19th ANNUAL STUDENT RESEARCH & COMMUNITY ENGAGEMENT SYMPOSIUM

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Deficits in social interaction are one of the main diagnostic criteria for autism spectrum disorder (ASD), but the underlying cause of these social deficits is yet unknown. One possible explanation is a failure to develop theory of mind (ToM), an understanding that another person’s perceptions and beliefs may be different from one's own, i.e., that people have different minds. The influence of family contexts on ToM development in children with ASD has been generally understudied. Sibling research has been limited to examining the presence or absence of siblings, neglecting the potential contributions of individual differences in the sibling relationship. Our ongoing study examines aspects of sibling relationships in relation to ToM development in dyads consisting of a preschool aged child with ASD and an older typically developing sibling. We are examining individual differences in child behavior, sibling interaction, empathy, and theory of mind to test the hypothesis that preschool children with ASD will demonstrate higher levels of ToM development when their sibling relationship is more positive and marked by more frequent and sustained interactions. Preliminary observations are that sibling dyads differ substantially in the degree and type of interaction, which suggests that this is a fruitful avenue for study. These observations, the process of recruiting this sample, and the implications and limitations of this study will be discussed.

A common belief, among both psychologists and laypeople, is that people with high self-esteem are less aggressive than those with low self-esteem. However, empirical support for this hypothesis is mixed. We propose two reasons some studies fail to find support. First, these studies focused on whether people's self-esteem related directly to their aggression. But it is possible that people's self-esteem tends to be indirectly linked-through one or more intervening variables-to aggression. People's level of emotional intelligence may be one of these intervening variables. Those high in emotional intelligence are good at reading the emotions of themselves and others. Indeed, some studies show that the higher people's self-esteem the higher their emotional intelligence, while other studies find that the higher people's emotional intelligence the lower their aggression. The second reason some studies may not show an effect is that they did not assess possible gender differences. Women, on average, are less aggressive than men. As such, there may be gender differences in whether or how self-esteem is linked to aggression. The present study tested these ideas in a sample of undergraduate college students using an online survey. Results provided evidence that male participants' level of self-esteem indirectly linked to
physical aggression through emotional intelligence. Among female participants there was no evidence of this indirect link; instead there was evidence of a direct link between self-esteem and aggression. These results may help to resolve some discrepancies in the psychological literature as well as inform interventions aimed at reducing aggression.

Clark, K., Rydberg, J.
*Criminology & Justice Studies*
**THE EFFECT OF INSTITUTIONAL EDUCATIONAL PROGRAMMING ON PRISONER MISCONDUCT**
(Advisor: Jason Rydberg)

Past research on prison educational programming has largely neglected to examine the relationship, if any, between participation in these programs and prisoner misconduct. Although there has been no lack of studies linking prison education program participation with a decreased incidence of recidivism, there have been few that focus on changes in behavior of offenders while still in prison. With prisons under pressure to improve safety outcomes among inmate populations, an examination of the potential for institutional programming to reduce inmate misconduct is pertinent. Using recent advances in propensity score matching methods to manage selection bias, this study utilizes data from the National Survey of Inmates in State and Federal Correctional Facilities (2004) to assess the relationship between participation in prison educational programming and instances of prisoner misconduct.

Herrick, S., Omobono, A.
*Criminology & Justice Studies*
**ANALYZING INDICATORS OF DISORDER, COMMUNITY STRUCTURE, AND CRIME IN LOWELL, MA**
(Advisors: Kelly Socia, Melissa Morabito)

At the beginning of the 2015-2016 academic year, the Google Street View Research Team was created to look at two research questions. The first is whether or not Google Maps is as an effective tool to assess indicators of disorder and crime in Lowell, Massachusetts. Traditionally, these indicators of social and physical disorder (ranging from excessive litter, to graffiti and loitering) have been analyzed by hiring graduate students to use video cameras to capture footage of the streets, which would later be watched and coded. Although this method has worked in past studies, our team believes that this process may not be as cost-effective or as efficient compared to coding using Google Maps. The second question is whether or not areas with higher levels of disorder have higher levels of crime. The answers to both these questions may not only influence future methodology, but may also contribute to existing knowledge about the relationship between disorder and crime. Our team is comprised of two professors, two graduate students, and two undergraduate students. After we collaborated to develop a code book containing all possible indicators of disorder that were within an urban setting, the undergraduate students began to code the randomly selected block groups using Google Maps and the graduate students began to code the block groups using video footage. Although we have not been able to finish comparing the manually recorded footage and the observations from Google Maps, we hope to reach more conclusive results before the end of the year.
Imperillo, N.
Criminology & Justice Studies
TRENDS IN SENTENCING TERRORIST IN AMERICA
(Advisor: Neil Shortland)

Relatively little research has explored the issue of terrorist sentencing, and most research that has focuses on offenders prosecuted within the United States between 1980 and 1990 (see Shields, Damphousse & Smith, 2006; Smith & Damphousse, 1996, 1998; Smith et al., 2002). To address this gap this research looks at the sentencing of individuals associated with the Global Jihadist Movement (al-Qa'ida and its affiliates) who were convicted in the United States, for terrorist offenses, between 1995 and 2012. This project used open-source data to develop data on the sentencing of 183 terrorist offenders. Specifically, this data includes the offenses they were charged of, the charges they were convicted of, the length of their sentence and if the offender received a life sentence. In addition to this, this project collected data on the nature of the behavior that the individual undertook while operating as part of a terrorist organization; Specifically whether or not they were directly involved in terrorist violence. This research looked at trends in sentencing and the role of extra-legal factors such as time and environment. These results, together with the other data collected for this project, will support the ability of judges to make intelligence-based decisions when sentencing those individuals who have been involved in terrorist activity.

Mannarino, R.M., Fanale, K., Gilligan, B., Long, M., Ekeh, S., Cruz-Rivera, S.
Criminology & Justice Studies
TOUR TO EXPLORE
(Advisor: Susan Thomson Tripathy)

The goal of the GEAR UP and International Institute of Lowell Homework Help programs is to promote increased rates of graduation among disadvantaged, immigrant and refugee high school students while encouraging the pursuit of higher education. The programs promote collaboration among schools and students, providing students with resources needed to achieve success at all levels of academic pursuit. As college students ourselves, our service efforts at both sites are aimed towards first listening carefully to the students, so that we may provide guidance necessary to strive for success, as well as eliminating false limitations the students may observe. We hope that by working with the students, we will be able to represent to them the endless opportunities that await them. Our community contributions will offer students from Lowell High a student-guided tour of UML; a showcase of the programs, offices and resources they will need to succeed, as well as a panel discussion in which we will answer questions they may have regarding the aggregate college experience. Also, workshops concerning various college related topics will be given at Lowell High to address student inquires in order to contribute to networking with the community and promote participatory research. We are proud to be working at GEAR UP and International Institute in order to assist students through the application process, as well as navigate through the financial aid and scholarship processes; ensuring students have the resources and information that they need in order to build a better future for themselves.
Maravelias, B.
Criminology & Justice Studies
EXAMINING HIGH-RISK SETTINGS FOR SEXUAL AGGRESSION AT UML
(Advisor: Christopher T. Allen)

Sexual assault, defined as any kind of nonconsensual sexual contact or behavior, is a pervasive problem for college students. Research has found that at least 20% of women and 6% of men will experience some form of sexual violence while in college. If efforts to prevent sexual violence among college students are to succeed, research examining where sexual violence occurs is needed to inform prevention efforts. The present study examined where college students experienced sexual violence using the Revised Sexual Experiences Survey. Three hundred fifty-one first-year students enrolled in Introduction to Psychological Science (61.2% female and 38.8% male) attending UMass Lowell completed the survey. One hundred eight (30.8%) of students reported experiencing sexual violence during their first semester at UMass Lowell. Of the 108 survivors, 46% experienced multiple acts of sexual violence. With regard to setting, 49% of experiences took place in UML housing (i.e. - university-owned housing), 28% occurred in other locations on-campus (i.e. - academic buildings, sport centers, etc.), and 23% percent occurred off-campus. As many prevention strategies encourage intervention in more public and heavily populated settings, such as parties or bars, the high rates of violence experienced in university housing suggests the need for strategies specific to such settings. More research is needed to understand how sexual violence occurring in university housing differs from other settings on and off-campus and to develop effective, setting-specific prevention strategies.

Maroun, R., Jordan, K.
Criminology & Justice Studies
MINORITY THREAT AND CRIMINAL SENTENCING: EXAMINING JUVENILES IN THE ADULT CRIMINAL JUSTICE SYSTEM
(Advisor: Kareem Jordan)

Racial/ethnic threat has been researched regarding its impact on criminal sentencing. Past research has been fairly mixed, but a significant number of studies suggest that in areas of higher minority concentration, sentencing is generally harsher. Most of the existing research has utilized adult samples in testing this hypothesis. The current research adds to the existing research through the examination of juvenile offenders convicted in the adult criminal justice system. The data included a national sample of 3457 juveniles convicted in criminal court during 1998 across 40 counties within the United States. In this study, the racial/ethnic hypothesis was examined to assess its effect on sentencing among juveniles in the criminal system. The findings suggest some support for minority threat having an effect on sentencing decisions.
Croughwell, J.

**English**

“TICKETS ARE TWENTY-FIVE CENTS AND LADIES ADMITTED FREE”: HORSE RACING IN POST-CIVIL WAR LOWELL
(Advisor: Jonathan Silverman)

This project explores public expression of horse racing, and by extension sport, in Lowell's post-Civil War history by compiling information from local newspapers. Racing in Lowell took place regularly at the fairgrounds located near where the train station is now. The highlights of horse racing coverage come in 1872, when the city hosted The New England Fair at the fairgrounds, attracting more than 20,000 attendees. The paper also covered racing in other jurisdictions. But the coverage of racing was relatively limited despite its nationwide popularity. Initial inquiries focused on the nature of audience, particular in terms of class, race, and gender, but aside from a brief mention or a headline, the coverage seems to eschew this line of reporting. Judging from newspaper coverage from the Lowell Courier and Lowell Citizen from 1866 to 1890, horse racing, while a part of sports coverage and interest, did not feature prominently in the pages of the paper. Baseball, for example, received much more coverage. Because the research is ongoing, these preliminary findings may be supplemented by additional materials located in the Citizen and Courier, initial research suggests that while horse racing was a consistent presence, it was not a significant one. This research was directed by Dr. Jonathan Silverman of the UMass Lowell English Department. The Emerging Scholars program is sponsored by the Center of Women and Work, and pairs undergraduate students with faculty researchers for a collaboration that lasts for the school year.

Dingle, E.

**English**

EFFECTIVE METHODS OF PEDAGOGY AT UMASS LOWELL
(Advisor: Mignon Duffy)

The objective of this cross-sectional study is to assess effective methods of pedagogy at the University of Massachusetts Lowell per students' major and college. There exists a myriad of pedagogical theories in the 21st-century, and the application of such a pool of ideas and concepts is muddled, not only by the diversity of classroom contexts and their needs (from STEM labs, to writing workshops), but also the recent theories of learning styles not previously understood, nor recognized. This study's survey seeks to quantify students’ perceptions of their own learning styles through the framework of Dr. Howard Gardner's research on Multiple Intelligences (MI), as well as the teaching styles and factors that have caused them to learn most effectively within classes specific to their major(s). The latter assessment takes the form of pedagogical theories (Cognitivism, Revised Taxonomy, Andragogy, etc.) operationalized into statements reflecting various classroom scenarios, which respondents will mark the level of importance each had on their ability to learn. The results of this study may prove beneficial for curriculum development, as well as for professors seeking to assess their pedagogical goals within their own classroom contexts.
McDonough, K.  
*English, Emerging Scholars*  
FROM A SHAWL TO A SHIELD: DOMESTIC OBJECT AS SELF PROTECTION  
(Advisor: Marlowe Miller)

Objects in literature have the capacity to convey meaning or tell a story; they may have personal significance for characters within a novel, or they may be symbolic representations of ideas or themes. In some cases, objects illustrate societal norms, expectations, or even gender roles. This social function of an object is especially evident when said object is an article of clothing that is typically classified as masculine or feminine. Throughout her novel, *To the Lighthouse*, Virginia Woolf makes repeated references to two shawls belonging to the central female character, Mrs. Ramsay. They are commonly analyzed as symbols of her maternal instincts and nurturing qualities; however, I would like to assert that they hold a more complex meaning. Although the shawls may represent Mrs. Ramsay's desires to fulfill her gendered role of protecting and preserving her children and her family, these objects also represent her desire to move beyond societal expectations and assert protective power over herself. Her shawl is not simply a cloak or covering; it is a shield. This novel, closely linked to Woolf's personal family heritage, was published simultaneously in England and America. Through archival research at Smith College, guided by Professor Miller, I am examining not only the first editions of *To the Lighthouse*, but also the page proofs for the first American edition. I would be grateful to have the opportunity to present my work supported by textual reference, alongside developing research regarding the editorial history of this novel.

Nizami, S.  
*English, Psychology*  
PAUL MARION BEAT AUTHOR COLLECTION  
(Advisor: Mehmed Ali)

During the late 1950s, after the recent World War and the boost in capitalism, people began to question the conventions of society. They were disillusioned by the rife materialism of this time and they called for a more open and expressive discussion regarding the illicit topics of sex, drugs, and other provocative subjects. The Beat Generation was a group of like-minded individuals who wrote and sought after a more truthful and authentic writing experience. The central group of Beat Authors were Jack Kerouac, Herbert Huncke, Allen Ginsberg, Lucien Carr, and William S. Burroughs, all of whom had meet in New York, during Kerouac's time at Columbia University. The Paul Marion Beat Author Collection represents the dedication of writer and editor Paul Marion himself, containing materials on not only the life of Jack Kerouac, but the work and influence of the Beat Authors and scholars, the Kerouac Literary Renaissance, and the worldwide resurgence of the Beat Generation's work. This digital archive will continue to grow as more items are uploaded and meticulously categorized. The collection was created by the work and dedication of the students and faculty of UMass Lowell and embodies the spirit of the Beatnik Generation, which will be shared with not only the students, but the entire community of UMass Lowell.
Santos, S.

English

(Advisor: Jenna Vinson)

Pregnant and mothering teenagers were once invisible in the American public sphere. However, beginning in the 1970s, national media outlets continually represented the so-called phenomenon of "babies having babies." Thrust into the spotlight, expectant young mothers were represented as naïve, selfish, and welfare abusers by mainstream media. Research by Deirdre M. Kelly (2000) and other scholars has analyzed and challenged the problematic discourse surrounding pregnant teens. However, no research has yet been done to examine the role visuals play in persuading the public to see teen pregnancy as only a problem. To fill this gap, this research project included the collection of articles representing pregnant and mothering teens in New York Times, USA Today, TIME Magazine, and Newsweek from 1985-2000. Themes identified as prevalent across the articles, such as "teen pregnancy prevention" or "the exceptional teen mom," were used to then systematically code articles. The frequency of specific themes in publications each year was counted to reveal trends. Finally, images of pregnant and mothering women used in the articles were examined and coded to identify visual rhetorical patterns. This poster will highlight the methodology used to search, collect, and code the articles; the visual rhetorical method of analyzing the images; and the application of feminist interpretative frameworks. Preliminary findings will also be discussed.

Andzenge, A.K.

Global Studies, Center for Program Evaluation

ASSESSING THE RELATIONSHIP BETWEEN GENDER IDENTITY AND RISK TAKING BEHAVIOR
(Advisor: Jill Lohmeier)

Most research into the relationship between gender and risk taking tend to rely on either male/female or masculine/feminine definitions of gender. However, this approach is inadequate and misleading as more knowledge on the complex nature of gender accrues, especially as many individuals today do not identify themselves by these clear dichotomies. Furthermore, research on gender and risk taking tends to focus on specific areas of risk taking, such as financial risk taking or the risk taking behavior of adolescents. This study addresses the question of how different gender identities, influences risk taking behavior across multiple domains. Using a survey of latent variables from a sample of 108 participants, this pilot study evaluates this question. Multiple linear regressions were conducted to analyze the relationship between the variables of interests. Preliminary findings indicate that risk taking behavior is domain specific, and that having a more masculine identity or trait makes individuals more likely to take risks in the social and investing domains in particular.
Pruitt, G.M.
*Global Studies*
LEGACIES OF GENOCIDE AND COLONIALITY: INDIGENOUS WOMEN AS MECHANISMS OF IDENTITY DESTRUCTION IN THE 20TH CENTURY TERMINATION ERA
(Advisor: Paula Rayman)

From Gloria Anzaldúa to Esther Belin, women of marginalized communities promote ideas of hybridity and contemporary reclaiming of identity. Yet this reclamation comes only with the international norms shift toward peoples' self-determination. Prior to this shift, assimilation policies enforce denial of culture and history of marginalized groups, especially indigenous peoples. While liberal democracies abandon domestic mass killing policies in favor of 'peace,' the issue of genocide still persists, through policies targeting the elimination of indigenous culture and tribal identity. Initial questions seek to understand the issue at a deeper level. Why were these policies enacted after transition to liberal democracy? How do these policies affect native peoples? What do these policies mean for native identity? Yet a trend within the policies' documents also prompts the issue of gender in relation to the native identity. Addressing the concerns of Anzaldúa and Belin, this paper seeks to understand the gendered aspect. Specifically, how do the assimilation policies affect indigenous women's identity? The paper argues that assimilation policies deculturate indigenous women's identities as a mechanism of root-and-branch cultural genocide. It recognizes the persisting inequality created by institutionalized racism and further, the ostracizing of indigenous populations from society's universe of obligation.

Ramirez, T.K., Turcotte, D., Adejumo, K.
*Global Studies*
LIFE CYCLE COST ANALYSIS COMPARING THE CONVENTIONAL AND A BIO-BASED MANUFACTURING PROCESS FOR A WIND TURBINE BLADE
(Advisor: David Turcotte)

Rising concerns about the environment and quality of products have created skepticism regarding the characteristics of truly sustainable renewable energy technologies. Harvesting wind energy is more sustainable than conventional electricity generation, but some aspects challenge it as a wholly sustainable process. This research conducted a life cycle cost analysis (LCCA) that compares the conventional manufacturing process of a wind turbine blade with a bio-based process that utilizes epoxidized linseed oil instead of epoxy resin. We take a cradle-grave approach and estimate the total life cycle cost (LCC) of the blade for each of the two manufacturing processes. Our LCCA includes economic, social and environmental components. Results suggest that under very conservative assumptions, the LCC of both manufacturing processes are very similar. Cost savings from material and energy consumption in the bio-based process may be offset by the cost that may be incurred when switching to a new manufacturing process. However, changing the assumptions regarding the potential expected benefits of the bio-based substantially increases cost-savings, making the bio-based cheaper than the conventional over the life cycle of the blades.
Carlo-Gonzalez, C., Whitten-Woodring, J.

History

LET’S REPORT IT: MEDIA FREEDOM, MEDIA ACCESS, AND GAY RIGHTS
(Advisor: Jenifer Whitten-Woodring)

Historically, gay men and women have been among the earliest and most voracious Internet users in countries where they are isolated due to high-levels of discrimination based on sexual orientation and gender expression. In many countries, efforts to advance an international human rights norm have faced local resistance to gay rights even as societal acceptance of other categories of rights (e.g. women's rights, labor rights, children's rights, etc.) has been championed by state actors and achieved marked progress since the 1948 adoption of the Universal Declaration of Human Rights. So what accounts for this variation in societal acceptance of gay rights compared with other rights? We argue that the combination of media freedom and Internet access provides gay activists the freedom to organize online that has been traditionally denied to them offline due to discrimination, including laws criminalizing homosexuality and cultural practices promoting identity-based persecution. We test our hypotheses across countries and find that the combination of media freedom and internet access has a positive impact on gay rights, but without media freedom, internet access no effect.

Kenney, A., Penh, Y., Ciociolo, J., Aung, J.

Liberal Arts

CULTURES OF LOWELL: ARTWORK BY REFUGEES FROM BURMA
(Advisor: Susan Thomson Tripathy)

The purpose of this project is to promote awareness of the SayDaNar Community Development Center and the work they do to help the Burmese Refugee community in Lowell, Massachusetts. Founded in 2012, SayDaNar's mission is to help promote self-help and the ability of immigrants and refugees to advance their overall life in the United States. In the interest of sharing social and cultural experiences and mutual learning in the community, our group of volunteers assists Burmese refugee students with educational and social support through the after-school homework help program. This program helps and supports Burmese refugee students with their homework by providing thirty hours of community service from volunteers who speak English as well as languages from Burma. This not only helps children with their homework overall, but also provides interactions with local volunteers, which can increase educational success. In addition to helping with homework, our group of volunteers will assist in showcasing artwork created by the refugee students. This art exhibit will take place during the Burmese Food Fair, to be held in May. At this fair, members from the Burmese community prepare and sell food from their cultural background, and also perform traditional Burmese dancing and music, to promote the importance of cultural diversity. The fair will help SayDaNar raise money for homework supplies to help students learn and succeed.
Santana, D., Penh, Y., Parravano, D., Brunelle, A., White, C., Paras, S.

Liberal Arts

ORGANIZING THE UMASS LOWELL PARENTS CLUB
(Advisor: Susan Thomson Tripathy)

UML is dedicated to transformational education that fosters student success, lifelong learning and global awareness (UML Mission). Among the top 200 research universities in the U.S., UML not only provides extraordinary education to its more than 16,900 students, it also promotes equality, social awareness, and community support. Despite all the achievements of this amazing university, we the students of the Honors Seminar on Homelessness in Lowell and Mumbai believe that UML is lacking some information about its demographics. There are many students among us who are not only pursuing a higher education but also a better life for their children, especially those who are living under precarious conditions or studying at UML while being homeless. Therefore, we would like to conduct a research study to determine how many student-parents UML has, and to start a Parents Club to provide support for them and their children. The UML Parents Club’s main purpose is to establish the first UML kid-friendly organization where current-and-expecting parents who are also students at UML can meet to share resources, as well as their own experiences inside and outside UML. Our goal is to provide them with unique opportunities for community building and professional/personal gain, such as fun/educational activities with their children, and workshops on social/personal topics like homelessness, finances, job training, housing opportunities, child care, time management, mental well-being, and so forth. To do so, we will also be partnering with Middlesex Community College and House of Hope.

Ciccarelli, L., Garcia, M., Robertson, M.

Music Studies

TEWKSBURY HOSPITAL TO THE MUSIC CLASSROOM
(Advisor: Gena Greher)

Many would agree that competence in a subject is what makes a great teacher while empathy is often overlooked as a valuable teaching trait. What's wrong with possessing both qualities? Through assisting in music therapy sessions at Tewksbury Hospital, we discovered that music can naturally evoke this kind of empathy in teaching. Music as a language has a way of breaking down barriers to allow for greater expression. In sharing this expression, the ego is forced to surrender leading to a richer learning experience. From a therapeutic point of view, the goals of the music classroom are largely redefined and put into a humbler perspective. It is no longer about reaching a general musical standard but about surpassing individual limits. The music therapist we worked with exhibited supreme flexibility in session plans, an acute awareness of patient response, and of course fearless compassion and empathy for every person that walked through her door. We suggest that the key traits a music therapist must have to help their patients can also be applied by music teachers in order to strengthen their students' learning experiences.
Degou, L.
Political Science
THE IMPACT OF MARIJUANA LEGALIZATION IN THE US ON TRAFFICKING DYNAMICS IN DRUG PRODUCING AREAS
(Advisor: Angelica Duran Martinez)

This research explores the impact of the change in certain U.S drug policy in recent years. More specifically, this research addressed the idea that the legalization of marijuana in states like Colorado, Washington, Alaska and Oregon may have an impact on the current trafficking dynamics established not only in the United States but throughout the Americas. Will marijuana still be smuggled in and sold illegally in these states? Will the drug stop being trafficked alongside other serious drugs and therefore be differentiated from other drugs and their sale/use? This research overall goes towards furthering insights on three key areas regarding drug use, production and transportation norms in the world. The first is the connection between the dynamics of drug distribution in the United States and the criminality in countries like Mexico and Colombia. The second aspect which is exemplified in this research directly is the possible impact that changes in United States drug policy could have on criminal networks abroad. Are states in which marijuana is legal still smuggling the drug in? If not, how is this changing the functionality of the crime networks abroad? The final area being explored is how to better connect research on drug trafficking in the United States with similar research on trafficking dynamics in other countries.

Adragna, R.
Psychology
LEARNING SCIENTISTS
(Advisor: Yana Weinstein)

The "Learning Scientists" community project aims to educate teachers and students about effective learning strategies, and motivate students to utilize them. By using optimal learning strategies, students can be more prepared for tests, and retain information longer. This information can also equip and encourage educators to use evidence-based methods in the classroom. We are achieving this by making scientific research available and understandable to the teachers and students who might benefit from the findings. The Learning Scientists use a blog, Twitter, and a Facebook group to communicate with the public about the science of learning. The blog includes "how to" guides for learning strategies, summaries of learning science research, and weekly digests on relevant topics.

Bard, G., Weinstein, Y.
Psychology
THE EFFECT OF QUESTION ORDER ON EVALUATIONS OF TEST PERFORMANCE: HOW DOES THE BIAS DISSOLVE?
(Advisor: Yana Weinstein)

Question difficult order has repeatedly been demonstrated to affect students' metacognitive judgments. When test questions are ordered from easiest to hardest (EH), students' self-evaluations of performance after taking the test - known as global postdictions - are far more optimistic than when the same questions are arranged from hardest to easiest (HE). The aim of
the current research was to try to eliminate the bias by providing participants with a study opportunity prior to the test. Participants studied 50 general knowledge questions with their corresponding answers for five minutes in either EH or HE order and subsequently took the test in the same order. After the study phase, participants were asked to provide a prediction of their test performance and then proceeded to answer all 50 questions and make a global postdiction. Our results indicate that the question order bias is highly robust and stable, and therefore very difficult to eliminate. The study phase did not eliminate the bias, and unique to this study, we found that participants already showed the bias in their predictions of performance before actually taking the test. This new finding is important because the presence of the bias before the test means that question order difficulty may affect students' learning behaviors (e.g., how long they choose to study, or which material they choose to focus on). It is critical for teachers to keep this bias in mind as they construct practice tests, homework problems, and examinations so metacognition is not impaired.

Bizeur, S., Zylkuski, N., Mahoney, S.

Psychology

THE SEARCH FOR IMPPLICIT BIAS IN DISCIPLINARY DECISIONS AND THE SCHOOL-TO-PRISON PIPELINE
(Advisor: Doreen Arcus)

Previous research has shown an overrepresentation of students with disabilities among those who are suspended from public schools, especially for offenses that are not severe. School suspensions have been shown to place students at risk for dropping out and the many negative developmental consequences associated with drop-out (or in this case, push out), including risk for criminal justice involvement. There may be many contributions to this phenomenon, known as the School-to-Prison pipeline, including bias on the part of those making disciplinary decisions. The suggestion of bias has not yet tested experimentally. To the degree to which bias contributed to longer suspensions our group developed a Disciplinary Review Board Simulation (DRBS), designed to test how participants would rate offense descriptions when they believed the same offense was committed by a student with a disability or one without, and whether the offender was a male or female. When asked to play the part of disciplinary review board members, undergraduates assigned longer suspensions to students with disabilities, especially girls, compared with students without disabilities. We are currently testing the DRBS with educators to pilot this method in the field and determine whether our results hold. Implications will be discussed.

Chapin, J., Soares, B.

Psychology

STE. JEANNE D'ARC ELEMENTARY SCHOOL SERVICE-LEARNING PROJECT: DES MÉTHODES D'ENSEIGNEMENT DE LA LANGUE FRANÇAISE
(Advisor: Danielle Boutwell)

As part of our French 4 Language & Culture class, we took part in a 9 week-long service-learning experience at the Ste. Jeanne D'Arc Elementary School in Lowell, MA. During these nine weeks, under the supervision of Mme Steeland, the school's French instructor, we helped teach 1st and 3rd graders various French vocabulary and grammar. During our time in the classroom, we played numerous educational games, sang songs, and observed 6-8 year old
children learn French vocabulary and grammar. Some of the classes we instructed were more advanced than others. As a result, we were able to witness how the classroom games and activities affected children with different levels of French understanding. This program showed us different ways in which language can be taught. For example, a variety of memory-based games were used in the classroom to promote acquisition of French vocabulary words. This experience not only reinforced our own knowledge of French that we gained from UMASS Lowell's Department of World Languages and Cultures' French program, but also gave us a glimpse into how children learn second languages. The time spent in the classroom taught us a great deal about language instruction, and we will take the knowledge we obtained from our time at Ste. Jeanne D'Arc Elementary School with us when we embark on our future personal and professional endeavors.

**Deckoff-Jones, A.**

*Psychology*

**DISABILITY ACCOMMODATIONS ON UNIVERSITY CAMPUSES**

(Advisor: Mary Duell)

The Americans with Disabilities Act (1990) requires that universities provide accommodations to their students with disabilities. However, there are a number of factors that influence whether students with disabilities are actually granted the accommodations that they need. Disability type is important because both physical (Dalgin and Bellini, 2008) and learning disabilities (Carpenter & Paetzold, 2013) are less stigmatized than psychiatric disabilities. Furthermore, people with visible disabilities are more likely to be granted accommodations because visible signs of disability make the need for accommodations more salient (Santuzzi, Waltz, Finkelstein, & Rupp, 2014). Finally, non-disabled individuals will judge an accommodation request based on whether they believe it is needed by the person with the disability (Collela, 2011). The current research examined the impact of four disability types (visible physical, invisible physical, psychiatric, learning) and two accommodation types (accessibility, academic) on evaluations of appropriateness of accommodations for university students. Participants included 194 undergraduates from the University of Massachusetts Lowell who were emailed a link to the online experiment on SurveyMonkey. Preliminary results revealed a significant interaction between disability type and accommodation type. Physical disabilities received higher appropriateness ratings for accessibility accommodations, and learning and psychiatric disabilities received higher appropriateness ratings for academic accommodations. However, visible physical disabilities received higher appropriateness ratings for accessibility accommodations than invisible physical disabilities, and learning disabilities received higher appropriateness ratings for academic accommodations than psychiatric disabilities. The results provided insight into the factors which influence whether students with disabilities receive the accommodations they need in real life situations.
Gilbert, K.

*Psychology*

**THE EFFICIENCY OF STUDYING RELATED READING AND VIDEO CONTENT SIMULTANEOUSLY OR SEQUENTIALLY**
(Advisor: Yana Weinstein)

In order to study course material in a shorter amount of time, students often multitask while completing their coursework. This study investigated the efficiency of studying related reading and video content either simultaneously or sequentially. Participants in this study were randomly assigned to either the sequential, simultaneous, or simultaneous extended time condition. In the sequential condition, participants read an article and then watched a related video, or vice versa. In the simultaneous method condition, participants read and watched a related video at the same time. Lastly, in the simultaneous extended time condition participants read and watched a related video at the same time, and then repeated this simultaneous reading and watching activity, so their total time spent studying was matched with the sequential condition. Following the reading and video, all of the participants completed a final multiple choice test assessing their memory of the information presented in both the reading and video.

Harfst, B.

*Psychology*

**SAINT JEANNE D'ARC SERVICE-LEARNING PROJECT**
(Advisor: Danielle Boutwell)

As a part of my French 4 & Culture class, I participated in a nine hour long Service Learning project at the Sainte Jeanne d'Arc Elementary School this semester. The Sainte Jeanne d'Arc Elementary School is a private, catholic elementary school located in Lowell, MA. I helped the French instructor, Madame Steenland, instruct and evaluate 2nd, 3rd, 5th, and 6th grade students. Methods of instruction included singing songs, playing games, completing written exercises, reading stories, and administering assessments to help the children learn French vocabulary and grammar points according to the curriculum. While instructing the class through these methods, I observed the students learn French vocabulary and grammar in small increments and in real time. I also was able to assess which of the methods seemed to have the most impact on the children's progress learning the material. Each of the grades I taught were separated into two groups, one of which was more advanced. During my time at Ste. Jeanne d'Arc, I observed the differences in ability and learning styles between the two groups in each grade as well as the differences between the grades. This project not only allowed me to further my knowledge of the French language and widen my French vocabulary through conversation with Madame Steenland, but also allowed me to gain knowledge about the process of learning and the uniqueness of the individual students within the classroom.
Janard, B., Canning, A., Coppola, A., Santana, D., Menardy, C., Pryor, R., Francis, T., Denaro, T.

*Psychology*

**PALS UMASS LOWELL MENTORING PROGRAM**
(Advisor: Susan Thomson Tripathy)

Partners in Achievement of Lowell Students, PALS, is a mentoring program for at-risk students at Lowell High School (LHS). PALS not only helps the Lowell youth achieve goals such as a higher education, completing advanced training, and securing a job, it also encourages community involvement, and self-improvement. "PALS was founded on a belief of a strong and meaningful relationship with a positive role model will facilitate the engagement of students in their learning community" (The PALS Program). The PALS program partners with UMass Lowell to bring together college students and high school students to form a mentor-mentee relationship. We as mentors have an important influence in our mentee's life and our goal is to form a positive relationship. Once a week, we meet with our mentee at Lowell High School or outside the school's facilities. We also have group meetings every Thursday at LHS in which we participate in activities with our mentees and other mentor-mentee partners. It is important for PALS students to have a positive role model in their life and a successful person to look up to. Our influence is a vital part to their success and progress. By creating a friendly, fun and safe experience for at-risk youth through the PALS program at LHS, our goal is to encourage them to pursue a higher education, and explore opportunities outside of high school while establishing a positive mentorship connection with current UMass Lowell students.

Ross, K.

*Psychology, Criminal Justice*

**CAMBODIANS OF LOWELL IN POLITICS**
(Advisor: Mehmed Ali)

Lowell is one of the most historically and culturally rich cities in Massachusetts. Its prestigious legacy of diversity and innovation has been bolstered by the various waves of immigrant groups throughout its history. Beginning in the 1980s during the genocidal reign of Pol Pot and the Khmer Rouge, Lowell experienced a huge influx of Cambodian refugees and immigrants. These individuals, who boast a vibrant culture and unique set of circumstances surrounding their immigration, have had a significant effect on the sociopolitical makeup of Lowell. The city is now home to the second largest population of Cambodians in the US, many of whom are small business owners, venerable monks, and politicians. The Cambodian citizens of Lowell have made viable progress in overcoming the challenges of their tumultuous exit from home, tenuous economic circumstances, maltreatment from their peers, and vast cultural differences. Khmer citizens are now prominent figures in local sociopolitical institutions such as the CMAA, and are active in local politics, with representatives in city and state legislature. These individuals are among the first Cambodian-Americans to be elected to offices, and represent significant historical markers for the US and for Cambodian-Americans alike. This LibGuide delves into the history of Cambodia, the US, Lowell, and how they intertwine; it also examines the bidirectional impact of history-making Cambodians on the politics and society of Lowell.
Tilton, N., Tran, S.

Psychology

FORAGING AND OBJECT MANIPULATION IN WESTERN LOWLAND GORILLAS
(Advisor: Mary Duell)

Our research focuses on two captive Western Lowland Gorillas, Azize and Gigi, who are living at the Franklin Park Zoo. We will be observing the foraging and object manipulation behaviors in both of these individuals. Azize is the youngest in the group, and is still nursing and learning how to forage on his own. Gigi is the oldest, and among the lowest in the hierarchy, and we are interested in the way she forages and interacts with various objects in their enclosure. The differences between the developing and developed individuals are meant to provide a contrast in the foraging styles of gorillas across the age spectrum. This research is meant to lay a foundation for future research on the cognitive processes of Western Lowland Gorillas. Preliminary findings from our initial observations will be discussed.

Tobey, B.

Psychology

THE DARK SIDE OF MENTORING
(Advisor: Michelle Haynes)

This study investigates whether having a mentor impacts the allocation of credit for successful work outcomes of male and female mentees differentially. Previous research has shown that when women and men work together on a team and have produced a successful work outcome, men receive more credit for that success than women (Heilman & Haynes, 2005). Heilman & Haynes (2005) tested, and found support for, the notion that it is the ambiguity regarding individual contribution (often found in a team context) that creates the opportunity for stereotype-based expectations to color evaluations. The purpose of the current study is to explore the extent to which other collaborative contexts, such as mentoring, may produce similar effects. Specifically, we tested whether having a mentor impacts how men and women are evaluated in terms of their contributions to a successful work outcome. One-hundred and twenty participants came into the lab and read about a male or female employee who completed a work task successfully. Participants learned that this person had a formal mentor, an informal mentor, or no mentor (control condition). While the data are currently being analyzed, preliminary results support our hypothesis that female mentees are disproportionately more likely to be derogated in terms of their contribution to the success than male mentees. Implications will be discussed.

Tran, S.

Psychology

ANALYZING VISUAL ATTENDING IN PRESCHOOL CHILDREN
(Advisor: Richard Serna)

Teaching and training methods based on the science of Applied Behavior Analysis have been shown to be effective for children with intellectual disabilities and very young, typically developing children. A key aspect of such teaching and training involves discrimination learning. This type of learning concerns the ability to discriminate between one stimulus, such as objects,
numbers, letters, and spoken words, and another stimulus that has similar features in common. Acquiring this ability is critical to subsequent success in pre-academic- and communication-relevant learning. There have been various methods developed that have achieved much success in teaching stimulus discrimination, but some children struggle with such learning. One potential factor is a tendency for children to "over-focus" on the similar, irrelevant features that some stimuli have in common, instead of the distinguishing features. This phenomenon is known as overselectivity. This study investigates the overselectivity that occurs in some preschool children when stimuli have many features in common, such as the letters "M" and "N." To determine where on a stimulus a child is visually attending, eye-tracking technology is employed, which allows the researcher to track the child's precise point of gaze on stimuli that appear on a computer screen. This poster will present eye-tracking data collected to date.

Savali, M., Gilbert, K., Dingle, E., Miller, C.
*Sociology*
**HOSPITABLE FOR THE HOMELESS**
(Advisor: Susan Thomson Tripathy)

To be considered a home the environment is thought of as welcoming and comfortable for the residents. Homeless shelters, however, provide homes but may not have the ability to provide that comfort. The purpose of this project is to create a more hospitable environment for the staff, residents, and guests at the Lowell Transitional Living Center (LTLC). To achieve this goal, we will reach our goal of hospitality by providing aesthetically pleasing artwork, a collection of donated resources, and informational brochures for both the residents and the volunteers. Moreover, reaching this goal is beneficial because a hospitable environment will positively impact the staff and their continuing efforts to help individuals experiencing homelessness. Additionally, a hospitable environment will also provide these individuals experiencing homelessness with the comfort and support they need in order to get back on their feet. In order to evaluate the needs of the residents and guests at the LTLC we will conduct a short verbal survey to collect valuable information on how to improve the hospitality at the LTLC. Following the survey we will implement our efforts to improve the environment to meet their needs to help improve the LTLC's services to the homeless population.

Tzizik, M., Duffy, M.
*Sociology*
**BARRIERS SURVEY**
(Advisor: Mignon Duffy)

The purpose of this research is to identify the barriers that can prevent a student from graduating in a four year time frame. The survey identifies potential causes of a delayed graduation including, being a caregiver, having a job, and financial troubles. This research can benefit the university as a whole, so that they may gain a deeper understanding of their student population and the challenges that they each face. This survey is a part of a larger two semester long project that puts a spotlight on student caregivers and their experiences at UMass Lowell.
McManaman, P., Parmenter, C., Braz, B.
Sound Recording Technology
BEN BLAST’S SCIENCE CLASS
(Advisor: Brandon Vaccaro)

Audio is half the art of filmmaking. As Sound Recording Technology students with an interest in film, our research focused on creative audio use in the context of film to create engaging works for broad audiences. We entered the Videoblocks.com Student Film Competition and were selected as finalists with the film project we created. Our production, inspired by Bill Nye the Science Guy, was focused on teaching basic sciences in a fun and engaging way for young children. The episode covers water and its importance to life. We incorporated techniques such as green screen overlay, animation, and sound design as tools to create the light hearted and intriguing atmosphere for both children and adults. Both equipment provided by the school and the use of our own was helpful in learning the ropes of both the production and post production sides of filmmaking. The knowledge gained through our project has provided other Sound Recording students with the means to be more involved with filmmaking and production.

Collins, A.
World Languages & Cultures
SERVICE LEARNING PROJECT AT STE. JEANNE D’ARC SCHOOL IN LOWELL
(Advisor: Danielle Boutwell)

For my service learning project, I volunteered at Ste. Jeanne d'Arc Elementary School over the course of two months. I worked under the supervision of Mme Kathryn Steenland, the school's French teacher. Each week, I assisted her with some of her French classes for approximately two and a half hours. The students that I primarily worked with were kindergarteners. However, I also had the opportunity to work with the third grade students as well as the fourth grade students. Each week, approximately an hour and a half was spent interacting with the students, while the other hour was spent working one-on-one with Mme Steenland. My responsibilities included organizing and setting up activities, overseeing games and activities, aiding in the administration of exams, and helping Mme Steenland prepare the lesson for the following week. In the classroom, we employed a variety of interactive methods to enable the students to learn the assigned material. Auditory, visual, and tactile techniques were all used, and students were often asked to generate their own ideas. For example, the students learned songs, identified pictures, and constructed sentences using the given material. This exposed me to a variety of learning styles and enabled me to explain concepts to students in ways that match their particular learning style. Another key element was repetition, which was particularly important in terms of correct pronunciation. I incorporated all of these elements into my project by creating a musical memory game for the children. This provided the students with multiple sources of sensual stimuli, involved repetition, and required the students to recognize and utilize vocabulary, rather than just memorizing lyrics.
Isabel-Baez, M.  
*World Languages & Cultures*  
**STE. JEANNE D'ARC ELEMENTARY SCHOOL SERVICE-LEARNING PROJECT: LES JEUNES ÉTUDIANTS DE L'ÉCOLE STE. JEANNE D'ARC**  
(Advisor: Danielle Boutwell)

This semester, I participated in a Service-Learning project offered in my Advanced French Conversation class. The Service-Learning site was the Ste. Jeanne D'Arc Elementary School in Lowell, MA. Throughout my time at Ste. Jeanne D'Arc, I worked closely with the school's French teacher, Mme. Steenland, to teach children from kindergarten to sixth grade French. New concepts and materials were introduced to the younger children through songs, games, visuals (such as pictures and videos) and gestures. The older children focused more on learning through practice worksheets, repetition, and listening comprehension exercises. For my project, I wrote short songs that were aligned with Mme Steenland's curriculum and that aimed to help the fifth and sixth graders learn French verb conjugations. My time at Ste. Jeanne D'Arc Elementary School provided me with the opportunity to practice using French. I also was able to learn new vocabulary I had not learned before and refresh my mind on words I do not use very often. Volunteering at Ste. Jeanne D'Arc was an eye opening experience for me. It was amazing to watch children as young as five learn a new language and retain so much information. It was even more exciting to witness the children's enthusiasm for the French language. I believe it is important for everyone to learn another language, and I appreciate what Ste. Jeanne D'Arc Elementary School is doing to provide their students with the opportunity to develop foreign language skills.

Lacroix, A.  
*World Languages & Cultures*  
**TEACHING ENGLISH AS A SECOND LANGUAGE (ESL) TO LOWELL’S REFUGEE POPULATION: MY PRACTICUM EXPERIENCE AT THE INTERNATIONAL INSTITUTE OF NEW ENGLAND (IINE)**  
(Advisor: Carole Salmon)

This project features a synopsis of my French practicum experience (10 weeks) with non-English speaking political refugees through the International Institute of New England (IINE), located in Lowell, Massachusetts. As one of the oldest and largest, non-profit service organizations for new Americans in the region, the IINE seeks to assist refugees and immigrants in gaining valuable life, language and job skills, while in pursuit of self-sufficiency and integration within their new community. Under the tutelage of Sherry Spaulding (ESL Coordinator), I provided English as a Second Language (ESL) instruction and support in the classroom, as well as through other program offerings, such as the DRIVE Program. Additionally, I served as a research assistant to compile numerous websites, training resources and materials for future class planning and lesson building exercises. As a French major, I am not only able to communicate with the refugees in French, but I can also help those whose first language is French learn English. Many immigrants are currently from French-speaking Congo, located in Central Africa. I soon realized that the usefulness of my language skills surpassed the benefit of speaking another language and afforded me with a greater perspective of each immigrant's struggles, allowing me to connect with them.
on a human level. While our cultures and backgrounds may be very different, sharing this experience together traverses any existing gaps and barriers. ESL is a powerful tool for successful social and linguistic integration of the new immigrant population in Lowell as well as nationwide.

Stephens, J.
*World Languages & Cultures*

**TECHNOLOGY IN THE FRENCH CLASSROOM**
(Advisor: Carole Salmon)

This study demonstrates how the use of technology in the classroom improves students' learning of a foreign language. I worked with kindergarten through sixth grade students in French classes at Ste. Jeanne d'Arc Elementary School, a private Catholic school in Lowell, to determine which programs are most beneficial for improving students' conversational learning skills. Using Voki, an online program, I created assignments and class activities that allow students to record themselves speaking and hear their pronunciation. I also implemented Quizlet, an online study program with a teaching functionality allowing teachers to incorporate games, quizzes, and progress monitoring into class time and homework. Because many concepts taught in French classes repeat in higher levels, the earlier programs can be used as a review for higher grades.

The most important factors needed for each game or activity were quick start-up and close time, ease of use for both the teacher and the students, and an added benefit to the classroom. To test these programs, the teacher used them with her classes to determine if they were, in fact, helpful for the students. Because of the nature of the programs, the teacher was able to individually test students' knowledge without taking extra class time. The results of this study conclude that by using technology in the foreign language classroom, students are more attentive and more students are able to grasp the material faster and retain it longer. This demonstrates that technology in the classroom is in fact an improvement to the learning process.
The human intestinal microbiota is an essential to the health and wellbeing of the host. It plays greater role of immune response, pathogen resistance, nutrition and metabolism. In recent advances of bacteria genome sequencing, specifically in the discovery of 16S Ribosomal RNA regional sequencing; there has been an increased knowledge of gut microbiota functions and its role in health and disease. In well balanced gut microbial state promotes a good health. However, this balance is altered in the cases of prolonged antibiotic use or over growth of same opportunistic microbes. The use of probiotic supplement may reinstate and restore the composition of gut microbiome and enhanced beneficial healthy microbiome. In this poster, we reviewed the current knowledge of gut microbiota functions on immune system, intestinal barrier, nutrient absorption and pathogen resistance. We also reviewed the current knowledge of probiotics play on maintaining healthy gut microbiome. Our purpose is to rule out the unknown knowledge about probiotics on gut microbiota and diseases for development of a research proposal.

Community-acquired C. difficile infections are increasing in incidence and severity. While healthcare facilities strive to eliminate environmental C. difficile, the incidence and significance of C. difficile in home, workplace, and other public environments is unclear. Most isolation protocols are designed for use with stool specimens, therefore effective methods for environmental samples must be validated. In this study, 3 initial enrichment broths, 2 spore enrichment techniques, and 2 agars were compared for their ability to recover C. difficile from spiked and environmental samples. For spiked samples, C. difficile ATCC 43255 was used. For the initial enrichment step TSB, BHIB and chopped meat broth (CMB) were compared. Broths were subjected to no treatment, absolute alcohol shock or heat shock. For comparison of the two selective agars; Columbia CNA (CNA) and C. difficile selective (CCFA) were used. While CMB provided the best overall recovery, TSB with alcohol shock and CCFA was equivalent. TSB is less costly than CMB therefore we selected TSB, alcohol shock and CCFA as our protocol. Protocol was tested environmentally in 2 public restrooms at UMass Lowell and 2 homes. Environmental samples were processed raw and spiked as described above. All spiked samples were positive. All raw home samples and 1 university restroom were negative, but 1 university raw restroom floor sample was positive for C. difficile. This pilot study demonstrates that TSB as an initial enrichment broth followed by alcohol shock and plating to CCFA is a lower cost, effective method of isolating C. difficile from environmental sites.
Mohamed, H., Sudur, F., Orbey, N., Goodyear, N.
Biomedical Engineering & Biotechnology
STABILITY OF HYDROGEN PEROXIDE ANTIMICROBIAL ACTIVITY IN SILICA HYDROGELS: A PILOT STUDY
(Advisors: Nancy Goodyear)

Hydrogen peroxide is an effective, environmentally friendly disinfectant. However, it decays rapidly into water and oxygen, limiting its practical applications. Sol-gel chemistry can be used to microencapsulate H2O2 in silica hydrogels, in which the H2O2 binds strongly with the silica gel surface. The resultant hydrogels have potential usefulness in wound treatment, hand sanitization, and other disinfection applications. Freshly prepared and 4 month old gels at 0, 10, and 20 wt% were compared for activity against S. aureus and E. coli using a standard agar well diffusion method. Each gel was tested in 2 separate runs. Average zones of inhibition (ZOI) are consistently larger for S. aureus than E. coli, suggesting greater activity, however this must be further tested. The average difference in activity between 10 and 20 wt% is 4% for fresh gel and 16% for 4 month old gel. This suggests a non-linear relationship between gel wt% and activity, however the difference is greater for the older gel, implying that a higher concentration might be more effective for long-term storage. Antimicrobial activity diminished by an average of 30% over 4 months, but significant activity remained. We conclude that H2O2 can be stabilized in silica hydrogels for at least a 4-month period. Further investigations into ideal concentrations, stability, release rates, and antimicrobial activity are needed.

Nicoloro, J., Sun, Y., Goodyear, N.
Biomedical Engineering & Biotechnology
PERFORMANCE OF TWO ANTIMICROBIAL FABRICS IN SIMULATED REAL WORLD CONDITIONS
(Advisors: Nancy Goodyear, Yuyu Sun)

Antimicrobial fabrics are used in healthcare settings to prevent transmission of microorganisms via soft surfaces. Currently available antimicrobial fabrics contain quaternary ammonium compounds, N-Halamines, silver ions, and others. The current standard for determining the efficacy of antimicrobial fabric uses multiple swatches of fabric and 1 mL suspensions of S. aureus, K. pneumoniae, and optional additional species individually. However, in real use fabrics will be exposed to multiple organisms, organism combinations and organic soils such as body fluids. Previously, we developed a more realistic in vitro method for characterizing antimicrobial fabric performance utilizing artificial sweat, 5% serum, and mixed organisms. The goal of this study was to compare the antimicrobial activity of rechargeable N-Halamine fabric to a commonly utilized silver based fabric, X-STATIC® using our more comprehensive testing method. To date, both fabrics have been tested with standardized suspensions (7.5 x 10^7 CFU/mL) of S. aureus and E. coli alone and together in PBS, artificial sweat, and 5% serum. All tests utilized 1-ply fabric swatches, a 15 min contact time, and were run in duplicate with control swatches. Two test runs were performed for each set of conditions. On average, the N-Halamine fabric reduced the initial bacterial suspension by >4.00 log10 (99.5678%) in every testing scenario. The X-STATIC® fabric was not effective at reducing the bacterial suspension within the 15 min contact time, with an average 0.04 log10 reduction (<0.01%). Our findings demonstrate the N-Halamine fabric is superior to the X-STATIC® fabric using our modified testing procedure.
**Walsh, D., He, G.**  
*Biomedical Engineering & Biotechnology*  
**IDENTIFICATION OF A NEW ANTIMICROBIAL PRODUCING STRAIN**  
(Advisor: Guixin He)

Microbes are the source of antibiotics. There is an urgent need to find new antibiotics against the bacterium Pseudomonas aeruginosa. P. aeruginosa is the causative agent of infection in cystic fibrosis patients and it can develop antibiotic resistance. We screened water samples from various marine environments by using P. aeruginosa ATCC 39324 (PAcf), a strain isolated from a cystic fibrosis patient. If a potential antibiotic is produced by the isolated water microbe, there would be growth inhibition of PAcf near the streaked area. One isolate was confirmed to inhibit PAcf. The microbial isolate was identified by Gas Chromatography (GC) as Pseudoalteromonas nigrifaciens. The potential antibiotics produced were acetone extracted, and identified by GC-Mass Spectrometry (GC-MS) as benzophenone, 1, 2-butanediol, and cetene. These molecules could perhaps be used in clinical phase I trials in cystic fibrosis patients. This could lead to a possible cure for this terrible disorder.

**Ehi-Adoghe, O.**  
*Clinical Laboratory & Nutritional Sciences*  
**DISINFECTION PERFORMANCE OF 7 PRODUCTS AGAINST S. AUREUS**  
(Advisor: Nancy Goodyear)

Disinfection and cleaning are essential in preventing the spread of infectious disease. Available cleaning and disinfection products often involve harsh chemicals that are quick and easy to manufacture but are not the safest for those handling them on a daily basis. Home and health care workers, cleaning professionals and anyone who is frequently exposed to cleaning and disinfectant products are higher risk for occupational asthma, allergic reactions and headaches. Purportedly safer alternatives are available, but their effectiveness is unclear. The purpose of this study was to compare the disinfection activity of seven different products, some traditional and some purportedly safer, for disinfection activity against Staphylococcus aureus on a stainless steel surface. S. aureus was grown overnight in broth and then spotted onto a stainless steel coupon and allowed to dry for 30 minutes. The coupons were exposed to the product for 30 seconds and then neutralized with DE broth in order to stop the activity of the disinfectant. The results show that thymol, hydrogen-peroxide, and silver dihydrogen citrate based products perform as well or better than traditional quaternary ammonium or bleach containing products on a stainless steel surface. Additional experiments will be performed to test performance on other surfaces and with longer contact times.
Farfan, S.
Clinical Laboratory & Nutritional Sciences

DISINFECTION PERFORMANCE OF HOUSEHOLD CLEANING PRODUCTS AGAINST E. COLI
(Advisor: Nancy Goodyear)

Vapors and liquids emitted from household cleaning and disinfection products tend to act as irritants to the dermis and/or respiratory tract of users working with them. Understanding which chemicals found in the products offer maximum effectiveness offers the first step in developing an alternative, safer product that reduces recurrence of user irritations, while retaining efficient decontamination viability. This study evaluates and compares performance of common household disinfectants and their respective abilities to disinfect E. coli from common household surfaces. Surfaces being tested include: stainless steel, formica countertops, and plastic light switch material. The disinfecting efficiency of cleaning products was tested through measurement of bacterial colonies incubated from cleaning product treated surfaces. Bacterial cultures were introduced to tested surfaces, exposed to the chosen cleaning product being tested for a set amount of time, and were incubated. Inoculation of cultures from the tested surface to agar plates yielded countable colonies to be quantified. The presence or absence of bacterial colonies are recorded and kept for comparison among other cleaning products. For the majority of our results obtained so far, our evaluations focused on stainless steel as our surface, and a 30 second contact time between bacteria and cleaning products. Current findings suggest thymol, hydrogen-persoxide, and silver dihydrogen citrate based products perform as well or better than traditional quaternary ammonium or bleach containing products. However, we plan on performing additional tests on additional surfaces and longer contact times between the cleaning product and bacteria.

Bettencourt, M., Wizboski, M., Lind, C.L., Willette, A.
Nursing

THE HEARTS OF FIRE: CARDIOVASCULAR DISEASE RISK AND PREVENTION EDUCATION TO FIREFIGHTERS
(Advisor: Alison Basmajian)

Motivation: Firefighters are 3 times more likely to die on the job from a cardiovascular event than in any other occupation. The motivation was to increase awareness of, and address risk factors for cardiovascular disease among firefighters. Background: Undiagnosed cardiovascular disease is as high as 30% in the firefighter population. On-duty firefighters are at a higher risk of suffering a fatal heart attack early in the fourth decade of life. 10% of firefighters have undiagnosed hypertension, a higher prevalence of metabolic syndrome, high cholesterol, and obesity than the general population. Target Population: Firefighters of Methuen Massachusetts. Specifically, two firehouse groups that consisted of males and females at various rankings. The Lieutenant had a personal interest in protecting the heart health of his staff, so mandated attendance. Design: Utilized andragogy, a method of teaching adult learners that uses all 5 senses: touch, taste, sight, smell and hearing. Anatomical models of heart and blood vessels at various stages of occlusion were presented. The education included pathophysiology, disease prevention, incorporating healthy lifestyle choices, and positive coping strategies.
Heart healthy turkey chili was provided along with resource information, and heart shaped stress balls which were positively received. Results: By engaging all of the senses, participants were able to verbalize hearth healthy food choices, positive stress reduction activities, and need for regular exercise, in order to prevent cardiovascular disease in this high risk population. Conclusion: The multifaceted approach, appealed to and engaged all participants. Firefighters will benefit from ongoing education that addresses cardiovascular disease prevention and risk reduction.

Burke, N., Ashley, S., Cabral, M., Rodrique, S.
Nursing
A COMMUNITY CRISIS
(Advisor: Alison Basmajian)

Motivation: In 2014 there were 62 reported drug overdoses in Tewksbury, Massachusetts resulting in 4 deaths. The purpose of this project was to provide education on drug abuse prevention, early detection, treatment and resources for the community. Background: Tewksbury is located in Middlesex County. In the last decade unintentional drug overdoses have more than quadrupled. This problem has become an epidemic drawing state and national attention. In 2015, there were 142 suspected heroin overdoses in Middlesex County alone. Since 2010 there has been a shift from alcohol being the predominant substance abused to heroin constituting 53% of all admissions for substance abuse in Massachusetts. Target Population: Ninety percent of addictions begin in teenage years. Parents and caregivers of adolescents were the primary focus of our project because of their influence on adolescent behavior. Methods / Design: A power point presentation was given at the Tewksbury library. This was done in collaboration with the Tewksbury drug prevention officer and local high school students who presented "In Plain Sight", a demonstration of a mock teenage bedroom with drug paraphernalia in plain sight to educate parents on common everyday items that are used for hiding drugs. The power point presentation led by the group included education on signs and symptoms of commonly used drugs, an instructional video on Narcan administration and information on communication skills and the importance of the parental role. Time was allotted at the end for questions. Results: The education was well received by the participants including the Tewksbury's drug prevention officer, Maria Ruggiero and Officer Jennie Welch. Multiple educational pamphlets provided by Health Resources in Action were supplied to audience members and positive feedback was received. Conclusion: Teaching parents and caregivers of adolescents is a valuable tool for early detection and prevention for this growing community problem. Continued education is needed to address this very serious health issue.

Eang, K., Mungai, B., Meyer, L., Awa, S., Kia, J.L.
Nursing
HYPERTENSION SELF-MANAGEMENT EDUCATION FOR LOWELL SENIORS
(Advisor: Alison Basmajian)

Motivation: The aim of this project was to increase awareness and hypertension self-management among participants at the Lowell Senior Center. The City of Lowell has a rate of 19.6% of cardiovascular disease among senior citizens compared to Massachusetts which was
Background or Assessment: During the community assessment of the City of Lowell, an interview was conducted with a nursing representative from the Department of Public Health. She identified that hypertension is one of the health problems among elders that needed increased awareness and improved self-management. In the Greater Lowell Community Health Network, 20% of those who have had their blood pressure checked by a health professional were told they had high blood pressure (Turcotte & Vidrine, 2013). Target Population: Our target population was the seniors at the Lowell Senior Center, aged 60 years or older. The elderly are the most highly affected by hypertension according to the Massachusetts Department of Public Health. Due to their age, they have a higher risk of complications related to poor self-management. Methods/Design/Approach/Project: The date and venue of the event were posted in the monthly bulletin and on the Lowell Senior Center notice board. The educational approach was one on one interaction with participants. Their knowledge of hypertension risk factors, medication regimens and diet was assessed. Face to face education was provided in these following areas: What is high blood pressure? What are the risk factors? What are some healthy lifestyle and food choices? What is the importance of proper medication regimen? When is it necessary to follow-up with a doctor? Education was reinforced with brochures and pamphlets from the Department of Public Health. In order to evaluate their ability to grasp the learning materials, participants were asked to identify healthy versus non-healthy lifestyle choices using pictures. For example: fatty cheeseburger versus fruit salad. This approach was used to address any literacy issues and to reinforce learning. Results: Participants were engaged and had demonstrated interest in achieving a healthier lifestyle by verbalizing an understanding of healthy life choices. The participants verbalized methods to improve self-management including proper medication regimen, a healthy diet and an appropriate exercise program. Conclusion/Discussion/Implications: This project was effectively geared towards participants and was positively received. In the future, it would be recommended to target other age groups in Lowell such as middle-aged persons to help promote prevention and management of hypertension.

Ludwig, D., Crawford, E., MacAdams, B., Maceus, D., Martin, J.

Nursing

NUTRITIONAL EDUCATION IN LAWRENCE MASSACHUSETTS
(Advisor: Alison Basmajian)

Motivation: The obesity rate in Lawrence Massachusetts is 31% among adults. This is among the highest in the Commonwealth of Massachusetts. The purpose was to provide nutritional education and principles to a selected population with the intent to influence the entire family unit. Background: The population of Lawrence is 73.8% Hispanic. In addition to the obese adult population of 31%, the childhood obesity rate is the highest in the state. Lawrence's average household income is half that of the Massachusetts state average. Low income directly correlates to poor nutrition. Target Population: Adult Hispanics were the target population with the intent that they will positively impact and influence the diet of the entire family. In the Hispanic family structure the elders are highly regarded as role models, caretakers, and typically prepare the family meals. Methods: The plan included education from the Choose My Plate government program in both Spanish and English. The method to measure this goal was by assessing participants' knowledge before and reinforcing information after the presentation using engaged discussion. Handouts and visuals from Choose My Plate were utilized to provide healthy meal
planning examples. This format was enhanced by demonstrating food portion examples such as a 3-ounce portion of chicken is the same size as a deck of cards.

Results: The participants were able to verbalize understanding of the concepts of portion control and the importance of healthy eating, and its relation to obesity reduction.

Conclusion: Participants were able to recognize simple solutions to preparing a healthy meal using portion sizes, cooking methods, and plate sizes. The participants demonstrated willingness to bring this information home to share with their family.

Musoke, S., Mutto, E., Kyambadde, E.
Nursing
EDUCATING BURLINGTON SENIORS ON HEALTH LIFESTYLES
(Advisor: Alison Basmajian)

Motivation: The presentation was to promote healthy living choices among seniors in Burlington MA located in the Middlesex County. Based on data from Mass Behavioral Risk Factor survey nearly 60 percent of adults in Middlesex County are obese compared to 56% in the Essex County.

Background: Burlington is a small community with multiple commercial fast food places and restaurants and limited physical activity areas. Older adults in Burlington are at increased risk for developing chronic illnesses related to obesity due to unhealthy nutrition and physical inactivity.

Target Population: The population of seniors at the Burlington Council on Aging represents a portion of Burlington seniors who are at increased risk of developing health complications due to obesity. Methods: The presentation occurred at the Burlington Council on Aging with the assistance of the program director. The methods of teaching included power point presentation, lecture, a video on adult health and nutrition, a My Plate poster, activity pyramid and benefits of nutrition posters. A healthy snack was provided to participants to demonstrate a healthy food choice.

Results: This education provided valuable information on the available resources and choices to promote healthy living among older adults. Participants were engaged, asked questions and responded positively to the information. The participants were able to state methods to increase physical activity and demonstrated appropriate food choices by selecting healthy vs. unhealthy food choices.

Smith, B., Sifferlen, C., Vaz, N.
Nursing
NUTRITIONAL EDUCATION IN PRE-SCHOOLERS IN HAVERHILL
(Advisor: Alison Basmajian)

Motivation: Haverhill has the fourth highest obesity rate in children in the Commonwealth of Massachusetts. The aim of the project was to teach the Prekindergarten children of Haverhill about healthy versus unhealthy food choices and the importance of exercise with the long-term goal of addressing obesity.

Background: More than 20% of children in Haverhill are obese. Leading statistics include, 1 in 3 children are overweight in Massachusetts and the percentage of obese children in Haverhill is higher than the states average of 16.3%. Although many food pantries are available in the city, the pantries lack an adequate supply of fresh fruits and vegetables. It has been well documented that unhealthy eating habits may lead to chronic diseases such as diabetes and heart disease. Target Population: Prekindergarten children at the Haverhill YMCA. This population was selected because of the importance of teaching healthy eating and exercise at a young age. Design: Utilizing primary prevention strategies, the project
involved three activities. The first activity consisted of children separating plastic foods into two baskets labeled "healthy" and "unhealthy." The second activity utilized the "Choose MyPlate" model in which the children were asked to place the plastic food items on the correct part of the plate model, reinforcing portion sizes and healthy selection choices. The third activity involved physical exercise with music through a modified dancing chair activity. The children first had to select a colored, fun, crafted shaped food item and hold on to it while the music played and they danced. Once the music stopped, the children ran to either of the room where signs were hung labeled "healthy" and "unhealthy", choosing the appropriate side in relation to the food item they had chosen. This activity reinforced the learning of selecting healthy food choices accompanied with exercise. Results: Through 100% participation, children were able to correctly identify healthy and unhealthy food choices, while enjoying the benefits of physical exercise. The activities were appealing, enjoyable, and appropriate to their developmental stage. Conclusion: Feedback from the YMCA staff was positive and constructive. The props used during the activities were donated to the center for continued education.

McCaulliff, M., Basma, Z., Turner, Z., Bilodeau, K., Ducasse, A., Ramirez, S

Nutritional Science

UML HAWKS GIVE HOPE
(Advisor: Susan Thomson Tripathy)

House of Hope is a family shelter located in Lowell, and first opened its doors in 1985. They have been at their current residence, 812 Merrimack Street, for 12 years now and have helped countless families get out of the cold and back on their feet. In the weeks that we have been volunteering here we have learned that the House of Hope would benefit greatly from donations of clothing and kitchen supplies. The House of Hope also operated The Hope Chest, a consignment shop, at 397 Market Street in Lowell. Any donations received can be sold here which provides the House of Hope with financial support as well as providing employment opportunities for the shelter residents. Several students from our seminar volunteer at the House of Hope in the playroom and spend a few hours a week supervising and playing with the children who currently live there. Our group of volunteers has decided to collect donations for the House of Hope from students on campus in hopes of strengthening the ties between UMass Lowell and House of Hope. Our goal is to collect at least one box of clothing, kitchen supplies, and gift card donations from local stores in Lowell. We hope that these collection will be utilized by the residents of House of Hope either within the shelter, in The Hope Chest, or to buy daily necessities. We hope that such simple contributions on our part can make a greater positive impact in the lives of others and lay down the groundwork to further the relationship UMass Lowell has with the House of Hope.

Eastman, G., Jamieson, A., Pierce, S.

Public Health

MILL CITY GROWS SERVICE LEARNING PROJECT
(Advisor: Leland Ackerson)

This project was a service learning project for the Public Health department where we paired up with the local non-profit organization Mill City Grows to help organize and run their annual Harvest Festival. The Harvest Festival is held each fall in Lowell, MA and is an event that not only celebrates the success of the past year, but is an informational event with activities such as
games, live music and refreshments to promote the organization. The organization itself focuses on providing fresh produce to the urban area that is Lowell by not only selling its fresh produce but providing nutritional education to the citizens as well as offering designated areas containing raised garden beds for the people of Lowell to grow fresh produce on their own.

**Post, M.**  
*Public Health, Center for the Promotion of Health in the New England Workplace*  
**CREATING AN EFFECTIVE SCORING SYSTEM TO MEASURE HEALTH POLICIES AND ENVIRONMENTAL SUPPORTS IN MASSACHUSETTS BUSINESSES**  
(Advisor: Suzanne Nobrega)

The Massachusetts Department of Public Health is implementing the Mass in Motion Working on Wellness Program to improve health policies and environmental supports in up to 350 Massachusetts workplaces. Worksites are social determinants of health as the conditions in worksites can impact health, injury, and illness. Worksites serve as a great setting for health interventions as the majority of adults spend most of their waking time at work. An Environmental Scan survey allows employers to review and monitor policies and environmental supports related to health dimensions such as physical activity, nutrition, tobacco and substance abuse, stress and mental health, medical and chronic conditions, and occupational health and safety. Through the use of Qualtrics survey software, intern Molly Post developed an effective scoring and reporting system for each health dimension in the survey. A scoring system allows for easier analyzation of data by program providers, participants, and evaluators in the Working on Wellness program. The scoring system tells employers which health dimensions they need most improvement in to build their worksite wellness action plans. The evaluators can use the data collected to compare results across all employers and search trends in each dimension. Trends assist program providers in modifying wellness training programs. The scoring system was tested in a sample of 72 worksites. Results displayed fairly low means and wide variability in each health dimension, indicating room for improvement throughout the course of the program.

**Taupier, T., Mercado, K., Post, M.**  
*Public Health*  
**PUTTING AN END TO DATING VIOLENCE**  
(Advisor: Leland Ackerson)

Our project was to create curriculum for the teen population of the Boys and Girls Club of Greater Lowell to educate them about safe dating practices, dating violence, and mental/physical/sexual abuse. The service we provided benefited the teens of the Greater Lowell area as we provided them with a safe place to discuss these important topics that are not always discussed in school. Additionally, we provided them with knowledge about these topics that many did not previously know and gave them the opportunity to discuss their opinions and knowledge regarding dating with their peers and mentors. We feel we benefited this population greatly and they benefited us as well as we were able to practice many community health professional skills. We created curriculum for two separate sessions: Teens (Male and Female) Ages 12-18 and Teens (Female) Ages 12-18. Our goals for the project, Putting an End to Dating Violence were to allow teens to: Acknowledge the different forms of abuse including physical,
sexual, mental and emotional. Realize the importance and factors of being treated respectfully in a relationship. Understand all aspects of safe sex including abstinence, condom use, and contraceptive use. Recognize the different resources for support involving dating violence, abuse, and sexual health. Overall, working with the LBGC was a very beneficial experience. This organization supported our academic learning as it provided us with the opportunity to work with a population of interest and implement programs that were beneficial to this population. Also, working with the LBGC allowed us to practice important skills, including but not limited to: assessing needs of a population, creating curriculum, administering and creating pre- and post-knowledge surveys, implementing programs, educating teens about important health topics, communicating professionally, and evaluating programs. We enjoyed our experience with LBGC and value the skills we were able to practice throughout the experience.

Chin, W.S.Y., Punnett, L., Gore, R.J., Kernan, L.

Work Environment

WORKPLACE PREDICTORS OF PERCEIVED QUALITY OF CARE IN NURSING HOMES
(Advisor: Laura Punnett)

Nursing home quality of care (QOC) is a matter of public concern and public policy. Higher nurse-to-patient ratios have been shown to decrease rates of adverse outcomes. Positive nurse-doctor relationships also have a positive effect, which might translate to other clinical staff, such as nursing aides, who perform the majority of direct care tasks in nursing homes. This cross-sectional study examined whether workplace factors in nursing homes were associated with QOC as evaluated by staff members themselves. Surveys were distributed to personnel in 24 nursing home facilities in the Northeast U.S. A total of 1463 respondents provided ratings of QOC and 14 work environment features. Analyses included correlations, Cronbach's alpha, and principal components analyses (with rotation) to examine psychometric properties of predictor scales and reduce multicollinearity. A multivariable model of QOC was built using all potential workplace factors to determine which factors contribute to self-reported QOC, with removal of those covariates that were not significant (p>0.05), decreased the model fit, or showed a confounding effect (>15% change in other coefficients). The final model showed that perceived commitment and obstacles to safe-lifting programs, respect and support between coworkers and supervisors, adequacy of staffing, physical exertion, safety climate, and psychological demand, were significant contributors to staff-assessed QOC. Nursing homes should consider cultivating these work environment characteristics for the benefit of both direct-care staff and the residents for whom they provide care.
Deschamp, B., Chandra, K.
Biomedical Engineering & Biotechnology
CHARACTERIZING CELLULAR NETWORKS WITH METABOLIC FLUX BALANCE ANALYSIS AND ELEMENTARY FLUX MODES
(Advisor: Kavitha Chandra)

The problem of relating variability in raw material to the end products of chemical reactions in is an important problem for the pharmaceutical industry. Two approaches in systems biology are reviewed in this presentation. They are Metabolic Flux Balance Analysis (MFBA) and Elementary Flux Modes (EFM). Their application to Chinese Hamster Ovary (CHO) cultures to evaluate the relationship between the variability of amino acid concentrations in different lots of wheat hydrolysates that drive the culture growth process is discussed. MFBA solves the system $Sv = 0$ where $S$ is $M \times N$ stoichiometric matrix of the system where $M$ is the number of metabolites and $N$ is the number of reactions and $v$ is the vector of flux rates. The solution for $v$ is obtained constrained with measurements of extracellular uptake and production rates, yielding estimates of intracellular flux rates. EFM's are the minimum set of flux vectors that allow all stationary states of the system to be represented and connect inputs to the products of interest in the biochemical network. The objective of this research is to identify pathways that connect particular group of elements of the raw materials which concentrations deviate from the control lots to end products generated from the culture.

Ankiewicz, S., Orbey, N.
Chemical Engineering
PRACTICAL USE OF CONTINUOUS SPECTRA FOR THE CHARACTERIZATION OF POLYMERS
(Advisor: Nese Orbey)

This work examines the practical use of calculating a continuous spectrum from the complex modulus. The continuous spectrum is known to show the strength and time scale of relaxation modes in viscoelastic materials, thus making it a particularly valuable function in the study of polymer behavior. The difficulty in calculating the spectrum has typically prevented its widespread use, but advances in computer speed, and non-linear regression techniques have contributed to the development of a number of programs which can complete the necessary calculations. NLREG has been identified as a likely option for widespread adoption amongst rheological researchers, due to its availability and easy application, and is used to calculate the spectrum of a variety of prominent model polymers. A novel treatment of time temperature superposition is proposed which drastically improves the quality of the generated spectra. Analysis of the spectra shows that the continuous spectrum reveals power law relaxation and single component relaxation times where they could not be accurately determined or detected via direct analysis of the complex modulus.
De Jesus Vega, M., Wakim, J.
Chemical Engineering, Plastics Engineering
STUDY OF DESIGN AND MICROFABRICATION PROCESSES FOR CROSS-FLOW MICROFILTRATION DEVICES
(Advisors: Nese Orbey, Carol Barry)

Separation of white blood cells from red blood cells is the first step in many blood analyses for disease diagnosis. A microfluidic device for blood cell separations based on cross-flow filtration is presented in this project. The effect of gap sizes and pillar shapes in separation efficiency was studied using COMSOL simulations. It was found that circular pillars separated by a 3.5 µm gap yielded in higher flow of fluid through the filtration barrier when compared to other pillar shapes and gaps. The device design was optimized based on these results. When building the optimized device, etching issues such as differences in features depth were noted and are discussed. In addition, variations of feature replication from silicon molds to PDMS devices are presented. The results presented here will help researchers when designing and manufacturing new microfiltration devices.

Doane, M., Park, S.
Chemical Engineering
ANALYSIS OF AMINO ACID CONSUMPTION AND FLUX DYNAMICS IN MAMMALIAN CELL CULTURES
(Advisor: Seongkyu Yoon)

Cell culture involving the development of useful gene-based products forms the basis for the modern biopharmaceutical industry. Optimal concentrations of amino acids are critically important to the efficiency and productivity of cell culture processes. This work investigated the differences in the utilization of 18 key amino acids in hybridoma cell cultures by comparing the amino acid concentration and metabolite flux for 12 different combinations of process operations (batch, fed-batch, and aerated) and medium type (with different supplemental amino acids). Culture samples were taken at regular intervals and NMR spectroscopy and HPLC were performed. Analysis of amino acid concentrations and flux was completed in spreadsheets by holding media type constant and showing the results of varied process operations, and vice versa. The results did not indicate that amino acid-supplemented media modified the amino acid consumption in this hybridoma cell line. However, both instantaneous concentrations and flux rates for the aerated runs showed deviations from the batch and fed-batch runs, indicating that aeration modulated the rate by which amino acids were being consumed. In general, the essential amino acids tended to show the greatest deviations when aeration was provided. Often this manifested as higher than normal flux rates early in runs, receding to lower than normal flux rates later. The aspartic acid/asparagine ratio deviations were also very pronounced in aerated runs, perhaps due to the higher initial pyroglutamate concentration having reached equilibrium by way of asparagine synthetase activity.
Dogan, E.M., Zalluhoglu, F.S., Orbey, N.

Chemical Engineering
EFFECT OF MONOVALENT AND DIVALENT IONS ON HYDROGEN PEROXIDE STABILITY IN SILICA HYDROGELS
(Advisor: Nese Orbey)

Hydrogen peroxide (H2O2) is an environmentally friendly, strong oxidizing agent. However, it is highly unstable and decomposes spontaneously into oxygen and water. Many industrial applications, including sanitation, disinfection, and tooth whitening, require that H2O2 be stable at ambient temperatures. Currently, the most efficient method to increase H2O2 stability is its microencapsulation in silica hydrogels and xerogels. The high stability of H2O2 in these systems arises from strong hydrogen bonding between silanol groups (Si-OH) and peroxide molecules. In the present work, H2O2 is encapsulated in silica hydrogels using sol-gel method and the effects of monovalent ions (K+, Na+) and divalent ions (Mg+2, Ca+2) on the gelation time of the hydrogel and the stability of H2O2 were studied. The pH of the sol was changed by using an ion exchange resin to replace a portion of the ions in the solution with H+ ions. Gelation time was observed with respect to pH value of the solution for each ion added to the starting precursor. The size and charge of ions present in the sol have a significant effect on the structure of the hydrogels and hence the stability of entrapped H2O2. Hydrogels are characterized by using scanning electron microscopy (SEM). The properties of hydrogels can be tailored to control the gel time and H2O2 stability.

Gentyala, V.

Chemical Engineering
THE POSSIBLE IMPLEMENTATION OF THE SHEWANELLA ONEIDENSIS IN THE GANGES RIVER
(Advisor: Lori Weeden)

The Ganges River, located in the Indian subcontinent, flows from Delhi to the Bay of Bengal. This river is central to both the Indian cultural and religious values. Unfortunately, this scared river has been polluted by various factories, illegal tanneries, household trash, and raw sewage. The current Ganges Action Plan (GAP), introduced by the Indian government, has failed to actively tackle the water pollution. The following research involves outlining a bioremediation plan to reduce the amount of chromium in the Ganges River, specifically in the Kanpur area. The plan centers around employing the Shewanella Oneidensis bacteria to effectively reduce harmful hexavalent chromium to a benign trivalent chromium state. Despite the incomplete understanding of the electron pathway, the Shewanella Oneidensis seems to be a reliable reducing argent. However further research has to be conducted in order to optimize the speed of reduction, also known as the kinetics, for an actual implementation in the Ganges River at Kanpur.
Nallar, M.
Chemical Engineering
INTERACTIONS BETWEEN BIOMASS AND PLASTICS DURING THERMOCHEMICAL CONVERSION
(Advisor: Hsi-Wu Wong)

The increasing amount of municipal solid waste (MSW) causes a growing problem for the humanity. While biomass has been recognized as a major world renewable energy source to supplement declining fossil fuel resources, plastic materials derived from petroleum take an active role in daily and industrial life because of their chemical and physical resistance and low costs. When these two most dominant components of the MSW are considered, many studies have shown that the co-pyrolysis of biomass with plastics provides oil with higher yields and the caloric value. Since the presence of oxygen in the pyrolysis oil causes low heating value, thermal instability and corrosiveness, the use of plastic wastes, which are rich in hydrogen and low in oxygen, may be helpful for reducing the production cost. However, the fundamental interactions between biomass and plastics during co-pyrolysis are still not well understood. As a result, there is a need to unravel the interactions between biomass and plastics on the molecular level. In this study, contradictory results in the literature are discussed, leading to our hypothesis that the synergy between the two components depend on the relative degradability, reaction duration, and the microscopic mixing.

Yu, P.
Chemical Engineering
SYNERGIC EFFECT OF CATALYTIC PROpane DEHYDROGENATION AND HYDROdeoxygenation BIO-oIL UPGRADING
(Advisor: Hsi-Wu Wong)

Due to recent discovery of abundant shale gas, utilization of light alkanes, which are the major components of shale gas, has attracted growing interest. Catalytic propane dehydrogenation (PDH) to produce propylene is one of the approaches to realize shale gas usage. However, this reaction is reversible and highly endothermic. As a result, high propylene yields are only possible when the reaction is operated at low pressure or high temperature. One strategy to achieve high propane conversion at milder conditions is to remove hydrogen on-the-fly, therefore shifting the equilibrium towards forward direction. On the other hand, bio-oil upgrading via catalytic hydrodeoxygenation (HDO) has been extensive studied. This reaction is exothermic and irreversible. The main bottleneck to commercialize this process is the excess amount of hydrogen needed. In this work, a novel reaction scheme coupling these two reactions has been hypothesized. Our approach has the benefits to improve the conversion of propane dehydrogenation for the production of propylene and at the same time to achieve bio-oil upgrading without the need for external hydrogen. Another advantage is that heat released from the HDO reaction can be used for the PDH reaction. Cresol is selected as a model bio-oil compound to test our hypothesis. New bifunctional catalyst will be designed, synthesized, and characterized, and the synergetic reaction pathways on the catalytic surfaces will be sketched.
Collins, S., Gonsalves-Lamontagne, R.
Civil & Environmental Engineering
WOBURN MS-4 STORMWATER MANAGEMENT PROGRAM
(Advisor: Edward Hajduk)

During the spring of 2015 a partnership began between the City of Woburn and the University of Massachusetts-Lowell's American Society of Civil Engineers (ASCE) student chapter to develop a program to not only help the city satisfy multiple aspects of the Environmental Protection Agency's (EPA) Municipal Separate Storm Sewer System (MS-4) Permit but also educate student volunteers about stormwater management. The following fall, twelve students from the UMass Lowell Civil and Environmental Engineering program were trained to collect outfall samples and perform field tests to determine dissolved oxygen content (DO), specific conductivity, total and free chlorine, temperature, ammonia and surfactants. Collected data was entered into a tablet that synced with the Engineering Department' GIS. Students were also taught to analyze qualitative data such as color, sheen, staining, odor, etc. at the outfalls, using Chapter 11: Outfall Reconnaissance Inventory of the EPA's Illicit Discharge Detection and Elimination Manual, as a reference. In addition to field testing, the students were trained to perform an EPA approved E.coli test in the laboratory to track the presence of E.coli in the city's non-distressed waters. Different concentrations of these parameters indicate if illicit discharges exist and what the source may be. In addition to field and laboratory tests, students learned delineation of tributary drainage areas and interpretation of land use within the catchment to better understand the potential sources of illicit discharge. This program looks forward to educating more students about the fundamentals of stormwater management as they begin their careers in the consulting field.

Fitzgerald, M., Strack, G., Su, J., Sun, H., Mosurkal, R., Kurup, P.
Civil & Environmental Engineering, US Army Natick Soldier Research, Development & Engineering Center
NANO-IMPRINTED SENSORS FOR THE DETECTION OF PATHOGENIC BACTERIA USING SURFACE-ENHANCED RAMAN SCATTERING
(Advisors: Pradeep Kurup, Ravi Mosurkal)

A practical, portable tool with minimal sample preparation is needed to help soldiers detect and identify pathogenic bacteria in their food. Current methods typically require pure isolated bacteria cultures, costly laboratory equipment, and technical training; therefore there is an urgent demand for a procedure that can deliver rapid analysis with a low detection limit. A promising method-surface-enhanced Raman scattering (SERS)-has shown a high sensitivity and a low detection limit for biological pathogens; however, given that most of these sensors are limited to the laboratory setting, there is a need to transition the research into scalable technologies that can be mass produced. One such technique, "nanoimprinting", allows for control over the sensor topography and nanostructure spacing through the careful selection of the pre-fabricated template. In this work, the original repeating nanostructure (template) was copied onto thin layers of commercially available polymers that were decorated with noble metal nanoparticles. Initial studies have shown that these sensors exhibit an enhanced Raman signal and are able to detect low concentrations of rhodamine 6G. Our current studies focus on increasing the Raman signal to detect low concentrations of pathogenic bacteria. The potential development of
sposable, low-cost sensors that can detect foodborne pathogens in a variety of relevant scenarios will be discussed.

**Sullivan, C., Azimi, H.**  
*Civil & Environmental Engineering, Chemistry, Plastics Engineering*  
**DEVELOPMENT OF A SENSOR SYSTEM FOR THE ONSITE DETECTION OF HEAVY METALS**  
(Advisors: Pradeep Kurup, David Ryan, Ramaswamy Nagarajan)

Heavy metals in water and sediments present a major environmental and health risk, as demonstrated by the Gold King Mine disaster in Colorado and the contamination of drinking water in Flint, Michigan. Current methods of heavy metal detection require sampling the contaminated water, and subsequent transportation to a laboratory for testing. This approach leads to a high cost per sample, a long wait time for results, and a limited number of data points. Through an interdisciplinary research project conducted at the University of Massachusetts Lowell, a novel onsite sensor system and methodology for qualitative and quantitative analysis of contaminated water was developed. The sensor system consisted of a miniature USB powered potentiostat and disposable screen printed electrodes. The electrodes were carbon paste modified with gold nanoparticles or bismuth. The potentiostat was programmed to perform square wave stripping voltammetry experiments and the test parameters were optimized for both electrodes. Tests were run on samples of lead, cadmium, and mercury. The concentrations tested were with 0 ppb to 100 ppb for lead and cadmium and 0 ppb to 50 ppb for mercury. The limits of detection were 10 ppb, 15 ppb, and 3 ppb for lead, cadmium and mercury, respectively. The limits are below or close to the maximum contamination levels set by the EPA (15 ppb for lead, 5 ppb for cadmium, and 2 ppb for mercury). Regression curves were fitted to the data of peak height vs concentration, to develop models for future analysis.

**Gandhi, P.**  
*Electrical & Computer Engineering*  
**ESTIMATING INDOOR BACKGROUND NOISE GENERATED BY A WIRELESS TRANSMITTER**  
(Advisors: Kavitha Chandra, Charles Thompson)

A statistical energy analysis of a coupled room system is investigated in this research. Room acoustic models are extended to describe the propagation of radio waves in enclosed spaces. In particular, the application of Eyring's model that describes the decay rates of sound energy in coupled spaces is considered. This model can be extended for indoor wireless signals by adding additional losses due to energy transfer between two rooms through a hollow space in between them. A comparison is made between the energy transfer between two rooms using original Eyring's model and the improved one. Depending on the absorption coefficient of the walls in the hollow space, the amount of energy transferred between two rooms can vary. The improved Eyring's model is seen to better represent experimental results. It is also shown that the two coupled room system can be extended to a multiple room system with various sources distributed among the rooms to estimate the noise floor in each room at a given time instance. From the application view point, the improved Eyring's model can be useful in quickly evaluating the indoor noise floor without running any test equipment to figure out expected quality of service in these environments.
Haghzadeh, M., Akyurtlu, A.
*Electrical & Computer Engineering*

**FERROELECTRIC NANO-INK FOR PRINTED FLEXIBLE TUNABLE MICROWAVE DEVICES**
(Advisor: Alkim Akyurtlu)

The focus of this project was to develop a ferroelectric nano-ink for printing electrostatically-tunable dielectrics on plastic substrates using direct-ink writing methodologies. This allowed realizing an all-printed high-frequency voltage variable capacitor (varactor) on a Kapton film to be used in tunable RF and microwave applications such as phased array antennas, conformal antennas, and tunable frequency selective surfaces. The tunable dielectric is based on multi-phase Barium Strontium Titanate (BST)/polymer composites made by suspending nano/submicron-sized particles of BST in a thermoplastic polymer, namely Cyclic Olefin Copolymer (COC). The composite is further dissolved in a solvent with a dispersant to obtain the Tunable nano-BST/Polymer ink (TnBST/P ink). The composite benefits from the processing flexibility of the polymer so that only a curing step at temperatures below 200 °C suffices to solidify the material, thus bypassing sintering steps traditionally required for such materials. In order to enable ferroelectric (tunability) properties in the composite, three inter-correlated parameters had to be fine-tuned: Ba/Sr ratio (or x) in BaxSr1-xTiO3, BST particle size, and BST loading fraction. In particular, the Ba/Sr ratio of the BST particles had to be appropriately selected from a narrow window, which depends on the particle size of utilized inclusions. The printed varactors were employed in a left handed transmission line design to realize printed tunable phase shifters, and in a metamaterial inspired design to realize printed frequency-agile frequency selective surfaces. The developed ink and printed varactors open up the possibility of printing reconfigurable, adaptive, or agile RF and MW systems on flexible substrates.

Harper, E.
*Electrical & Computer Engineering*

**EXPLORING ADDITIVE MANUFACTURING FOR USES IN ELECTRONIC PACKAGING**
(Advisors: Craig Armiento, Alkim Akyurtlu)

Additive manufacturing (AM), such as used in 3D printing, is being used increasingly to develop new mechanical structures. AM processes using electronic materials are now being developed for manufacturing of electronic products. An important element of this trend is the potential of AM technology for microelectronic chip packaging. This research integrates AM with developing a novel way to create interconnects between bare die microchips for high frequency applications. The conventional method of making these interconnects is to use bond or ribbon wires to connect components. Initially, an electromagnetic analysis of various models were simulated in HFSS to determine which means of printing interconnects was most effective. A piece of dielectric material, which is essentially a "bridge", was placed in the air gap between a coplanar waveguide and a microchip. The initial analysis was conducted by varying two parameters: the relative permittivity of the dielectric material and the width of the printed line. Simulations were conducted over a frequency range of 0.5 - 26GHz, and the reflections between the input and output of the model were analyzed. It was found that the best results (i.e. lowest reflections, S11 and S22 parameters) occur when the relative permittivity of the dielectric material is near the permittivity of air and the printed line width is close to 20µm. Based on these
results and other material constraints, candidate materials were chosen. Characterization of the
dielectric, mechanical, and thermal properties was also conducted to ensure the appropriate
materials are chosen to provide the desired performance results.

Homan, K.
Electrical & Computer Engineering
ANALYSIS OF CONDUCTIVE POLYMER NANOCOMPOSITES FOR USE IN 3D PRINTED
MICROWAVE DEVICES
(Advisor: Craig Armiento)

3D Printing has long been used in prototype fabrication due to its fast design cycle and ability to
create complex structures. The most common Fused Filament Fabrication (FFF) method of 3D
printing uses plastic extruded in a layer by layer fashion to create 3D models. FFF (also referred
to as Fused Deposition Modeling or FDM) has historically only been used to create prototypes of
purely mechanical structures constrained by the properties of the polymer used in printing. The
growing industry of Polymer Nanocomposites has spilled over into the realm of 3D Printing and
for the first time, electrically conductive polymers using Carbon Nanotubes (CNTs) and
Graphene are commercially available in filament form for use in 3D Printing. Using the material
properties of these nanocomposites, electro-mechanical systems can now be fabricated using FFF
to create a wide range of devices with an added degree of functionality. These electro-mechanical
systems are still limited by their material properties and CNT or Graphene based nanocomposites
still have a way to go in terms of their resistivity compared to bulk metal. However, it was found
that electrically conductive polymer nanocomposites are adequate in its printed form for direct
electroplating. The electroplating process coats an object in a layer of metal and requires the part
to be electrically conductive prior to its treatment meaning an insulator such as plastic has
several steps before it can be electroplated. An inherently conductive plastic eliminates multiple
pre-treatment processes and a 3D printed object can now be coating in metal directly. What this
means for electronic devices is that they can benefit from the fast design cycle and complex
designs of 3D Printing while still being able to achieve the same performance from a plated
metal. The development of printing and plating processes for these CNT-loaded filaments will be
discussed as it related to printing 3D electronic devices that work at microwave frequencies such
as antennas.

Kessler, T.
Electrical & Computer Engineering
PREDICTING CETANE NUMBER OF BIOFUEL CANDIDATES WITH AN IMPROVED
ARTIFICIAL NEURAL NETWORK
(Advisor: John Hunter Mack)

Due to the high cost and high production time needed to synthesize possible alternative fuels for
ignition quality testing, a predictive model would allow chemists to preemptively predict
desirable fuel properties of potential fuel candidates for the purpose of finding alternatives to
gasoline and diesel fuels. Recent work has shown that predictive models, in this case artificial
neural networks (ANN's) analyzing quantitative structure property relationships (QSPR's), can
predict cetane number (CN), a measurement of fuel ignition quality, of a proposed fuel molecule
with relatively small error. The present work improves on an existing model by optimizing the
model architecture and key learning variables of the ANN, and making the model more generalizable to a wider variety of fuel candidate types, in this case a group of furan-based molecules. Model architecture adjustments improved the overall root-mean-squared-error (RMSE) of the core database predictions by 5.54%. Additionally, through the targeted database expansion, it is shown that the predicted cetane number of the furan-based molecules improves on average by 49.21% (3.74 CN units) and significantly more for a few of the individual molecules. This indicates that a selected subset of representative molecules can be used to extend the model's predictive accuracy to new molecular classes. This approach enables chemists to focus on promising molecules by eliminating less favorable candidates in relation to their ignition quality.

Misiunas, N., Au, J., Nguon, C., Chandra, K., Thompson, C.
Electrical & Computer Engineering
BEAM FORMING FROM NON-UNIFORMLY SPACED ARRAYS
(Advisors: Kavitha Chandra, Charles Thompson)

The activation of antenna elements located at random positions on a linear aperture with constant currents so as to collaboratively transmit or receive in preferred directions is investigated. Assuming the elements are located in continuum spatially, the objective is to determine a probability distribution function for the element positions and characterize the random features of the resulting beam patterns. Two approaches are presented, one analytical and another that computationally determines the optimal positions using a firefly algorithm, where each firefly models an array with finite number of elements. The analytical model of the probability distribution is derived constrained to match the expected value of the beam response to the directivity function of a uniformly spaced element Dolph-Chebyshev array with a prescribed side-lobe level. The variance in the side-lobe amplitudes as a function of number of array elements is determined. The firefly algorithm utilizes a fitness to the desired beam pattern to iteratively update the array positions of fireflies to move towards those fireflies with better fitness that are within a visible range. A weighted random movement is superposed to enable searching for global solutions. The ensemble averaged variance of all arrays found viable is characterized as a function of the beam parameters. Joint probability distributions for distances between neighboring elements is empirically modeled to enable a fast configuration of arrays for beam forming.

Morrison, B., Decker, B.
Electrical & Computer Engineering
DESIGN AND VERIFICATION OF X-BAND ANECHOIC CHAMBER
(Advisor: Craig Armiento)

The Raytheon UMass Lowell Research Institute is a new research facility on-campus focused on the advancement of innovative technologies, including flexible and printed electronics. In order to properly test and characterize developed technologies, the laboratory requires a test facility free of electromagnetic interference. A group of undergraduate students was tasked with creating a far-field anechoic chamber for testing devices exposed to microwave frequencies. The project involved selecting appropriate materials, designing the layout and installing equipment to
optimize testing capabilities. Upon completion of construction, industry-standard validation tests were used to measure chamber performance. An overview of design expectations are compared to the measured performance of the chamber; demonstrating the capabilities & limitations of chamber constructed.

Nguon, C., Chandra, K., Thompson, C.
Electrical & Computer Engineering
NUMERICAL ANALYSIS OF DIFFERENCE FREQUENCY ULTRASOUND
(Advisors: Kavitha Chandra, Charles Thompson)

The nonlinear propagation of ultrasonic waves in biological media is of interest for diagnosis with increased image resolution and penetration depth. A numerical solution of the governing equations was obtained using the finite-difference time-domain (FDTD) method with a perfectly matched layer (PML) at the boundary to terminate the grid to a finite region. A phased array transducer was modeled to focus a high-frequency beam at a desired location on the computation grid. The scattered field resulting from variations in the medium compressibility as well as the B/A nonlinearity parameter is simulated. The effect due to fundamental excitation frequency as well as the difference frequency component that results from two incident frequencies is investigated.

Reistad, C.
Electrical & Computer Engineering
ANALYSIS OF THE REACTIVE FIELDS FOR HIGH-FREQUENCY STRIPLINE AND VIA MODELS USING HFSS SIMULATIONS
(Advisor: Alkim Akyurtlu)

The ability to simulate models and observe their electromagnetic responses before physical implementation is crucial part of the product development process. HFSS from Ansys® is a high-frequency simulation software that allows users to build models and analyze their electromagnetic properties. In this study, HFSS was used to simulate the effects that a stripline has on its surrounding substrate with the goal of minimizing the footprint of a printed transmission line, which is important for manufacturing compact RF and microwave devices. Models of striplines with and without vias were simulated using copper traces and Taconic RF-35 substrate. The S parameters and electric field magnitudes for each model were graphed and analyzed. Results showed that for stripline models that include center vias, the ground cage surrounding the center via drastically affects the reactive fields propagating through the substrate. Without proper field containment, transmission lines cannot be placed in close proximity to the center vias and striplines. Two possibilities for containing the fields were studied. First, the number and placement of the ground cage vias around the center via were varied with some success. Second, perfect electric conductors (PECs) that cut off higher-order modes were inserted near the wave ports of the striplines. Introducing the PECs greatly decreased the reactive fields in the substrate. Results of combining the optimized ground cage and the PECs resulted in a stripline model with minimized reactive fields will also be presented.
**Vaillancourt, J., Armiento, C.**  
*Electrical & Computer Engineering*  
PRINTABLE TRANSISTORS BASED ON CARBON NANOTUBES  
(Advisor: Craig Armiento)

Printed transistors are an important building block in the emerging field of printed electronics. Presented here will be a review of the experimental methods and procedures used to improve the DC operating characteristics of field effect transistors (FET) where the semiconductor layer is based on a printed network of carbon nanotubes (CNT). I will discuss the challenges and opportunities of working with high purity semiconducting polymer wrapped single walled CNTs. As well as novel processing techniques that can reduce the metal to CNT contact resistance as well as significantly reduce the hysteresis of an unpassivated CNT FET.

**Zhou, H.**  
*Electrical & Computer Engineering*  
FAST MULTIPOLe EXPANSION AND PADÉ APPROXIMANTS METHOD TO ANALyZE ACOUSTICAL SCATTERING PROBLEMS  
(Advisor: Charles Thompson)

In this work, we examine acoustic scattering from media having high compressibility contrast. Typically, the pressure in the scattered the field can be expressed in terms of Neumann series when the compressibility contrast is relatively small. However, divergence can occur due to resonant scattering. The fast multipole expansion method is used to evaluate the terms of Neumann series, and Padé Approximants are used to extend the range of validity of the solution. Particular interest is paid to the convergence of the translation operator used in the fast multipole method.

**Barry, C.**  
*Mechanical Engineering*  
THE IDENTIFICATION AND SCREENING OF LOWER TOXICITY SOLVENTS FOR CONTACT ADHESIVES  
(Advisors: Christopher Hansen, Gregory Morose)

Contact adhesives are adhesives that bond to themselves upon contact. These adhesives are commonly applied to the surfaces of dissimilar materials, such as particleboard and laminates, to create a strong bond. These contact adhesives are composed of solvents and polymers and are used to bond two materials together. Upon evaporation of the solvent, the remaining polymer can bond upon contact of the two materials. Toluene, hexane, and acetone are commonly used to solvate and SIS/SBS rubbers that are used in contact adhesives. Though these solvents exhibit excellent performance, they have been shown to have significant acute and long-term health effects on humans, animals and the environment. Long-term exposure to toluene has been shown to permanently damage the brain causing loss of speech, hearing, muscle control and memory. Long-term inhalation exposure to hexane may lead to neuropathy. Long-term exposure to acetone can lead to headaches, dizziness or unsteadiness, which can be dangerous when working in a factory or lab setting. This poster describes a process to identify safer alternatives to toxic solvents using the software program Hansen Solubility Parameters in Practice. This program
uses the concept of Hansen Solubility Parameters to identify similar chemicals/chemical solutions to the target chemical/chemical solution. The poster will demonstrate the usage of this predictive data to guide the testing and screening of the identified alternative solvent solutions. The testing process consists of solubility testing, evaporation rate testing, and bond strength/application testing.

**Benedict, J., Laird, D., Shuey, N., Wigglesworth, J.**  
*Mechanical Engineering*  
**CONDUCTIVE-PRINTING ROBOTIC ARM PROJECT**  
(Advisor: Craig Armiento)

The Raytheon UMass Lowell Research Institute has the ability to print conductive inks and paints on 2D surfaces. Moving this capability to the 3D design space will allow new and enhanced printable antennas and electronics to be created on virtually any surface. As part of the Industry Capstone Partnership with Raytheon, this team has created a system that is able to dispense conductive inks on 3D objects using a robotic arm. This system, developed with MATLAB, has the ability to read STL and DXF files for the object and trace drawing respectively. Using 3D vectors, rotation matrices, and many other different algorithms, the 2D trace drawing is projected onto the STL file in the software. After the user processes the data, the pattern is sent to the robotic arm to be printed. MATLAB simultaneously communicates over 4 serial ports to control the robotic arm, ink dispenser, and safety system. Using very precise movements, the arm moves the object under the dispenser while ink is dispersed, creating the trace. This system could revolutionize the way multiple industries operate. Due to the ability to add an infinite amount of tools, mechanical and electrical assemblies can be combined with the addition of a 3D printing nozzle. For Raytheon, this means antennas and phased array radars could be completely printed using entirely additive processes, substantially decreasing the cost of manufacturing these systems and enabling new radar evading technologies.

**Dev, S., Hansen, C.**  
*Mechanical Engineering*  
**EVALUATION OF SELF-HEALING PERFORMANCE IN EPOXY/GLASS FIBER COMPOSITES MANUFACTURED USING VARTM**  
(Advisor: Christopher Hansen)

Wind turbine blades are manufactured using the Vacuum Assisted Resin Transfer Molding (VARTM) method. These blades are subject to close to a billion loading cycles in a typical twenty year life span, which leads to the initiation and propagation of micro-cracks through the blade matrix material. Healing using dual microcapsule populations filled with amine and epoxy are investigated for implementation into epoxy-based adhesive bond lines and fiber-reinforced composite materials. Composite coupons are manufactured using the VARTM process, in which microcapsules are sprayed onto each ply prior to resin infusion. Capsule stability and fill content are examined using characterization techniques such as differential scanning calorimetry (DSC), thermogravimetric analysis (TGA) and Fourier transform infrared spectroscopy (FTIR). The effect of the resin flow on the migration and final distribution of microcapsules during the VARTM process is studied using fluorescence techniques. Mechanical performance of these coupons is characterized through a series of static tensile tests. Self-healing performance is
quantified by performing quasi-static fracture on TDCB (Tapered Double Cantilever Beam) specimens. Healing efficiency of specimens is calculated as a ratio of the Mode I fracture toughness of healed to virgin TDCB specimens and indicates the degree of recovery.

**Gunter, N., Anwar, M.I., Machmouchi, A., Cater, C.**  
*Mechanical Engineering*

**COMPUTATIONAL FLUID ANALYSIS OF A RACING CAR**  
(Advisor: Iman Mirzaee)

Society of Automotive Engineers (SAE), a U.S.-based, globally active professional association and standards organization, is conducting a student racing car design competition. For the competition SAE will be conducting an aerodynamic analysis on the developed car designs based on the 2016 Formula SAE rules. In this study, a numerical simulation of the fluid flow over the designed car body by the University of Massachusetts Lowell's team has been performed. The fluid flow over the car body has a significant importance in the overall efficiency and ride stability of the car. The car body is designed in CAD software and then it is imported to meshing software for computational domain discretization. The governing equations in the Computational Fluid Dynamics (CFD) software for the simulations are continuity and momentum equations which are solved on an unstructured mesh. It is found that the flow over the car body shows a three dimensional and unsteady turbulent characteristic. Large Eddy Simulation (LES) model is employed to take into account the turbulency effects. Vortex shedding, flow reattachment and recirculation zones were found around the car body. These flow instabilities significantly influence the lift and drag coefficients which are fundamental for car stability and energy efficiency. The numerical simulations will be ultimately used to analyze and optimize the flow over the body for different body shapes.

**Hallissey, N.**  
*Mechanical Engineering*

**EZ REMOVAL**  
(Advisor: Robert Parkin)

Two major problems of today's solar panels are low efficiency and shading caused by snow. When the snow covers the surface of solar panels, output power goes to zero. The new "EZRemoval" device has two parts; Smart Albedo and Snow Removal that can increase efficiency of solar panels by automatically removing snow from the surface of a solar panel. This will limit the shading and increase energy efficiency. Also, by using this device more electricity will be produced through the reflection of the Smart Albedo.

**Keane, O.**  
*Mechanical Engineering, Plastics Engineering*

**NANOLAMINATES FOR POTENTIAL HIGH-SPEED IMPACT APPLICATIONS**  
(Advisors: Emmanuelle Reynaud, Daniel Schmidt)

There is a need for polymeric materials able to resist high-speed impact events for safety applications. Safety glasses made of the polymer most commonly used for these applications, polycarbonate, has proven insufficient to completely eliminate eye injuries in combat situations.
Most safety glass systems consist of several layers of a rigid material, to catch projectiles, separated by several layers of flexible interlayers to inhibit crack propagation. Nanolaminates are a category of polymeric nanocomposites characterized by a highly oriented microstructure. These materials can have good damping properties and may be a suitable interlayer material. Nanolaminates have been produced at UMass Lowell in the past; however, previously the maximum sample size able to be produced was 33 square inches. Presented is a redesigned nanolaminate production system capable of producing nanolaminates up to 150 square inches in size. Nanolaminate films consisting of a matrix of Eastman's Tritan TX1000 and films with a matrix of Eastman Tritan's TX2000 were produced on this redesigned setup. After an investigation of solvents and solvent blends facilitated by the computer program Hansen Solubility Parameters in Practice, chloroform was selected as a working solvent to produce these films. The filler used in these films was Cloisite 20A, and filler contents ranged from 0 vol% to 90 vol% of the final nanolaminate. Once produced, the TX2000 nanolaminate films were successfully incorporated into laminated stacks. These stacks consisted of a nanolaminate film hot pressed between two injection-molded Tritan TX2000/Cloisite20A nanocomposite bars ranging from 0 to 0.79 vol% inorganic content.

Le, D., SPACE HAUC Student Team  
Mechanical Engineering, Lowell Center for Space Science and Technology  
SPACE HAUC: SCIENCE PROGRAM AROUND COMMUNICATIONS ENGINEERING WITH HIGH ACHIEVING UNDERGRADUATE CADRES  
(Advisor: Supriya Chakrabarti)

Science Program Around Communications Engineering with High Achieving Undergraduate Cadres (SPACE HAUC, pronounced "Space Hawk") aims to demonstrate the practicality of high data rate X-band communications using a phased array of antennas on a satellite of the CubeSat standard. The phased array will allow for the dynamic beam steering of the satellite's downlink transmission in order to maximize gain, and as a result, maximize the data transfer rate. Successful demonstration of this technology on a CubeSat would open up opportunities for more sophisticated small-satellite communications systems suited for advanced missions in low-Earth orbit and beyond.

Modir, Khazeni, S.M.  
Mechanical Engineering  
COMPREHENSIVE COARSE-GRAINED SIMULATION METHOD FOR TURBULENT NONEQUILIBRIUM PLASMAS  
(Advisor: Juan Pablo Trelles)

Nonequilibrium (NLTE) plasmas are partially ionized gases with high collision frequency among its constituents and significant difference between the temperatures of electrons and heavy-species. These plasma flows, often generated by electric arcs, are at the core of diverse technologies, such as plasma cutting, spraying, circuit breakers, lighting, fuel reforming, and gasification. NLTE plasma flows are inherently multiscale and are often unstable and turbulent, particularly under industrially relevant conditions. Therefore, a comprehensive approach (i.e. complete and consistent) and computationally feasible modeling and simulation of NLTE turbulent plasma flows is needed to advance plasma technologies. The computational exploration of turbulent plasma flows with Direct Numerical Simulation, which resolves all the involved
scales (large and small) will remain unfeasible with current and foreseeable computational resources. In contrast, Large Eddy Simulation (LES) techniques, which explicitly solve for the large scales and model only the small one, rely on assumptions that are not valid for plasmas and cannot provide adequate descriptions of turbulent plasma flows. Towards a comprehensive coarse-grained formulation for the modeling of turbulent NLTE plasma flows, the Variational Multiscale-n (VMSn) method is presented. VMSn avoids the assumptions in traditional LES by using a variational decomposition of scales together with a residual-based approximation of the small scales without the need for empirical parameters. An algebraic VMSn formulation is implemented within a Finite Element Method solver. Preliminary results confirm that VMSn can generate significantly improved results than those from state-of-the-art solvers for the same level of discretization.

Polcari, M.  
Mechanical Engineering  
DESIGN FOR THE AUTOMATION OF COMPOSITE WIND TURBINE BLADE MANUFACTURING  
(Advisor: James Sherwood)

Traditionally, the forming of composite wind turbine blades has been accomplished with the use of a hand-layup process. The blade to blade quality variance of this hand-layup process is high. Fabric layers of hand-layup preforms can exhibit out-of-plane wrinkling and in-plane waviness. Fabric imperfections such as these can reduce the strength and stiffness of the formed structure. To address these concerns, a piecewise shifting method has been proposed as an automatic fabric placement method. This method was intended for, but not limited to, use with unidirectional glass-fiber fabrics and it reduced the out-of-plane wrinkling resulting from applying a curvature to a fabric preform. This automated layup method saves time on the preform process and reduces quality variability from blade to blade. The goal of this research is to simulate the automated shifting layup method using a robust and easy-to-use finite element modelling software. A discrete modelling approach will be used that accounts for fabric shear stiffness evolution and fiber orientation changes during the forming process. The simulation approach will be demonstrated on the geometry of the trailing edge of a wind turbine blade. The simulation will consider the mechanical behavior of the fabric and reliably predict fabric deformation and failure zones. Analysis of the detailed modelling of the forming process will inform design changes that mitigate defects or relocate them to non-critical areas of the structure. The simulation will allow for the revision and iteration of fabric system selections without requiring the actual forming and testing of prototype parts. Benefits of the simulation include reduced prototyping costs and time expenditure, reduced material usage, and improved blade reliability and service life due to reduced structural defects.

Poozesh, P., Baqersad, J., Niezrecki, C.  
Mechanical Engineering  
HEALTH MONITORING OF WIND TURBINE BLADES USING ACOUSTIC-BASED AND IMAGE-BASED TECHNIQUES  
(Advisor: Christopher Niezrecki)

Wind turbines operate autonomously and can possess reliability issues attributed to manufacturing defects, fatigue failure, or extreme weather events. The current state of practice to
detect damages or cracks in wind turbine blades relies on traditional sensors (e.g. strain gages, string potentiometers, and accelerometers) that provide information at a number of discrete points. Owing to the large sizes of these structures, hundreds of sensors are generally required to capture information that can represent the current conditions of the blade. Even with a multitude of sensors, the data collected is not always comprehensive or is expensive and time consuming to instrument. More recently researchers have begun to exploit the sound-based and light-based measurement techniques to detect damages on a structure. A non-contacting measurement technique based on acoustic monitoring works by placing an audio speaker inside a hollow structure, such as a wind turbine blade, and observing the sound radiated from the blade to identify damages. Optical measurement systems use photogrammetric techniques in conjunction with image processing methods to determine the full-field strain and displacement of a turbine blade subjected to dynamic or static loading. Within the current work, novel non-contact measurement techniques based on sound and light radiation is proposed. The results of optical measurements performed on a 50-meter utility scale blade as well as operating wind turbine blades reveal the capability of the proposed system to detect damages on wind turbine blades. In another attempt, an acoustic microphone array with 62 microphones was used to measure the sound radiated from a wind turbine blade when an audio speaker generating random noise was placed inside a cavity emulating a wind turbine blades. The signals received by the microphones were processed to reveal damage locations.

Shahsavan, M.
Mechanical Engineering
STUDY ON BEHAVIOR OF LIGHT GASEOUS FUELS INJECTED INTO HEAVY WORKING FLUIDS
(Advisor: John Hunter Mack)

The efficiency of power generation through internal combustion engines and other thermodynamic cycles is heavily dependent on the properties of the working fluid. Considering the low density and momentum of the injected light gaseous fuel, the fundamental behavior of the interactions with a heavy working fluid will drastically affect the combustion properties of the non-premixed combustion event. The ability to conduct numerical studies will help parameterize the experimental design and provide insight into the contributions of considered molecules. In this study, preliminary modeling using ANSYS Fluent computer software has investigated how a hydrogen jet, as a lightweight injected gaseous fuel, behaves in different ambient environments. The jet geometry, velocity, duration, and composition are held constant for each case while the working fluid is varied. Nitrogen, argon, and xenon were chosen as the working fluids to cover a landscape of increasing molecular weight. As the molecular weight (or density) of the ambient fluid is increased, the penetration depth and shape of the hydrogen jet is severely impacted. The case that includes nitrogen, the lightest working fluid, clearly shows the most penetration and a relatively consistent shape. Conversely, when xenon is the working fluid, the increase in density gradient between the fuel and ambient medium results in much shorter penetration depth, a significantly altered jet shape, and regions of complex flow.
Yudzinsky, R., Liu, X., Burke, A.  
*Mechanical Engineering, Advanced Composites Materials & Textile Research Lab*  
**DESIGN OF SELF HEALING COMPOSITE MATERIALS AND TENSEGRITY STRUCTURES FOR ADVANCED STRUCTURAL APPLICATIONS**  
(Advisor: Chris Hansen)

The manufacturing of multifunctional and optimized composite materials offers the potential to produce longer service life structures and structures that can be reversibly assembled and used in multiple configurations. In our first NASA-funded project, the team investigates the development of composite fiber pre-impregnated tapes for automated fiber placement (an industry standard for manufacture) that are suited for healing of microscale fractures. This material forms an internal network of cavities which enable the flow of a fluid to repair damage. In the second NASA-funded project, the team is developing a three-dimensional approach to structural design that is more efficient than current structures in terms of typical load applications. The structural system is referred to as "tensegrities", as opposed to typical truss networks. Tensegrities are more powerful than truss systems by more evenly redistributing loads applied to the network and by transmitting the forces strictly down the length of its members, making tensegrities more apt to use the high strengths inherent to composite materials.

Bunker, M., Nguyen, H.  
*Plastics Engineering*  
**MECHANICAL PROPERTIES OF BIODEGRADABLE PHA-BASED SUBSTITUTE FOR PVC RUBBER**  
(Advisor: Stephen McCarthy)

This research, performed in partnership with Tauten Sports, Inc. and University of Massachusetts Lowell, involves characterizing the mechanical performance and biodegradation of rubbers based on Polyhydroxyalkanoates (PHA) versus the performance of existing non-biodegradable PVC rubbers. While PVC is recyclable, this requires collection and processing. PVC sees a wide variety of uses, including ones where elastomeric mechanical properties are desired. While PVC and PHA are also miscible, doing away with the PVC component entirely would greatly reduce the environmental impact. Many different formulations were profiled, varying fillers, plasticizers, crosslinkers, and properties of the PHA itself. Once compounded, formulations were cured via various thermal profiles into the approximate shape of the final product, and the resulting parts were subjected to tensile testing via Instron and biodegradation testing via Oxitop respirometry. Existing retail PVC products were also subjected to tensile and biodegradation testing, with the results taken as performance guidelines, informing the course of the research progression. Future work will include further refining the formulation and processing conditions to further improve properties versus PVC.
Microvascular channels embedded in composites materials have been demonstrated in heat transfer and self-healing applications. These channels are created via sacrificial filaments of polymeric material. To date, the manufacturing of these filaments for fused deposition modeling has been hindered by poor process control that prevents this technology from leaving research-scale production. In this research, production of extruded filament with strong evacuation properties such as Polylactic Acid (PLA) or Polypropylene Carbonate (PPC) able to be 3D printed onto carbon fiber prepreg and evacuated in heat ovens will be studied. In addition, specific qualities of these processes, including evacuation characterization of filament, transfer qualities of fused deposition modeling bed materials, and plastic extrusion consistency are evaluated and analyzed to develop commercial-scale materials processing.

Prior work suggests that rubber-containing polymers like impact modified polystyrene (HIPS) and thermoplastic vulcanizates (TPVs) exhibit unusual behavior when injection molded to create parts with microstructured surfaces. This work was an in-depth investigation of the effects of material composition, including matrix stiffness, rubber content, and rubber domain size, on replication of injection molded microstructured surfaces. Multiple grades of TPVs and HIPS allowed for a range of material properties. The polymers were molded using a range of processing conditions (melt and mold temperatures, packing pressures, and cooling times) and replication was measured using scanning electron microscopy. Microfeature replication (feature definition and depth ratios) was correlated with matrix stiffness, rubber content, and rubber domain size in the polymer materials and with the processing parameters.

Pill cutters are used as a way of cutting pills into even segments. The majority of cutters are design based around round pills, and don't always work well for other shapes. Most cutters work on the assumption that the pill being cut is symmetrical and as such as being split evenly. The goal of this project is to redesign the current available pill cutters to be more versatile and user friendly. Our design will enable the consumers to cut pills of all shapes and sizes that are available in the market. Our aim is to make the simplest design possible and which is cheaper than the pill cutters available today.
Drammeh, A., Atkinson, C.
Plastics Engineering
A METHOD OF CHARACTERIZING ADHESION STRENGTH OF POLYMER COATINGS ON EXTRUDED WIRE AND CABLE
(Advisors: Margaret Sobkowicz-Kline, Stephen Johnson)

In general, cables used as a means for various forms of telecommunication are coated with polymer based resins to protect the wire. The coatings are typically a combination of one or more materials to enhance the protective aspect of the finished product. Since some of these cables are exposed to a variety of different environmental and climatic factors, it is important to accurately determine the relationship between the coating and the wire substrate. Some standards exists today which succeed in explaining the adhesive forces between certain types of wires such as optical fiber cables, however the simplicity of these methods aren't necessarily very practical and easy to understand. In this paper, we will attempt to investigate a method to quantify adhesion strength of a polymer coated wire by modifying an existing ASTM testing method. An attempt will also be made to try and understand what the influence of different processing conditions and material selection has on the nature of the adhesion between the finished product.

Facendola, P., Connor, S., Langlois, C., Belyea, K.
Plastics Engineering
REWORKABILITY OF UNSATURATED POLYESTERS USING A METAL SALT CATALYST
(Advisor: Daniel Schmidt)

The defining feature of thermoset resins is that, once set, they cannot be melted. They therefore offer high thermal stability, good rigidity, and resistance to creep. This also means that, once cured, the resin and its laminate cannot be recycled. However, recent studies have shown that the bonds in cured epoxy resins can be reworked via a transesterification catalyst. Expanding on previous research, it is theorized that this transesterification catalyst will produce a similar result in unsaturated polyesters. In theory, the transesterification catalyst allows the polymer's ester linkages to break and reform in new positions. The purpose of this capstone is to create a reworkable unsaturated polyester that increases end-of-life uses for polyester composites and laminates in order to reduce waste.

Flynn, J., Zubricki, J.
Plastics Engineering, Mathematics
EFFECTS OF EXTERNAL SIGNAL TRANSFERS AND VELOCITY CONTROLLED PACKS ON VISCOSITY CHANGES IN FEED MATERIAL OF INJECTION MOLDING
(Advisor: Jan Huang)

The use of recycled thermoplastic material in plastics processing is a growing trend in today's market. Reincorporation of reground material can reduce material costs and lessen a processor's environmental footprint. In injection molding processes, scrap parts and runners are commonly reground to be reused in the process. One major obstacle in the use of regrind material is the increased batch to batch material variation, specifically viscosity, compared to that of virgin material. Viscosity variations affect how a part is packed out which can lead to significant dimensional variations or even visual defects such as short-shots. This study focuses on the use
of cavity pressure controlled transfer via external signal and corresponding velocity controlled pack in an injection molding process to overcome the viscosity changes in the regrind. A single cavity mold instrumented with post gate and end of fill cavity pressure sensors was used to produce spools made from 100% regrind comprised of primarily polyamide-6 (PA-6) and PA-6,6 of various colors and glass fiber loading levels. Parts will be made using a traditional position transfer process and cavity pressure transfer process. Process parameters such as injection pressures and injection integrals, as well as finished part measurements, will be used in order to determine the effectiveness of using cavity pressure sensors and velocity controlled pack to mitigate the effect of viscosity variations. In addition, rheological measurements will be taken for different lots of regrind to further highlight the viscosity variation present.

Hovagimian, D.
Plastics Engineering
CLASSIFICATION, MAINTENANCE, AND FLOW SIMULATION OF UNIVERSITY MOLD BASES
(Advisor: Stephen Johnston)

The Plastics Engineering department has dozens of molds donated by industry and manufactured for various research projects. Each mold manufactures a unique part providing specific research capabilities when studying plastics processing. Unfortunately, molds lack sufficient documentation when they are donated to the University. The goal of this project is to clean, repair, and run newly donated molds so that their research capabilities are fully documented in the Department's mold catalog and these tools can support ongoing and future research projects.

Kender, L., Morrisey, P., Polanco, A., Kender, E.
Plastics Engineering
REWORKABLE VINYL-ESTER COMPOSITES
(Advisor: Daniel Schmidt)

The reworkability of vinyl-ester (VE) composites is considered. A typical thermoset is a polymer that cures irreversibly. In other words, a thermoset cannot be heated and reshaped. Our goal is to produce a reworkable vinyl-ester composite and test to see if it can be healed. Vinyl esters are a type of thermoset resin formed from the esterification of an epoxy resin and a carboxylic acid. A vinyl ester resin from Ashland Inc. was mixed with varying amounts of initiator, accelerator, and transesterification catalyst. In addition, multiple transesterification catalysts were tested. Samples were cured and the effects of different mixtures were examined. The samples were tested to see if they remained reworkable.

Ly, W., Tran, L., Chhim, C., Keane, O., Vaidya, A.
Plastics Engineering
TWIN SCREW COMPOUNDING WITH CO-POLYESTER TRITAN TX2000/TX1000 AND NANOCLAY CLOISITE 20A
(Advisor: Daniel Schmidt)

The objective of this study is to determine the optimal amount nanoclay with a CBDO co-polyester then be investigated for high speed impact strength properties. Adjusting the amount of nanoclay improves the mechanical properties of the co-polyester but at a certain percentage the
properties of the material drops significantly. Two different grades of co-polyester are used to investigate and see the difference in properties. The nanoclay and both co-polyester are first dried for four hours and mixed with addition of mineral oil to allow the nanoclay to stick onto the co-polyester. The mixed formulation is compounded on a twin screw compounder using a volumetric feeder. Five formulations were processed for both co-polyesters to help narrow down the optimal nanoclay needed to maintain excellent impact strength. Thermogravimetric Analysis (TGA) showed that there was a slight percentage of nanoclay missing from the polymer matrix but it is negligible. The results for this study showed that the process used for both co-polyesters and nanoclay was successful.

McCabe, M., Bain, C., Lay, A., Sarittick, S.
*Plastics Engineering, Business, Electrical Engineering, Mechanical Engineering*

**3RD ANNUAL COLLEGIATE WIND COMPETITION**
(Advisors: Stephen Johnston, David Willis, Christopher Hansen, Michael Darish, Tom O'Donnell, Christopher Niezrecki)

The Department of Energy (DOE) and National Renewable Energy Laboratory (NREL) facilitate the annual Collegiate Wind Competition. The competition uses the goals of DOE, "to catalyze the timely, material, and efficient transformation of the nation's energy system" through the use of wind energy. UMass Lowell's interdisciplinary team is responsible for a 40 page business plan outlining our "business" as a whole. This includes the business overview of the product, the market opportunity, the development and operations, a financial analysis to explain any capital required for development and going forth with the design and a deployment strategy. The team is also responsible for a technical design in the form of a prototyped turbine. This prototype must follow the competition standards such as withstanding continuous winds up to 18 m/s, producing a minimum, continuous output of 10W for a wind speed ranging from 5-11 m/s and withstanding a load that ties the prototype to the product's real world application. Our team has been working alongside Army Natick Laboratories to develop a kite wind turbine to eliminate some diesel fuel generators used in forward operating bases. Army is the primary market for our business so they act as the "voice of the customer". In May we will travel to New Orleans to participate in the competition and hopefully take first place for UMass Lowell.

Mohd Aris, Z.F., Pelletier, M.G.H., Gaines, P., Nagarajan, R.
*Plastics Engineering, Biological Sciences*

**MICROWAVE ASSISTED TRANSFORMATION OF POLYSACCHARIDES FROM RENEWABLE SOURCES TO SURFACE-ACTIVE POLYMERS**
(Advisor: Ramaswamy Nagarajan)

There is a growing interest in utilizing renewable resources and exploiting 'greener' methods for the synthesis of environmentally friendly products. Here we present a new approach for converting abundantly available polysaccharides (i.e. pectin and pectic acid) derived from fruit waste to surface-active polymers. These polysaccharides are hydrophilically and hydrophobically modified accordingly to achieve surface-active properties. More importantly, these transformations can be accomplished very efficiently in a microwave reactor, resulting in improved product yields and significantly shorter reaction times. Detailed structural characterization of products, surface and interfacial properties of these surfactants will be presented. To establish the safety of these polysaccharide-based surfactants, detailed cytotoxicity
evaluation using human dermal fibroblast (HDF) and human leukemic (HL-60) cell lines will also be presented. Lastly, the potential for utilization of this new class of surfactants in detergent applications will also be presented. This research establishes the development of safer surfactants from renewable feedstock using 'greener' microwave-assisted synthetic routes, opening new possibilities for the synthesis of more sustainable amphiphilic polymers that can be useful in various applications.

Staub, N., Dunh, J., Mitchell, J.
Plastics Engineering
REINFORCEMENT OF BIOBASED AND BIODEGRADABLE PHA WITH SISAL FIBERS
(Advisor: Aldo Crugnola)

Prior work of alkali and acetylation pretreatments of the fiber revealed a lack of coupling between the fiber and the matrix (Mirel 2200). This study investigated an improvement in coupling between the fiber and the matrix by a creation of free radicals on the fiber by gamma irradiation, and the introduction of a peroxide. The level of adhesion was examined by mechanical properties and SEM work.

Theriault, M., Matar, J., Yoeuth, S., Bello, D., Barry, C.
Plastics Engineering, Work Environment
INVESTIGATION OF NANOPARTICLES Emitted WHEN INJECTION MOLDING NEAT AND ADDITIVE-FILLED POLYPROPYLENE AND POLYCARBONATE
(Advisor: Carol Barry, Dhimiter Bello)

Injection molding of thermoplastic resins is well known to produce volatile organic compounds which can adversely affect operator health, but there is little understanding of particulate emissions. Recent molding of nanocomposites produced no emission of carbon nanotubes, but emission of organic nanoparticles of unknown composition. This work is an investigation of those particulates with the gaseous phase emissions of airborne nanoparticles collected during injection molding of neat and additive-filled polypropylene and polycarbonate compounds. The starting materials, collected nanoparticles, and molded parts were analyzed using thermogravimetric analysis, thermogravimetric analysis coupled with Fourier-transform infrared spectroscopy, differential scanning calorimetry, and gas chromatography-mass spectrometry. The results were analyzed to determine the composition of the nanoparticles and compounds lost from the polypropylene and polycarbonate during injection molding. Characterizing these emissions will allow for a better understanding of the precautions and safety equipment needed during melt processing.
GRADUATE SCHOOL OF EDUCATION

Farmosa, E.
*Education – Research Methods & Evaluation*

**HONORS COLLEGE’S THESIS/PROJECT PROCESS EVALUATION AND ITS UTILIZATION**
(Advisor: Jill Lohmeier)

The goal of this project was to evaluate the Honors Thesis/Project process from the faculty perspective. A theses/project is a mandatory requirement to graduate with Commonwealth Honors. The project consisted of a survey that was sent to anyone who has taught an honors section of a course, an interview with a faculty member who has advised multiple theses, and a review of the current policies. Part of the project goal is to examine survey results and implement new retention strategies focusing on the honors thesis/project process as a vehicle to a more successful program. Faculty mentor(s) (Thesis Advisors) meet with students frequently and will therefore have a greater impact on whether or not they successfully complete the thesis/project. The focus of the evaluation was specifically on the faculty and how they view the thesis/project process, their role, specific requirements of individual disciplines and how the process can be improved to promote better and greater student success and completion. There were some recommendations that have or will significantly improve the process for both students and faculty. The evaluation has some areas that can be improved upon in the future iterations, but overall this was a successful utilization-focused evaluation. The Honors College is seeing the benefits of the evaluation and plans on doing more with other aspects of the Honors College. The poster will discuss what went wrong, what data was collected, what the major themes were, and how the evaluation has been used.

Kelley, J.
*Leadership in Schooling*

**THINKING ABOUT LEARNING IN MATHEMATICS: UNDERSTANDING WHY AND HOW TEACHERS SUPPORT THE DEVELOPMENT OF SELF-REGULATED LEARNERS**
(Advisor: Phitsamay Uy)

Self-regulated learning is an elaborate metacognitive process consisting of an individual's awareness of the thought process, flexibility in one's approach to problem solving, and motivation to persist through obstacles until a goal has been met. Strategies and instructional practices used to develop mathematically proficient thinkers also develop self-regulated learners. The guiding principles: metacognition, motivation, and strategic competence propel self-regulated learners through phases of a cyclical learning loop (Zimmerman, 2001). A qualitative case study was conducted in an urban elementary school in New England. Data was collected through interviews, observations and student performance. The three participants were self-reported effective math teachers. The data collected reveals that there is a need to develop more clarity about the meaning of thinking. Teachers and students need support in developing a shared understanding of the metacognitive processes involved at each phase of self-regulated learning and making the thinking process in each phase transparent to others. Findings suggest that a fourth phase of self-regulated learning be incorporated into the self-regulated learning cycle and the term thinking needs to be clearly defined. This study presents implications for three areas of future research. First, the proposed addition of a fourth phase of self-regulated learning would need to be further studied to determine its relevance in contexts beyond this study. Second, the
impact of the collaborative nature of teachers on self-regulated learning should be further explored. Finally, similar studies should be conducted in situations where instruction is balanced across all phases of self-regulated learning.

**Thompson, S.R.**
*Leadership in Schooling*

**THE NATURE OF WORKING IN AN ALTERNATIVE HIGH SCHOOL**
(Advisor: Stacy Szczesiul)

This ethnographic investigation examined the nature of working in an urban alternative high school specifically designed for students, ages 16-21 years old, who have either left their district high school prior to graduation or are significantly at risk of dropping out of school. This study focuses on the perspectives and experiences of 11 teachers and two administrators working with students at this site during the 2012-2013 school year. In order to build redundancy into my study, the following sources of data were collected: 40 in-depth one-on-one interviews, more than 50 school days of participant observations spread throughout the school year, four focus groups, school artifacts, school documents, and visual data. Analysis of the aforementioned data reveals that the school examined has strong teacher retention even though these teachers are underpaid compared to their traditional counterparts and experience emotional stress due to the population of students they serve. However, it appears that the school's teachers remain resilient while serving as life coaches for their students and that the teacher retention at this school is attributable to a high level of resilience. Moreover, the teachers' resilience is bolstered by how they collectively cope with the emotional stress inherent to their work, how they collectively define themselves, the transformational leadership the administrators provide and the strengths-based approach they employ, as well as the purposeful, collective actions this community takes to maintain a supportive, rewarding, and meaningful work environment that promotes positive mental health and well-being.
KENNEDY COLLEGE OF SCIENCES

Abdou, M., Schwager, E., Fish, J.

Biological Sciences

EFFECTS OF SATB2 KNOCKOUT AND SF3B4 KNOCKOUT ON DIFFERENTIATION AND TRANSCRIPTION IN TRANSFECTED MOUSE-DERIVED OSTEOBLASTS
(Advisors: Jennifer Fish, Evelyn Schwager)

The genes Special AT-rich sequence-binding protein 2 (SATB2) and Splicing Factor 3B, Subunit 4 (SF3B4) are known to be involved in craniofacial abnormalities during vertebrate embryogenesis. In humans, defects in these genes can cause various dysmorphic facial phenotypes such as cleft palate and micrognathia. SATB2 knockout mice have very small jaws and die of cleft palate. Interestingly, heterozygous SATB2 mice have variable reduction in jaw length. The purpose of this research is to investigate how differences in transcriptional levels of SATB2 and SF3B4 may affect jaw size by generating variation in the process of ossification during bone development. Using Crispr/Cas9 genome editing, specific gene disruption and replacement, allows genetic modification of mouse-derived osteoblast cells (MC3T3-4). In this study we want to individually knock out SATB2 and SF3B4 by gene disruption, through insertion of a GFP open reading frame into the genes' coding sequence. Successful disruption of the target gene will be accompanied by cells showing expression of GFP. Preliminary results hint toward successful integration 24 hours post transfection of SATB2 knockout/GFP knock-in. However, 48 hours post transfection, we observe significant cell death, which is consistent with the requirement of this gene for osteogenesis. Future research on SATB2 knockout and SF3B4 knockout cells will include quantitative analyses of transcription and differentiation.

Bradley, C., Wernick, N.L.B.

Biological Sciences

ANALYSIS OF FRESHMEN BIOLOGY UNDERGRADUATES' METACOGNITIVE AWARENESS IN RELATION TO SEMESTER GRADES
(Advisor: Naomi Wernick)

Metacognition refers to a student's ability to understand which strategies are most beneficial in their everyday learning (Flavell, 1979). This study assessed the possible relationship between biology undergraduates' metacognitive awareness and their success in introductory biology, using final grades as a measure of success. Students' motivation and test anxiety were compared with their metacognitive awareness as an additional component of this study. In order to investigate these relationships, the Motivated Strategies for Learning Questionnaire (Pintrich et al., 1995) was used to determine student's metacognitive and motivational tendencies. Undergraduate biology students completed the questionnaire at the beginning and end of their first college semester (Pre and Post-Survey: n=12, Post-Survey: n=16). Student responses were compared to their final semester grades. Data obtained from this study indicates that students in the A/B grade range exhibited higher metacognitive awareness than students in the C/D range (p<0.05). In addition, it was observed that as the semester progressed, students in the A/B range showed a higher improvement in metacognitive awareness compared with students in the C/D grade range (p<0.05). The data also illustrates that students in the A/B grade range demonstrate higher motivation as well as self-regulation when compared with students in the C/D grade range.
(n=6). Finally, the data indicates that students in the A/B grade range tended to have higher self-regulation and less test anxiety than students in the C/D grade range.

**Dowrey, T., Fish, J.**  
*Biological Sciences*  
**IMPORTANCE OF SATB2 AND SUMO1 IN OSTEOGENIC DIFFERENTIATION**  
(Advisor: Jennifer Fish)

Individuals with similar mutations often exhibit disease phenotypes that show significant variation in severity. This concept of phenotypic penetrance is thought to have a genetic basis, however, even twins with the same disease may show different phenotypes suggesting an additional role for stochastic developmental variation. To evaluate the role of developmental variation, two genes thought to be significant in bone development, Satb2 (special AT-rich sequence-binding protein) and Sumo (Small Ubiquitin-Like Modifier) were experimentally altered in mouse osteoblasts in an attempt to understand their role in osteogenic development. Reduction in Satb2 levels is known to generate variation in osteogenic differentiation. Satb2 and Sumo were over-expressed via transfection in two different cell lines with a wild type cell line acting as a control. An in vitro model of a 17-day differentiation timetable was used to simulate bone development. RNA and protein were extracted at four different time points in all three cell lines. An alizarin red stain was also conducted at each of the four time points. qPCR and western blot methods were used to analyze RNA and protein levels throughout differentiation. Initial results suggest that Satb2 levels do correlate to osteogenisis and may increase levels of other osteogenic promoting genes. Also, data gathered at the day 10 time point gave the most interesting differences between the Satb2 over-expression cell line and the control cell line. Future work may include using RNA FISH methods to study mRNA levels in individual osteoblasts under varying Satb2 conditions.

**Gambino, K., Chakrabarti, D., Fish, J.**  
*Biological Sciences*  
**QUANTIFYING THE SHH PATHWAY THROUGH EXPRESSION OF GLI2 IN DUCK AND QUAIL MANDIBLES**  
(Advisor: Jennifer Fish)

The Sonic Hedgehog (SHH) signaling pathway has a profound effect in the organization of size and shape in developing structures. Alterations to SHH signaling during development are known to affect jaw size and contribute to defects, such as cleft palate. However, it is not known how changes in SHH signaling in normal development relate to species specific differences in size. In order to test the hypothesis that differences in jaw size between duck and quail are due to variation in SHH signaling, we investigated the expression of the Gli2 protein, which plays a role in both the activation and repression of the pathway. Protein was isolated from the whole mandibles of duck and quail at three critical stages, HH21, HH24, and HH27. At all time points, we find species-specific patterns of Gli2 processing. Banding was expected at 185kD and 75kD, which depict the full length active Gli2 and the cleaved repressive Gli2 proteins respectively. Multiple bands are visible at higher weights that are only present in duck samples, while quail samples depict multiple bands at lower weights. Further investigation, will determine the extent of post translational modification on this patterning, and determine if this species specific patterning is consistent with other members of the SHH pathway, such as Patched and Gli3.
Lutaaya, A., Marcello, S., Rolle, L., Sullivan, E., Garb, J.

Biological Sciences

THE HOST WITH THE MOST: QUANTIFYING AND IDENTIFYING PARASITES FROM ENDANGERED KEMP'S RIDLEY SEA TURTLES
(Advisor: Jessica Garb)

The Kemp's ridley (Lepidochelys kempii Garman, 1880) is the smallest of all sea turtles, most commonly found off the east coasts of North and Central America. These turtles are also classified as a critically endangered species that is threatened by human disturbance of nesting grounds, trawl and longline fishing, and boat strikes. Another threat to juvenile members of the species is a phenomenon known as cold-stunning. Cold-stunning is characterized by hypothermia-like pathologies, and in some cases it can result in strandings or even death. In recent years, the New England Aquarium (NEAq) has had opportunity to study the biology of juvenile Kemp's ridleys as they manage animal rescue during cold-stun events. At the NEAq rescue facility, biologists, veterinarians and volunteers focus on the rehabilitation of these turtles by providing husbandry care and administering medical treatment. Our research focuses on investigating the parasite infracomunity within juvenile ridleys. The implementation of various molecular techniques and bioinformatics has enabled the identification of numerous parasite specimens, using the COI gene as a marker. Successful PCR amplification of this gene is achieved using a nematode-specific primer cocktail. Sequencing of amplified products has been used to determine taxonomic relationships of the parasites. The majority of the parasites examined belong to the nematode genus Anisakis, which is a type of roundworm parasite usually found in marine mammals, fish and crustaceans. By examining the biodiversity present in juvenile Kemp's ridleys, we hope that our data will contribute to the understanding their ecology as well as future rehabilitation efforts.

Master, R., Fish, J.

Biological Sciences

DEVELOPMENTAL ORIGINS OF THE STOMODEUM: COORDINATING BRAIN AND JAW SIZE EVOLUTION
(Advisor: Jennifer Fish)

Variation in jaw size produces morphological diversity in vertebrates but variation in jaw size early in development can potentially be linked with diseases such as cleft lip or palate. Therefore, understanding how jaw size is regulated can potentially help understand both disease and evolution. Avians are good models for studying jaw size because of the great diversity in beak morphology in this clade. In particular, duck and quail exhibit large differences in jaw size, which make them a suitable system to study how jaw size varies during development. Our previous work showed that differences in jaw size occur very early in development. Specifically, by HH13 when the jaw primordial is first formed, duck already have a significantly first pharyngeal arch than quail. In order to understand how this initial difference arises, we conducted a series of experiments that compared gene expression in duck and quail embryos at stages HH6-HH13. In particular, we examined Otx2, Fgf8, Shh, and Pitx2 expression in the prechordal plate, neural and facial ectoderm, and pharyngeal endoderm. Our data suggest that the head and jaw primordia are can be distinguished in duck and quail embryos before morphological differences appear. Further, morphological comparison of duck and quail brain,
jaw, and mouth primordia, suggest that evolutionary differences in brain regionalization may also contribute to differences in jaw size.

Matte, T., Haney, R., Garb, J.
Biological Sciences
IDENTIFICATION OF VENOM PROTEINS IN THE COMMON HOUSE SPIDER USING GENOMIC AND BIOINFORMATIC ANALYSES
(Advisor: Jessica Garb)

Spider venoms have been of interest to researchers because of their importance both ecologically and pharmacologically. However, there have been relatively few studies that utilize genomic and transcriptomic approaches to research these venoms. Here, we used the recently sequenced common house spider (Parasteatoda tepidariorum) genome and tissue-specific RNA-seq data to uncover venom specific transcripts (VSTs) that have a potential role in venom. By comparing transcript quantities across three tissues we discovered 1465 VSTs. Among venom overexpressed transcripts, we found many with a significant BLAST hit to a toxin protein. These include latrotoxins, latrodectins, inhibitory cystine knot toxins, and CRISPs, among others. Computationally grouping all predicted genes into families yielded 651 gene families that contained at least one VST. Interestingly, many of these families (>100) have proteins that are overexpressed in other tissues (silk or ovary) as well, raising the question of whether or not these venom proteins evolved from a previous function in a different tissue. Together, these data contribute to a growing picture of the "pharmacological cocktail" in spider venom and open the door for further research regarding the evolutionary origins of some of these toxin proteins.

Nadile, E., Wernick, N.L.B.
Biological Sciences
THE ROLE OF STUDENT MOTIVATION IN ACADEMIC SUCCESS IN A FRESHMEN BIOLOGY COURSE
(Advisor: Naomi Wernick)

This study examined the academic motivation, or self-determination, of freshman students in an introductory Biology course. Self-determination theory concerns the extent to which behaviors controlled by motivation are autonomous (intrinsically based) or controlled (extrinsically based). Intrinsic and extrinsic motivational factors were assessed using the Learning Self-Regulation Questionnaire (LSRQ) adopted from Black and Deci (2000) (used in 2014) and the Motivated Strategies for Learning Questionnaire (MSLQ) from Pintrich (1991) (used in 2015). Pre and post-surveys were administered at the start and completion of the course; student grades were also collected. We hypothesized that students who received an A or B would be more extrinsically motivated by the reinforcing nature of grades, and external sources of praise or pressure. We also hypothesized that C, D, and F students may be more intrinsically driven, by focusing on material of interest instead of current topics being assessed. Results from the 2015 MSLQ study demonstrated that student grades were not strongly correlated with motivation. When results from the LSRQ and MSLQ were combined (n= 63), it was found that, over the course of the semester, intrinsic motivation decreased in C/D students, whereas it increased in A/B students (p<.05). Additionally, over the course of the semester, extrinsic motivation
decreased for A/B students, and extrinsic motivation increased for C/D students (non-significant p value for these averages). By investigating the motivations behind student participation and learning, instructors and students can further understand the ways in which they are motivated and can develop appropriate interventions and/or classroom instructions.

Patel, S.D., Dewilde, A.H., Fish, B.L., Medhora, M.M., Moulder, J.E., Tries, M., Braunhut, S.J.

Biological Sciences

LISINOPRIL, AN ANGIOTENSIN CONVERTING ENZYME (ACE) INHIBITOR, MITIGATES NEUTRON-GAMMA IRRADIATION INDUCED NEPHROPATHY IN A RAT MODEL
(Advisor: Susan Braunhut)

The United States is at risk for a nuclear attack with an improvised nuclear device (IND) due to theft of nuclear material. Neutron-gamma exposure can occur from a terrorist attack using IND or an accidental nuclear reactor leak. Due to higher relative biological effectiveness (RBE) of neutrons, the damaging effects are significant. Major biological effects of radiation exposure include hematopoietic syndrome, gastrointestinal (GI) syndrome, lung pneumonitis, nephropathy, and brain-cognitive defects. Since the Cold War era, minimal research has been performed regarding the development of effective medical countermeasures after exposure to high linear energy transfer (LET) radiation, such as neutron-gamma. Our objective is to study the biological effects of mixed neutron-gamma radiation and to test mitigators for their effectiveness in preventing radiation-induced nephropathy when high LET is used. Unanesthetized female Dahl/SS rats received varying doses of neutron-gamma radiation (up to 8 Gray equivalent, estimated RBE of 1.0) with syngeneic bone marrow transplant performed post irradiation. Palliative care (antibiotics and hydration) was provided within first two weeks after irradiation. Mitigating agent, lisinopril (40 mg/L in water), was administered starting 7 days post exposure. Lisinopril has proven efficacy against low LET radiation such as x-ray. Proteinuria and blood urea nitrogen (BUN) levels were monitored as indicators of radiation-induced nephropathy. Weight loss, tooth loss, cataract formation, and survival were monitored, and necropsies were performed upon death or euthanasia. We observed that lisinopril was effective in preventing radiation-induced nephropathy. This indicates that lisinopril may be an effective mitigator after exposure to high LET radiation.

Saint-Louis, R., Fish, J.

Biological Sciences

ASSESSING THE ROLE OF SONICE HEDGEHOG SIGNALING IN JAW SIZE
(Advisor: Jennifer Fish)

Sonic Hedgehog (SHH) plays a critical role in jaw development; it affects proliferation and outgrowth of developing structures. In humans, abnormal expression of SHH can cause defects in jaw size, including cleft lip or palate. Yet it is unknown how differences in SHH signaling may contribute to species-specific differences in jaw size in normal development. To test the hypothesis that species-specific differences in SHH signaling is associated with differences in jaw size during development, we took advantage of two avian species, duck and quail, which are remarkably different in jaw size. We examine the regulation of the Hedgehog (Hh) pathway through several critical genes including Patched-1, a negative regulator of Hh signaling, and Gli-1, a Hh signaling effector. It is our goal to quantify differences in the expression of Patched-1
and Gli-1 mRNA and protein between quail and duck. To this end, we have collected quail and duck embryos at significant developmental stages and dissected their mandibles or jaws. We next extracted protein and RNA from our samples for analysis via quantitative polymerase chain reaction (qPCR) and Western blot. Our data indicate species-specific regulation of the SHH pathway, especially of Patched-1. Future experiments will test the functional role of Patched-1 in jaw size by manipulating its expression in jaw development. By better understanding how the jaw size is regulated, we can work towards creating better treatments for jaw size defects in the future.

Theochares, B., Pelletier, M., Gaines, P.
Biological Sciences
EXAMINING THE ROLE OF LAMIN A AND LAMIN C ON THE MATURATION AND FUNCTIONALITY OF MOUSE NEUTROPHILS USING AN IN VITRO MODEL
(Advisor: Peter Gaines)

Neutrophils are the most abundant white blood cell in the body and are commonly known as the primary mitigators of infection. During differentiation from myeloid progenitors in the bone marrow, neutrophil nuclei become hyperlobulated, a process dependent on changes in expression levels of several proteins within the nuclear envelope and nuclear lamina. These nuclear changes are thought to facilitate the capacity of mature neutrophils to travel through endothelial cells of capillaries as they migrate to sites of infection to phagocytose foreign microorganisms. Fc receptors on the surface of a neutrophil recognize and bind to opsonized targets, initiating signals that cause cytoskeletal rearrangement and induce F-actin polymerization to bring the target into the cell. Due to the quick and easy nature in which this must occur, any stiffness imposed upon the cytoskeleton may impede this process. Previous studies demonstrated stiffness of the nucleus depends on expression of lamin A, increases of which delayed migration of neutrophils. Because of the association of the nuclear lamina with the cytoskeleton, stiff nuclei resulting from overexpression of lamin A or its splice variant lamin C may alter the ability of neutrophils to engage in phagocytosis by hindering cytoskeletal rearrangement. To address this possibility, we analyzed murine promyelocyte (MPRO) cells stably overexpressing lamin A or lamin C for functional capacity through flow cytometry upon maturation. To date, we have characterized the MPROs through cell-surface marker analysis (Gr-1 and Mac-1) to demonstrate that they have hypo-lobulated nuclei, and show that phagocytosis of fluorescence-labeled E. coli is impaired.

Dolan, K., Fish, J.
Biomedical Engineering & Biotechnology
TISSUE-SPECIFIC THRESHOLDS OF FGF8 ACTIVATION AND DEVELOPMENTAL INTERACTIONS CONTRIBUTE TO JAW ASYMMETRY IN DISEASE
(Advisor: Jennifer Fish)

Fgf8 is a secreted signaling factor that contributes to the growth and development of many tissues, including the limbs and jaw. Using an allelic series of Fgf8 mutant mice to generate embryos with 5 distinct genotypes and Fgf8 dosages: Fgf8+/+ (WT), Fgf8Neo/+, Fgf8Delta/+, Fgf8Neo/Neo, Fgf8Delta/Neo, we investigated the effects of reductions in Fgf8 dosage on size and symmetry of the jaw and limbs. Bone length in the limb extremities was measured and compared left versus right sides in WT, Fgf8Neo/+ and Fgf8Neo/Neo neonatal skeletons. Mutant limbs are somewhat smaller than in the other genotypes, but no apparent asymmetry is observed.
Mutant mandibles are smaller and much more variable in size than WT or Fgf8Neo/+ mandibles, exhibit directional asymmetry and unilateral fusion of the jaw in approximately 33% of Fgf8Neo/Neo neonates. We compared the size of the left and right mandibular arches at E10.5 and found that Fgf8Delta/Neo mutants are asymmetric and smaller than WT or Fgf8Delta/+ individuals. We evaluated Fgf8 expression as a potential source of asymmetry at E9.5 and E10.5. Fgf8 is expressed asymmetrically in the developing heart at both stages and is expressed asymmetrically in the forelimbs of E10.5 embryos of all genotypes, a typically morphologically asymmetric stage. Neonatal mice do not exhibit limb asymmetries. This data suggests that jaw development is more susceptible to reduction in Fgf8 dosage than is limb development and asymmetries in jaw defects may result from early developmental asymmetries in gene expression in other tissues that develop in close association with the jaw.

Martin, J.

Biomedical Engineering & Biotechnology
CONTINUOUS-WAVE CIRCULAR POLARIZATION TERAHERTZ IMAGING OF NONMELANOMA SKIN CANCERS
(Advisor: Cecil Joseph)

Biomedical applications of terahertz (THz) radiation are appealing because THz radiation is non-ionizing and has the demonstrated ability to differentiate between cancerous and normal tissue. A linear polarization-sensitive detection technique for tumor margin delineation has already been demonstrated; however, utilization of a circular polarization-sensitive detection technique has yet to be explored at THz frequencies. In this research, a reflective continuous-wave THz imaging system capable of illuminating a target sample at 584 GHz with either linearly or circularly polarized radiation, and capable of collecting both cross- and co-polarized signals remitted from the target, is implemented. To demonstrate the system's utility, fresh ex vivo human skin tissue specimens containing nonmelanoma skin cancer were imaged. Both polarization-sensitive detection techniques showed contrast between tumor and normal skin tissue, although some differences in images were observed between the two techniques. Our results indicate that further investigation is required to explain the contrast mechanism, as well as to quantify the specificity and sensitivity of the circular polarization-sensitive detection technique.

Giarrosso, A., Morose, G., Pascal, K.

Chemistry
CREATING A SAFER ALTERNATIVE FOR METHYLENE CHLORIDE IN PAINT STRIPPERS
(Advisors: Jason Marshall, Gregory Morose)

Methylene chloride (MC) is a liquid solvent used as the main active ingredient in many paint strippers. Unfortunately, MC is an inhalation hazard and a probable carcinogen according to the Environmental Protective Agency. Despite its toxicity, MC is still used because it's cheap and effective. No current safer alternative paint strippers can match MC cost and effectiveness. Recently, the company Savogran approached the Toxics Use Reduction Institute for help in eliminating MC in their paint stripping products. Replacing MC has long been a goal in the field of green chemistry, but no one has found a suitable replacement. Many researchers have looked for a 1:1 replacement, but no such chemical was as effective. The research method used for finding a replacement for MC in this project was to find a solvent blend that imitates similar
solubility characteristics as MC using the Hansen Solubility Parameters in Practice (HSPiP) software application. HSPiP works with the intermolecular forces and solubility of a molecule and can optimize a blend of multiple solvents to reach the target. Creating a target value by averaging HSP values of common paint polymers resulted in identifying several possible blends that were soluble, cheap and effective. Preliminary lab testing results showed that the formulated blend of three chemicals solvents worked as well, or better, than the MC stripper and other existing alternatives. Having found a successful methodology for identifying safer solvent blends, there is hope that other toxic chemicals used in consumer products can be replaced with a similar approach.

Hannagan, R., Ryan, D.
Chemistry
SIMULTANEOUS DETECTION OF ARSENIC AND MERCURY USING GOLD NANOPARTICLE MODIFIED SCREEN PRINTED ELECTRODES
(Advisor: David Ryan)

There is a need for an inexpensive, robust, and easy to use, analytical method to detect trace heavy metal contaminants in water samples. Towards this goal, we present a method for simultaneous detection of arsenic and mercury in water using gold nanoparticle modified screen printed electrodes and anodic stripping square wave voltammetry. Both of these toxins have been successfully analyzed on solid gold macro electrodes (e.g. gold disk electrode), however, these electrodes are expensive and difficult for untrained technicians to use. The gold nanoparticle modified screen printed electrodes we fabricated are a fraction of the cost of macro gold electrodes and allow low part per billion detections of both heavy metals with no need for electrochemical conditioning. The gold nanoparticle electrodes also exhibit freedom from copper interference. This is a common problem experienced with similar techniques when analyzing field samples where copper competes with arsenic and mercury for sites on the electrode diminishing the analytical signal for the metals of interest. These electrodes show promise for incorporation into an automated handheld "Electronic-Tongue" voltammetry system which will allow untrained technicians to analyze aqueous samples in the field at relatively low costs.

Khan, E.H., Thota, S., Li, L., Gill, H.S., Wilusz, E., Osgood, R., Kumar, J.
Chemistry, US Army Natick Soldier Research, Development & Engineering Center
CONDUCTING POLYMER ON FLEXIBLE SUBSTRATES FOR THERMOELECTRIC APPLICATIONS
(Advisor: Jayant Kumar)

Organic semiconducting polymers exhibit low thermal conductivities while maintaining electrical conductivities on the order of that of lightly doped silicon, suggesting they may be potential candidates for thermoelectric power generation and refrigeration. Highly conductive PEDOT films were prepared by solution casting polymerization method using finely tuned oxidation solution. Thermoelectric (TE) properties of these PEDOT thin films were systematically investigated with different organic additives. These films exhibited an average Seebeck coefficient of 94 µV/K and thermal conductivity of 0.37 W m⁻¹ K⁻¹ and could be processed as flexible thermoelectric films to generate measurable electrical currents of microamperes at temperatures differences of 13-14 Kelvin, which corresponds to the difference between body temperature and an ambient temperature of 25 °C. An average electrical
conductivity of 343 S/cm was measured giving a figure of merit (ZT) value of 0.25. Experimental details and characterization of the fabricated TE thin films will be presented.

Wen, S.
Chemistry
SYNTHESIS AND CHARACTERIZATION OF IRIDIUM OXIDE NANOPARTICLES
(Advisor: Kwok-Fan Chow)

Iridium oxide nanoparticles were widely used for many catalytic studies to improve electrochemical materials such as supercapacitors. However, little was known about this particular nanoparticle because of its recent applications to the electrochemical industry. The analytical technique that was used to characterize iridium oxide nanoparticles was cyclic voltammetry. The set-up of the experiment was a three system electrode with glassy carbon electrode, silver/silver chloride electrode, and a platinum wire reference electrode. This technique was used to observe unique peaks on the voltammogram when the nanoparticles were deposited onto the glassy carbon electrode and applied to different pH systems.

Martin, R.
Physics
ANALYSIS OF POLARIMETRIC TERAHERTZ IMAGING FOR NON-DESTRUCTIVE DETECTION OF SUBSURFACE DEFECTS IN WIND TURBINES BLADES
(Advisor: Christopher Niezrecki)

During the manufacture of wind turbine blades, internal defects can form which negatively affect their structural integrity and can lead to premature failure. These defects are often not detected before the final installation of the blades onto wind turbines in the field. The purpose of this research was to investigate the advantages of using fully-polarimetric inverse synthetic aperture radar (ISAR) terahertz imaging techniques for scanning the interior structure of the wind turbine blades in order to detect and identify any defects in the blade's internal structure before the blade leaves the manufacturer. Additionally, the research has investigated the use of the Euler parameter polarimetric transformation in improving defect detection, and increasing understanding of the scattering properties of such defects. Use of an image compositing algorithm and of the Euler parameters was found to enhance defect detection.
Liu, Y., Gan, H., Karim, K.
Accounting
DOES INVESTMENT EFFICIENCY IMPROVE AFTER ADOPTION OF COMPENSATION CLAWBACK PROVISIONS?
(Advisors: Huiqi Gan, Khondkar Karim)

This study provides the direct evidence on the relation between the adoption of clawback provisions and investment efficiency. We examine the investment behavior of a sample of firms that adopt clawbacks under both Sarbanes-Oxley Act and Dodd-Frank Wall Street Reform and Consumer Protection Act. We document a conditional negative association between clawback adoption and investment for firms operating in settings more prone to over-investment. These results suggest that, after adopting clawbacks, these firms' investment efficiency improves significantly.

Tang, J., Suh, S.
Accounting
EMPLOYEE RELATION DAMAGE FROM EXECUTIVE-TO-WORKER PAY GAPS, THE ROLE OF CORPORATE SOCIAL RESPONSIBILITY (CSR)
(Advisor: SangHyun Suh)

The increasing pay gaps between executives and employees in the U.S. have generated much controversy in terms of business ethics. Based on equity theory, pay disparity instigates employee dissatisfaction and internal conflicts. Large pay gaps also indicate more managerial power and less employee protection. Consequently, pay gaps worsen employee relations and firm reputation. Facing possible corporate misdeeds, management often seeks ways to conceal such behavior by focusing on other reputation-enhancing activities, one of which is to invest in CSR. Our results confirm that executive-to-worker pay ratios are negatively related to firms' employee relations, and positively related with future CSR engagement in some areas, including environment, community and diversity. In addition to damaged employee relations, large pay gaps are also associated with worse human right protection and product quality. Our study offers insight on the negative impact of pay gaps between executives and workers, we also provide evidence of firms using CSR to strategize reputation management.

Al-Ebbini, L., Oztekin, A.
Biomedical Engineering & Biotechnology
A DECISION ANALYTIC APPROACH TO PREDICTING QUALITY OF LIFE FOR LUNG TRANSPLANT RECIPIENTS: A HYBRID GENETIC ALGORITHMS-BASED MODELING
(Advisor: Asil Oztekin)

Feature selection, a pre-processing step of data mining, is aimed at determining representative features from a given dataset for an effective prediction. The purpose of this research is to develop a hybrid methodology of feature selection using genetic algorithms to identify such representative features and hence in turn to ensure a better prediction of quality of life (QoL) for patients undergoing a lung transplant. The evaluation of three classification models, i.e. GA-kNN, GA-SVM, and GA-ANN, demonstrated that the performance of lung transplantation process has
been significantly improved via the GA-SVM approach as though other two models also yielded considerably high accuracies. This present study presents uniqueness in that it proves a GA-based feature selection methodology along with powerful classification models helpful to find the most important features in the UNOS dataset for lung transplant with significantly increased accuracy.

**Balasubramanian, S., Mumi, A., Pulya, S.**  
*Business Administration - Entrepreneurship*  
**VISUALIZING THE DEVELOPMENT OF ABSORPTIVE CAPACITY RESEARCH: A CO-CITATION ANALYSIS**  
(Advisor: Berk Talay)

Since its introduction by Wesley Cohen and Daniel Levinthal in their 1989 study published in the Economic Journal, Absorptive Capacity (henceforth: ACAP) has become one of the most actively researched concepts in management. ACAP refers to the "ability of a firm to recognize the value of new, external information, assimilate it, and apply it to commercial ends." (Cohen & Levinthal, 1990) and has been cited in over 25,000 published studies, chapters, and conference proceedings across disciplines including strategic management, entrepreneurship, international business, marketing, information systems and economics. However, the definitions components, antecedents, and outcomes of ACAP have been extremely heterogeneous hindering the progress of the ACAP literature. This study presents an extensive bibliometric co-citation analysis to map the evolution of the scholarly research on ACAP and identifies crucial directions for its future progress. We use co-citation analysis to decipher the underlying structure with variations in degree of relatedness among 10315 articles citing 96 articles published in 23 academic journals spanning 25 years of ACAP research. The strength of the relationship under co-citation analysis is reflected in the number of times the articles are cited together. We employ two techniques predominantly used in co-citation analyses - factor analysis and multidimensional scaling, to reflect the conceptual proximity among the 96 highly cited papers and objectively classify the highly fragmented literature ACAP literature into four thematic areas - knowledge management, dynamic capabilities, inter-organizational activities and intra-organizational activities.

**Cronin, M.**  
*Business Administration - Management*  
**THE THEATRE OF THE ABSURD: FACES THROUGHOUT TIME**  
(Advisor: Rachel Mansfield)

This project examines production design and comic conventions across 2000 years. Plays are a medium unlike any other. They enable the author to use lively sociopolitical commentary, satire, and other tools that they are unable to utilize on the same level in books. Often times, this came as a shock to the audience, upsetting many, but it grew more acceptable over time. Behind the seemingly pointless ridiculousness and randomness of Farces lie deep, hidden meanings. In The Clouds, the Ancient Greek politician Cleon was slandered. The playwright, Aristophanes, was able to use the Chorus of the Clouds and careful wording to protect himself from unjust retribution. He also reasserts religion at the end of the play, to protect himself from being declared an Atheist. Other aspects of Farces include crude humor, seemingly untimed/chaotic entrances and exits, and often a difficult to follow and ultimately relatively unimportant plot. The
absurdist comedy *The Bald Soprano*, for example, was inspired by Ionesco's English teaching book. The playwright grew bored with it and the pointlessness of the book's dry characters upset him. In *The Bald Soprano*, the play has no important dialogue, no events of significance, and ends with the principle characters starting the play over with reversed rolls, signifying the death of quality in modern conversation. On a final note, Farces have paved the way for modern comedy in theatre, television, and casual conversation alike.

**Yacus, A.**
*Business Administration - Entrepreneurship*

**MULTI-DIMENSIONAL ENTREPRENEURSHIP ECOSYSTEMS IN THE U.S.: OPERATIONALIZING FRAMEWORKS FOR QUANITATIVE ANALYSIS**
(Advisors: Yi Yang, Tommaso Tempesti)

Entrepreneurship Ecosystems are generally regarded as a collective set of organizations, institutions and stakeholders involved in the nurturing and support of entrepreneurs and their endeavors to bring products, services or ideas to market. Ecosystems may pertain to a particular geographic region or to a domain such as the Internet. Existing literature describes entrepreneurship ecosystems as multi-dimensional, and several studies have attempted to organize these various dimensions into conceptual frameworks. Examples of these dimensions include access to financial support (e.g. venture capital, small business loans, etc.); the availability of human capital; access to knowledge resources and R&D; infrastructure and access to technology; access to affordable commercial work spaces; supportive governmental policy; and entrepreneurial culture. This research will attempt to operationalize these dimensions using state-level longitudinal panel data. Through the collection and analysis of empirical data related to each of these constructs, it is hoped that this research will extend what we presently know about entrepreneurial ecosystems and demonstrate the effect of these variables upon new business establishment. This preliminary attempt to develop a quantitative model for analysis is not likely to include all the factors that should be taken into consideration. However, it is hoped that by conducting this analysis and sharing it with the entrepreneurship research community, a practical, data-driven starting point will emerge from which we can better observe the relationship between these variables. Comments and suggestions are welcome and may be used to build upon this model.

**Nguyen, N.**
*Finance, Management*

**POLICY UNCERTAINTY AND MERGERS AND ACQUISITIONS**
(Advisor: Hieu Phan)

This research empirically examines the relation between policy uncertainty and mergers and acquisitions (M&As). We find that firms are more prudent with M&A activities during periods of high policy uncertainty. In particular, firms are less likely to pursue M&A deals, and, even if they do, it takes them longer to consummate the deals. Acquirers are more likely to use stock as payment consideration and pay lower bid premia. Interestingly, we find that acquirers create larger shareholder value from M&A deals undertaken during the high policy uncertainty periods, which could be explained by the acquirer prudence as well as the wealth transfer from the financially constrained targets to acquirers.
Sun, L.  
*Finance*  
**BOND LIQUIDITY, CORPORATE CASH HOLDINGS, AND THE VALUE OF CASH**  
(Advisor: Hieu Phan)

This study investigates the effect of bond liquidity on cash holdings. Exploiting two exogenous bond liquidity shocks, namely the inception of TRACE and Lehman bankruptcy filing, as well as the traditional measures of bond liquidity, we show that bond illiquidity has a causal positive effect on corporate cash holdings. Additional analysis suggests that bond illiquidity increases the value of cash and this effect is more pronounced for financially constrained firms. Our findings are consistent with the view that because bond illiquidity hinders firms' access to external debt market and hence increases the cost of debt, they maintain larger cash holdings to mitigate underinvestment.

Albashrawi, M.  
*Operations & Information Systems*  
**DETECTING FINANCIAL FRAUD USING DATA MINING TECHNIQUES: A DECADE REVIEW FROM 2004 TO 2015**  
(Advisor: Luvai Motiwalla)

Financial fraud has been a big concern for many organizations across industries; billions of dollars are lost yearly because of this fraud. Data mining techniques play a major role in addressing this continued and growing problem. Reviewing prior research between 2004 and 2015 reveals 65 research articles conducted to address different types of financial fraud via various data mining methods. Concluded points of this review are discussed and communicated to both academic scholars and industry practitioners.

Kartal, H., Li, X.B.  
*Operations & Information Systems*  
**PROTECTING PRIVACY AGAINST MULTIPLE RECORD LINKAGE ATTACKS**  
(Advisor: Xiao-Bai Li)

This study examines privacy disclosure risks when multiple records in a dataset are associated with the same individual. Existing data privacy approaches typically assume that each individual in a dataset corresponds to a single record, which tends to underestimate the disclosure risks in the multiple-record problems. We propose a new privacy measure, called g-balance, and develop an efficient algorithm based on the g-balance measure to protect against the multiple-record linkage attacks. The effectiveness of the proposed approach is demonstrated in an experimental study using real-world data.
Liu, X., Li, X.B., Motiwalla, L.

*Operations & Information Systems*

**SHARING PATIENT DISEASE DATA WITH PRIVACY PRESERVATION**

(Advisor: Xiao-Bai Li)

When patient data are shared for studying a specific disease, a privacy disclosure occurs as long as an individual is known to be in the shared data. Individuals in such specific disease data are thus subject to higher disclosure risk than those in datasets with different diseases. This problem has been overlooked in privacy research and practice. In this study, we analyze disclosure risks for this problem and identify appropriate risk measures. An efficient algorithm is developed for anonymizing the data. An experimental study is conducted to demonstrate the effectiveness of the proposed approach.