt Herm, Chad Buchholz, Jana Miller, Scott Roden and Lindsay Tracy
Mentor: Dr. Roger Nemeth
Department of Sociology and Social Work

Childhood obesity has become a major health and social problem throughout America. In an effort to measure the severity of the problem for local youths, basic health and wellness data were collected on 177 students at Quincy Elementary School. In addition to measuring students' height and weight, parents were surveyed about their child's eating habits and level of physical activity. Students' Body Mass Index (BMI) scores reveal that a higher percentage of Quincy students were overweight and/or obese than national averages for children of similar age and gender. The percentage of students classified as overweight or obese did not vary significantly by gender. Findings from the parent survey indicate that the amount of time local students watch TV/DVDs, play computer games, and are involved in vigorous physical activity is consistent with national averages for American children of similar ages. These findings are also consistent with findings from a 2003 study of Holland area youth. Parents report that their children eat five or more servings of fruits and vegetables (the recommended daily amount), an average of only 1 to 3 days per week. Likewise, most students drink milk only once or twice a week but consume an average of 1-2 bottles/cans of soft drinks weekly.

This research was supported by Hope College's Center for Faithful Leadership.

Parental Experiences and Religiosity in Young Adulthood: Does Parental Style Matter?

Lindsey Rhodes and Matt Herm
Mentor: Professor Pamela Ray Koch
Department of Sociology and Social Work

Every parent dreams of having their children grow up to be responsible adults who can contribute good to the world. Adolescents and young adults live in a battlefield of social pressure. One aspect that has been illustrated to reduce destructive behavior in adolescents and young adults is religion. For this reason, many parents include instilling religious commitment in their children as a parenting goal. However, many struggle in which parenting approach to utilize with their children. The goal of this project will be to investigate whether or not parenting style during adolescence is associated with religious involvement in young adulthood. Using four parenting styles (authoritative, authoritarian, permissive, and uninvolved) and the National Longitudinal Survey of Youth, this project looks at which parenting style leads to the most religiosity in young adulthood.

This research was supported by The Carl Frost Center for Social Science Research.