2016 STAR SCHOLARS SUMMER SHOWCASE

Thursday, August 25, 2016

Edmund D. Bossone
Research Center
9:00am - 5:00pm

DREXEL UNIVERSITY
Office of
Undergraduate Research
Pennoni Honors College

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Suzanne Rocheleau, PhD
Associate Dean, Pennoni Honors College
Director, Office of Undergraduate Research

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Program Coordinator
Office of Undergraduate Research

The STAR Scholars Program is administered by the Office of Undergraduate Research, a unit of the Pennoni Honors College.

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Bossone Research Center
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Bossone Research Center
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A Message From the DIRECTOR & DEAN

Welcome to the 2016 STAR Scholars Summer Showcase.

The STAR Scholars Program, administered by the Office of Undergraduate Research and housed within the Pennoni Honors College, has, over the past fourteen years, witnessed the impact that Drexel's focus on undergraduate research has had, not only on our students and their faculty mentors, but on our broader Drexel community, the City of Philadelphia, and our wider world.

Since the Program's inception, more than 1,300 Drexel students have participated in the STAR, iSTAR and Rising STAR Scholars programs, including our first two students who are working with faculty at the Indian Institute of Technology Madras, India, and the research, scholarly, and creative partnerships of our STARs and their faculty mentors continue to produce exceptional results.

This fall, two current undergraduates who were STAR Scholars will represent Drexel at the first World Congress of Undergraduate Research in Doha, Qatar, and more than 40 former STAR Scholars have presented their work at discipline-specific and undergraduate research conferences this year. Because of their participation in early undergraduate research, STAR Scholars are retained at a high level within the University, go on to graduate school in higher numbers than their peers, secure premier co-ops and prestigious fellowships, and graduate to outstanding careers. We are confident that our 2016 class of STAR Scholars will shine as brightly.

Over the summer, 176 STAR Scholars have completed faculty- and professionally mentored projects, working in 10 colleges and schools. Under the direction of their outstanding mentors, our rising sophomore researchers have been designing play spaces for children with autism, using nanomaterials to develop a device that functions as a wearable external kidney, and analyzing the impact of activist shareholders on corporations, among many other outstanding projects.

Each summer, as we meet with our STAR Scholars, we see them grow in competence, confidence, and maturity as they begin to reimagine their lives as a result of this extraordinary experience. It is our hope that, as you see the result of their work, you are inspired, as well.

Dr. Suzanne Rocheleau, Director
Office of Undergraduate Research

Dr. Paula Marantz Cohen, Dean
Pennoni Honors College

OUTSTANDING Mentor of the Year

The critical piece of the STAR Scholars Program that makes it such a valuable experience for the students is, without a doubt, their Mentors. The STAR Mentors give much to their students' summer experiences and do so with no compensation.

In Summer 2011, the Office of Undergraduate Research created a process to recognize the STAR Mentors and to particularly celebrate the Outstanding Mentor of the Year. STAR Scholars are given the opportunity to nominate their faculty mentors or graduate student mentors for the "Outstanding Mentor of the Year" award, which provides the awardee with a $1,000 award to futher his or her research with undergraduate students.

Each nominated mentor receives a letter signed by Provost Blake that outlines the common characteristics held by all nominated Mentors, and each letter includes excerpts from the students' nomination letters to provide an individualized account of just how these Mentors have contributed to those specific students' experiences.

Based on these nominations, outstanding Mentors:

- Are passionate experts in their field who freely share their expertise with students
- Care deeply about their students and treat them with respect
- Generously foster students' intellectual and professional development
- Actively engage students in learning and celebrate their success
- Go above and beyond in supporting their students

All of our mentors go beyond the call in their work with STAR Scholars, and we are genuinely grateful for the time and effort they commit to furthering the education of undergraduate students.

2015 Outstanding Mentor of the Year
Professor Genevieve Dion

The 2015 Outstanding STAR Mentor of the Year Award was presented to Professor Genevieve Dion (Fashion Design, Westphal College of Media Arts & Design) at the 2015 STAR Summer Showcase. Professor Dion received a plaque engraved with her name, as well as a $1,000 grant to support her further work with undergraduate researchers, which she has used to support the continuation of her STAR Scholar's research in her lab through a research co-op.

> "While the ExCITe Center is Drexel's home of collaboration, the Shima [Seiki Haute Tech] Lab's success of gathering great minds from various disciplines is directly attributed to Genevieve Dion. In our lab, you will find students from Fashion Design to Chemical Engineering to Custom Designed majors... [Professor] Dion inspires everyone in our lab to share her vision of integrating technology and textiles at a deeper level. [Professor] Dion pushes us all to apply to opportunities to present our research and network with others in our field, even this early into our research careers ... [We] work hand in hand with other engineers, industrial designers, and fashion designers."
>
> - Tauheed Baukman (Chem. E.) & Keith Taylor (Mech. E.)

Professor Genevieve Dion has an extensive background in bespoke clothing and industrial design. Her research focuses on the investigation of flexible production methods and mass customization of smart garments, and the development of seamlessly integrated knitted electronic components into "Garment Devices". In September 2012, following the signing of a groundbreaking agreement with Shima Seiki USA, Professor Dion launched a state-of-the-art laboratory, The Shima Seiki Haute Tech Lab, to conduct multidisciplinary research on smart textiles and wearable technology. In 2014, she was named Fast Company's Top 100 Most Creative People in Business.

It is for Professor Dion's commitment to educating and mentor students, both in the STAR Scholars Program and through her work with the Shima Seiki Haute Tech Lab, that we honor her as our 2015 Outstanding Mentor of the Year.

Antoinette Westphal College of MEDIA ARTS & DESIGN

Stephanie Aranda

Westphal College of Media Arts & Design

Architecture

Prof. Ulrike Altenmueller-Lewis

Faculty Mentor

Architecture & Interiors

Inclusive Playground Design for Autism Spectrum Disorder

The rate at which individuals are being diagnosed with Autism Spectrum Disorder (ASD) is rapidly growing. According to Centers for Disease Control and Prevention, it was prevalent in 1 in every 150 individuals in the United States in 2000; by 2015 it was 1 in 68. Autism affects the individual person and those around them. With Autism's increasing numbers, more and more people will become in closer contact with ASD.

Play spaces provide opportunities for individuals to develop their own skills and interest and their design is about curating an experience for their users. Inclusive design seeks to unite all individuals despite physical or mental barriers. As numbers rise, research has begun to define ASD design criteria, focused specifically on school design. This project investigates how a play space can nurture the developmental growth of an individual with ASD, cultivate their cognitive skills, and highlight the importance of inclusive design.

Investigation and research for this project was conducted through a series of case studies, literature review, and meetings with professionals of various disciplines.

The purpose of this project is to develop sensory-friendly design criteria for playgrounds that will allow the ASD individual to gain exposure and mastery of sensory experiences. This will be exemplified through sharing knowledge on Autism and proposing a prototype play space designed for Evergreen Manor Park in Abington, Pennsylvania.

Disintegrating Brick in West Philadelphia: Algal Hydroponic Growth & Cultural Preservation

Globally, there have been a growing number of research projects examining how algae may benefit modern life. URBN STEAMLab focuses on using algal hydroponics to grow plants indoors, particularly in low-income row homes of West Philadelphia -- where there is a need for affordable fresh produce and backyard conditions are not suitable for planting. By designing small modular units, hydroponic farming becomes manageable inside the urban home.

In researching and developing units for the existing row home, I have focused on the disrepair of the brick wall - a symbol of the urgent need for preservation and regrowth in the communities of West Philadelphia. The texture and porousness of a crumbling brick wall are problematic to the homeowner yet ideal for hosting growth at multiple scales on the interior. By refining and exaggerating these qualities, the broken brick becomes a module for controlled algal and plant growth rather than a costly home repair.

Using various design methods, I have developed a series of 3-D printed prototypes that explore the form of disintegration within a modular system for re-growth. In the next phase of research, these prototypes will be tested - in both laboratory and residential settings - for successful food growth.

Kiera Townsend

Westphal College of Media Arts & Design

Architecture

Prof. Diana Nicholas
Faculty Mentor

Architecture & Interiors

Dr. Shivanthi Anandan
Faculty Co-Mentor

Biology

Antoinette Westphal College of MEDIA ARTS & DESIGN

Design in Serious Video Games

Kelly Abramowitz

Westphal College of Media Arts & Design

Animation & Visual Effects

Dr. Paul Diefenbach

Faculty Mentor

Digital Media

Robert Gray

Graduate Student Co-Mentor

Enable Games, a game development team, focuses on serious video games for patients with Cerebral Palsy. Cerebral Palsy is an incurable neurological disorder that has a large spectrum of symptoms and severity, including, but not limited to, poor muscle control, lack of problem solving ability, and trouble with the senses. Though currently incurable, there are different treatments that can improve a person's symptoms. From Enable Games, patients are able to play therapeutic video games in which their motion and progress can be tracked and sent to their doctors and other medical professionals for progress analysis. Art is a large part of what makes these games enjoyable and playable by the patients. During the summer, I was assigned the task of helping to create games that were visually easy to read by the patients. One way to do this is by implementing the use of different Shaders. Shaders are codes that alter the appearance of models or textures, to allow the patients to be able to differentiate between the background and foreground objects. Apart from Shaders, depth is also an important aspect that allows patients to correctly perceive the environment in games. Finally, with the prevalence of different types of colorblindness, it was important to research color combinations that would be most practical in making the games accessible to the most amount of patients.

The Gender Divide in Technology and Video Games: A Comprehensive Literature Review

The absence of women in STEM fields, particularly in Information Technologies, has long concerned educators and employers. Many interventions work to even the field: nonprofits (Girls Who Code), government initiatives (Computer Science for All), and efforts here at Drexel (Skyscraper Games). These efforts are vital to closing the gender gap, but it is equally important to understand the factors that contributed to this divide.

Many experts have correlated a player's level of comfort with video games with their comfort with technology as a whole. Gamers are more confident with technology, and the video game gender divide is theorized to be deeply connected to the general technological one. My literature review studies that relationship, by analysing publications by experts, interviews with industry professionals, national surveys, news articles, and scientific papers.

After organizing these sources chronologically, I identified key eras (such as the 1950s and mid-80s) where technology was distinctly gendered, followed by years of prevalent stereotypes and decreases in women pursuing computer science as a career. These cycles continue into the modern day, creating harmful pressures that keep women out of computing fields and away from game controllers.

Lily M. Lauben

Pennoni Honors College

Custom-Designed Major

Dr. Frank J. Lee
Faculty Mentor

Digital Media

Arianna Gass
Program Manager, EGS
Co-Mentor

Antoinette Westphal College of MEDIA ARTS & DESIGN

Erin Jane Katharine Truesdell

Westphal College of Media Arts & Design

Game Design & Production

Dr. Frank J. Lee
Faculty Mentor

Digital Media

Arianna Gass
Program Manager, EGS
Co-Mentor

The Five Pillars of Effective Curriculum Development

Drexel's Entrepreneurial Game Studio (EGS) offers workshops and online lessons to students (especially girls) between the ages of 11 and 15 in an effort to address the gender gap and increase interest in Science, Technology, Engineering, Art & Design, and Mathematics (STEAM) fields. A review of a body of research focused on curriculum development and online Python learning environments was performed to improve the existing curriculum and provide a credible base for the changes made. Sources included studies on gaming and computer science education, books about learning theories and gaming, and articles on developmental psychology. An analysis of the reviewed literature yielded Five Pillars of Curriculum Development: Playground, Identity, Community, Confidence, and Student Position.

Nine external and widely available programming websites were evaluated using these as criteria. The review found that the five pillars are applicable to teaching programming. With this information, I reviewed and extended the lesson plans for the EGS Skyscraper Games workshops. These added activities took the form of discussions of the relevance of learning to code, unplugged problem-solving exercises, and opportunities to share projects and ideas. Additionally, guidelines for implementing the Five Pillars were developed for broader applications of this framework in online learning environments.

VR in Children's Hospitals

Brendan Luu

Westphal College of Media Arts & Design

Interactive Digital Media

Dr. Glen Muschio
Faculty Mentor

Digital Media

This research explores how virtual reality technology (VR) can be used by staff in children's hospitals to reduce patient anxiety when preparing for surgical procedures.

I first met with the Child Life staff at St. Christopher's Hospital for Children's Play Room on June 29th and presented a demonstration of Samsung's Gear VR system. Given their expertise in Child Life care, I asked them how they thought VR could be used to help patients in their hospital. They identified a handful of opportunities such as: using VR as a distraction during procedures; creative self-expression using gaze (some children cannot use their hands to interact); and pre-operation preparation. The staff was most intrigued by the last idea, because children are often extremely uncomfortable in the Operating Room (OR) and consequently sedated.

I proposed to create an immersive 360 degree photo tour of the OR that will be displayed in the Gear VR to patients prior to surgery. The VR headset will be administered to patients by a Child Life staff member and will have a reusable/hygienic face liner. An external monitor will enable the staff member to see what the patient is looking at and guide them through the tour.

This research is a form of exposure therapy and has the potential to decrease patients anxiety during their OR experience. It could also enable nurses to administer less sedatives and ultimately boost patient moral. This project is limited to creating virtual assets for later analysis.

From paper origami to auxetic self-folding textiles

Maria Kadieva

Westphal College of Media Arts & Design

Fashion Design

Prof. Genevieve Dion
Faculty Mentor

Fashion Design

Chelsea Knittel
Graduate Student Co-Mentor

Wearable technology is often regarded as the synthesis of usable high-tech electronic devices. Some is clothing made from textiles embedded with electronics, also known as smart fabrics or e-textiles. However, smart fabrics can go beyond electronics, ranging from molecular variations at the fiber and yarn levels to the structural and/or architectural composition of the textile, creating high-performance functional fabrics. The Shima Seiki Haute Tech Lab at Drexel University researches how variations in yarns and knit structures can influence the functionality of a textile end product. This research focuses on creating knitted self-folding and auxetic fabrics, textiles that can proportionally expand in both the lateral and axial direction upon stretching along any of those axes. This property would allow the creation of garments with improved articulation, protectiveness and user-friendliness for the HUBO Robot, a project exploring expressive humanoid robotics in the MET Lab of the ExCITe Center. This robot incorporates touch, visual, and audio sensors that help it interact with humans.
To create improved garments for HUBO, origami paper patterns were studied to identify folding structures that could be translated into a knit structure. After exploring different folded paper structures, the three most suitable ones were then knitted into various patterns using the Shima Seiki SDS-One Apex design software and the SWG-041N knitting machine. Alternating knit and purl stitches cre

Visualizing the Touch of Capacitive Textile Sensors

The Shima Seiki Haute Technology Laboratory facilitates extensive collaboration between designers, engineers, and scientists. The research team works in the field of functional fabrics, using industrial knitting machines to prototype high-tech concepts involving novel fibers, yarns, and knit structures. One of these research projects involves using conductive yarns to produce a textile touch pad whose sensors are fully integrated into a knitted fabric. This capacitive touch pad is flexible, abrasion-resistant, and pressure-sensitive.

In order to accurately monitor and interact with these fabric sensors, a user interface is required. My research project consisted of designing and programming a desktop application that displays input from the touch pad in real time. The program displays both where and how hard the user is touching the sensors. This visual interface is useful for monitoring textile performance and for demonstrating underlying scientific concepts at a level that those without a technical background can understand. It also establishes a foundation for future data analysis as the sensors are knitted into larger, more complex systems. Along with the Lab's concurrent development of knit RFID antennae and knit supercapacitor batteries, these sensors imply future innovations in garment devices: textiles with interfaces more integrated than those in wearable technologies like smartwatches; textiles that do not house electronics but are devices themselves.

Deborah Stoddard

College of Computing & Informatics

Computer Science

Prof. Genevieve Dion
Faculty Mentor

Fashion Design

Richard Vallett
Graduate Student
Co-Mentor

Antoinette Westphal College of MEDIA ARTS & DESIGN

The Westphal College of Media Arts and Design's Polish Poster Collections

Ridge Chin

Westphal College of Media Arts & Design

Graphic Design

Prof. Mark Willie

Faculty Mentor

Graphic Design

In the twentieth century, post WWII, Poland was occupied by the Soviets. With a society that required every instance of public branding to be vetted by the government and outside influences censored, graphic artists and designers had to rely on their own creativity and each other. This led to the development of the Polish School of Posters, in which the Polish poster aesthetic formed and proliferated throughout the country's artists. Since then, Polish posters have influenced design around the world. The Westphal College of Media Arts and Design at Drexel University currently hold the largest institute-held physical collections of Polish posters in the country, encompassing graphic designers from the founder of the Polish Poster School, Henryk Tomaszewski, to more modern artists, such as Rafal Olbinski. Unfortunately, despite the depth of the collection and the untapped historical significance of Polish posters, both within and outside of the world of design, it is currently figuratively collecting dust in a room on the fourth floor of the URBN Center.

My STAR Project was to try to get the Frank Fox and Kenneth F. Lewalski Polish poster collections into the public eye through an exhibit showcasing the posters. I researched the Polish poster artists in the collections and organized them by their significance and prevalence, learned where and how to set up an exhibit, and I am currently designing a brochure for the collection.

Wood Type Collection

Maura Dougherty

Westphal College of Media Arts & Design

Graphic Design

Prof. Mark Willie
Faculty Mentor

Graphic Design

The first evidence of printing using wooden stamps dates back to 200 CE in China, where stamps were often used to spread religious messages and to represent the ideas of Buddhism. Within the next several centuries, the process of creating these stamps was quickly adapted so that printers were able to mass-produce books. In 1041, movable type, with which each individual letter could be printed by itself, was invented in China, making the process of printing much easier. At the start of the 16th Century, the first model of a printing press was designed and eventually was used hand in hand with movable type to create the simplest printing process yet.

Although movable type lost much of its traction in the printing world towards the end of the 20th Century when more efficient technology took its place, wooden letterpress still attracts type enthusiasts and purists today. With their passion and nostalgia for this lost art, these designers and type dabblers bring the spirit of wood type back to life within the design world. Westphal's collection of wood type gives insight into the diversity of the font styles and creation techniques that were employed for type design. As a member of the STAR Program, I have delved into this history and have watched as its timeline has coincided with the multifaceted collection.

Modern Rock Music Recording and Production Methods

Benjamin Weiss

Westphal College of Media Arts & Design

Music Industry

Prof. Ryan Schwabe
Faculty Mentor

Music Industry

Kyle Pulley
Alumnus
Co-Mentor

Joe Reinhart
Alumnus
Co-Mentor

Everyone appreciates well-produced music, but a great recording is something only a few know how to capture. There is an endless number of articles about what makes a good recording. They share an abundance of tips that can aid in capturing and creating a song. Recording and production are more art than science, and that means that many of those tips are situational. What makes one recording great, may ruin another. Through working with Kyle Pulley and Joe Reinhart of The Headroom, I attempted to learn as much as I could about what makes a recording great. The Headroom is where Mr. Reinhart recorded and produced Modern Baseball's latest album Holy Ghost, which peaked at 53 on the Billboard 200. I observed their methods of recording drums, guitars, and vocals. I then applied the knowledge I learned in Drexel's studio C. Alongside the knowledge I gained from working with two industry professionals, putting it into practice shed even more insight. I attempted to create 5 professional quality original recordings. The writing and performance of those songs also helped to shed light on the production process and the artist's perspective. In the process of recording and producing, getting a great take is the best way to ensure a good product. Choosing the correct microphones and their placement alongside a good performance from the artist is key. It is very difficult to edit something bad into something good, but a take that already sounds good can be edited into a great recording.

Devising Theatre: Various Approaches to Play Creation

Devised work in theater is roughly defined as a method of play creation without an initial script. This method typically originates with improvisation games, research around a historic event, and themes out of the aforementioned which are then utilized to form the story and ultimately script. My research explored devised work from various angles including: initial stages of research for the Drexel Co-Op Theatre Company's devised production celebrating Drexel's 125th Anniversary this winter; production management for a piece as part of the 2016 SoLow Fest; stage management for Corn Exchange workshops in preparation for the Mandell Professionals in Residence Project this fall with Inis Nua Theatre Company for "Dublin by Lamplight" as well as the development of "Carmilla Video Nasty," a devised piece in the Corn Exchange style. These various approaches demonstrated the initial research needed as the basis for themes, the improvisation process as the basis for dialogue and even casting during the workshop, and the premiere of an in-progress piece, Rachel Gluck's "Magdalene," similar to devised in that the playwright continued to revise it during and after the rehearsal process. This research will serve as the historical research for the development of the winter mainstage production, working title "125," that will be devised this fall and premiere at the Black Box Theater in winter.

Allison Jasne

Westphal College of Media Arts & Design

Screenwriting & Playwriting

Prof. Nicholas Anselmo
Faculty Mentor

Performing Arts

Looking Into The Creative Process

Caraleigh Stifler

Westphal College of Media Arts & Design

Dance

Dr. Miriam Giguere
Faculty Mentor

Performing Arts

Boris Charmatz, a well-known French choreographer will be involved in a four-day residency in Philadelphia. In this residency, he will be giving three choreographic workshops to twenty-four professional dancers/artists. Chosen through an application process, these professionals are also participating in a research study being conducted by Miriam Giguere, head of the performing arts department at Drexel University. Professor Giguere will be interviewing the twenty-four participants before and after working with Charmatz, for a total of 48 interviews. The questions in these interviews have to do with the creative process and their artistic experiences as professionals. My study focuses on seven participants who have had less than nine years of professional experience. I chose to focus on this group because there was a split within the data that separated more experienced from less experienced professionals. I fixated on interview questions regarding the role of an ensemble member and a choreographer within an artistic work. After looking through these interviews, each participant's response was recorded into sections for both the role of an ensemble member and the choreographer. Themes were found within the responses, and it was discovered that both the job of the choreographer and ensemble member have elements of communication, audience connection, and experimentation. From these results, it becomes clearer of how some professionals see these roles in the creative process.

De-growing Wasteful Habits

Karim Chen

Westphal College of Media Arts & Design

Product Design

Prof. Michael Glaser
Faculty Mentor

Product Design

This grassroots research project investigated the patterns, knowledge, and behavior of recycling and trash disposal of Drexel students living on campus. The Design research focused on what students throw out, how frequently trash is thrown away, where trash is disposed of, and when a particular item becomes trash. The primary methods of data collection used were a 48-hour trash challenge which instructed students to collect all of their trash and participate in an extensive interview which analyzed the student's experience carrying trash. Key insight was gained from their decision making process in determining when an item becomes trash. Observational research was also used to understand how people interacted with recycling units and traditional open top trash cans. Furthermore, students' knowledge of recycling on Drexel's campus was also tested by means of a quiz. These experiments led to my thesis of whether the ease of accessibility of trash cans around campus promotes wastefulness and discourages accountability and responsibility of what the individual disposes of. However, having substantiated my thesis, trash cans are still necessary to discourage litter. Thus, accountability over trash and knowledge about recycling must be brought to the trash can by creative means of reward and education.

Antoinette Westphal
College of MEDIA ARTS & DESIGN

Matthew Dessner

Westphal College of Media Arts & Design

Product Design

Prof. Michael Glaser

Faculty Mentor

Product Design

DEGROWTH: Object Permanence

DE-GROWTH: Object Permanence is a collaborative project devoted to understanding relationship between users and products over time. Working from the observation that Drexel students throw out most of their possessions during the end-of-term move out, we became interested in how designers could use a design process to reduce moveout waste. Our goal was to explore methods of preventing waste instead of responsibly disposing of it. Early research showed that people are disconnected from the responsibility of the waste after it is disposed. The project thesis we adopted was can good design facilitate a sense of attachment between users and objects over time, particularly young people who live transient lifestyles.

Using design research activities, we determined what objects students view as disposable and permanent. We took an inventory of students' possessions and used the data to determine how people define value, and how value can motivate people to commit to the maintenance of an object. We validated our assumptions by prototyping permanent versions of disposable objects and presenting them to potential users for validation. Our ultimate goal is to determine design criteria for a product that users feel motivated to maintain and repair rather than replace.

DE-GROWTH: Object Permanence

Object Permanence is a collaborative project devoted to understanding the widespread use of disposable products. I observed a massive disposal of students' possessions during the end-of-term move out. The other students working under our professor took an interest in waste reduction, and I incorporated that goal by exploring methods of preventing waste instead of safely disposing of it. I focused on how to facilitate a sense of attachment between users and objects, particularly young people who live transient lifestyles. Using design activities, I determined what objects students currently dispose of and hold onto. The activity produced data which I used to identify what motivates people to allocate irreplaceable value to products. We tested our observations and assumptions by redesigning long-lasting versions of disposable objects and offering them to potential users for feedback. My ultimate goal is to determine design criteria for a product that users feel motivated to maintain and repair rather than replace.

Emiko Inskeep

Westphal College of Media Arts & Design

Product Design

Prof. Michael Glaser

Faculty Mentor

Product Design

Antoinette Westphal
College of MEDIA ARTS & DESIGN

Evan Mosko

Westphal College of Media Arts & Design

Product Design

Prof. Michael Glaser

Faculty Mentor

Product Design

Degrowth: Converting Waste and Perceptions

This research focuses on how we as Americans can successfully incorporate the principles of Dutch repurpose design into American consumerism to create a more sustainable future. From research I found two statements. 1. In dutch design, users give stories their the objects. 2.In American design, objects give stories to their users. I began to research what fabrication techniques the average American possessed in order to see if repurpose design was even possible as a reality in America. I conducted an online survey and asked people to perform tasks involving basic fabrication. I learned that the more accessible and simple the tools, the more comfortable people felt using them. I also tested their perceptions of trash, and whether or not they could view it as raw material. I found an ironing board in a dumpster and asked the people who took my skills test if they would use it. The people who would were the most proficient with tools saw it as usable raw material. People who said they wouldn't pick it up cited that it was garbage and unusable. I examined my research and saw an opportunity in the fact that people took an interest in what I was creating. I spent my free time creating objects from trash I found or bought second hand in Philadelphia. Although people were interested in these objects, they did not feel motivated to make their own. I plan to design a kit that would include a inspiration book and the basic tools needed to get started creating repurpose design.

James Galanos: Evaluating the Fashion Designer's Legacy

In the 20th century, James Galanos was renowned for selling ready-to-wear designs with couture-like quality, winning numerous industry awards for his work. However, while designers such as Christian Dior are still household names, the Galanos label is largely forgotten.

The Robert and Penny Fox Historic Costume Collection (FHCC) has recently been promised a gift of over 700 Galanos ensembles from the designer's personal archive, making the FHCC a notable center for academic study on this respected designer. In anticipation of this transformative gift, I researched Galanos's contributions and continuing relevance to fashion.

There has been little analysis conducted on Galanos, so I approached this topic through primary research, using the historic New York Times, the Condé Nast archives, and the collection's extant garments.

My findings established Galanos's success in several aspects: how effectively he ran his business, his prestige within the fashion community, and his overall fame. I found that his lack of coverage in the present day is not due to declining technique, but rather Galanos's choice to not pass down his label after retiring in 1998. His designs still reveal an awareness of taste over trend, proving to be timeless, high-quality pieces that have lasted years physically and stylistically.

Elizabeth Bauman

Westphal College of Media Arts & Design

Design & Merchandising

Prof. Clare Sauro
Faculty Mentor

Robert & Penny Fox Historic Costume Collection

Joseph Campbell

LeBow College of Business

Accounting, Business Analytics, Management Information Systems

Prof. Barbara Grein
Faculty Mentor

Accounting

An In-Depth Look at Non-GAAP Earnings

Generally accepted accounting principles (GAAP) are the common set of accounting rules and procedures companies use to prepare and present financial statements. In contrast, non-GAAP earnings, by definition, use an alternative, non-standard method to measure a company's earnings and profits. These non-standardized earnings are an increasing concern to the Securities and Exchange Commission (SEC) due to their potential use in misrepresenting a company's performance. Specifically, non-GAAP are typically used to represent a company in a favorable, potentially less-accurate light. Since non-GAAP earnings are company specific, they also decrease the comparability of reported results across firms. While companies currently disclose a reconciliation between their reported GAAP and non-GAAP earnings, the SEC has been considering how ethical the practice of reporting non-GAAP earnings really is.

Due to its lack of standardization, our research looks at how this practice is used, within companies that are a part of the S&P 1500. Our research builds on a graduate student's dissertation. We are expanding the sample to a more recent time period, 2013-2015 as well as collecting more detailed data on the reconciling items between GAAP and non-GAAP disclosures. We have hand collected data from company press releases which have guided our research in the determination of which exclusions are typically made, as well as the possible reasons for why companies use certain non-GAAP methodologies.

Gender Equality in Nonprofit Executive Compensation

A popular notion is that women are paid less than their male colleagues. Prior research found that women have usually held non-executive positions and have been paid much less than the men in the same industry. However, with the changing times, this may no longer be completely true. In this research, we investigate current gender equality in nonprofit executive compensation by collecting data on CEO compensation for a sample of nonprofit organizations from IRS 990 forms. Our analysis shows that women hold about thirty-six percent of the CEO positions in our sample and are annually paid an average of $533,000, compared to $767,000 for men holding the same position. However, the reason for this "wage gap" may not be simply due to gender. Thus, we examine additional reasons for this difference including the organization's industry and size, as well as the executive's education, experience, and tenure.

Sheeba Karmaker

LeBow College of Business

Accounting

Dr. Curtis Hall
Faculty Mentor

Accounting

Do different firm sizes have different Beveridge curves?

Abdullah Omer

LeBow College of Business

Economics

Dr. Roger McCain
Faculty Mentor

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What is a Beveridge Curve? The Beveridge Curve, also known as the UV curve is graphical representation of the relationship between the job vacancy rate, and the unemployment rate in the country as a whole.

Why is it important? The closer a Beveridge Curve is to the origin, the more efficient the economy is in providing jobs. Unfortunately, most Beveridge curves are significantly far away from the origins. As a result, even when there are a good deal of job openings, a significant portion of the population is still unemployed. This may reflect different behavior of enterprises of different sizes, as we have evidence that small business employment is more volatile than that of larger businesses.

What this research is about: We take a look at Beveridge Curves for different firm sizes and develop regression models for each, which we then compare to check if there are differences between them. We also take a look at whether the financial crisis of 2008 created a shift in the Beveridge curves.

How this can be used in future research: Finding out if Beveridge curves are different for different firm sizes can help us tackle issues like making them more efficient in terms of helping employers and employees find jobs.

Implications of business cycles during a company's foundation year on its long term performance

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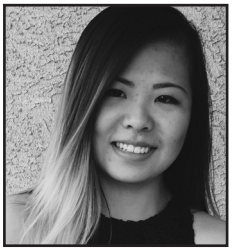
When we talk about recessions, there are certain connotations that immediately pop into our heads - scarce credit, bankrupt companies, unemployment, reduced spending, bleak outlook. However, a 2009 study by the Kauffman Foundation concluded that 51 percent of Fortune 500 companies were founded during a recession or bear market, including Disney and Microsoft. The purpose of our research is to build upon the Kauffman Foundation study and conduct a more in depth analysis of the links between a company's year of foundation and its long term performance. In other words, we are trying to understand how a company might perform in the long run if it was founded in a recession/boom period. Over the course of this project, we have gathered data on thousands of companies, both big and small, and we are using Stata to analyze numerous variables like total assets, operating profit/loss, net income etc. over several years to understand the company's overall performance. The results of this research project might change our perception of business cycles, and can help inform government stabilization policies.



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The Return of the Activist

If you had the power to drive a firm's stock price and earn a hefty premium, how often would you do it? Pretty often if you are Mario Gabelli.

Activist investors take large stakes in firms to try to impact their decisions and boards. Often, activists look for slow growing, poorly performing firms that need help ("value firms"). Others try to talk up the stock of high-flying firms to make a quick profit. I examine nearly 1,200 large public firms (1996- 2012) to study activist investors' actions around a crucial event: a firm being acquired.

These activists can take one of two paths: invest before the announcement (pre-merger activists) or once a deal is announced (during activists). Pre-merger activists usually target value firms while during activists invest in smaller firms with high returns and sales that are nearly 2½ times greater than pre-merger firms. Many activists target high-flying firms, but those that enter pre-merger, target only one deal or are the only activist involved, appear to seek value firms.

An example of these high flying activists is Mario Gabelli. If an activist is present, Gabelli is there 63% of the time during a merger and 9% pre-merger (which is 3.4 more than any other activist). Frequent activists like Gabelli invest in firms that price rose 400% more pre-merger and have 25% higher premiums than firms with non-frequent activists. It appears that these frequent activists target high growth firms to push up the deal price and make a quick buck.

The Good, the Bad, and the Activist

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There has been a dramatic increase in attention on activist investors that buy large stakes in a firm in attempt to control the boardroom and pressure management. Almost daily, the media reports on these activists (e.g., Carl Ichan or Bill Ackman) and their investments. It is not clear, however, how often these activists are involved and whether they add value. Some argue that activists seek to maximize their own wealth at all costs, while others believe activists make tough decisions that benefit all shareholders. My research investigates activists' ability to influence management around the decision to acquire another company (one of a firm's most important decisions) and firm performance once an activist is involved. I analyze nearly 1,200 acquirers in large mergers from 1996 to 2012. Less than 5% of acquirers had an activist involved at any point from two years pre-merger until completion. Further, activists target firms with high growth potential, yet are more susceptible to change (e.g., small, focused boards). Although these firms have potential growth, activists do not appear to help. Businesses controlled by these investors see their stock drop by nearly 8% over three years (compared to the market) and perform 6.3% worse than firms that also did an acquisition without an activist. Finally, when activists stay more than a year post-merger, firm performance is 4% worse. While activists invest in struggling firms, they do not appear to help shareholders in the long-run.

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Changes in the Newsweek's Green Company Rankings over Time and Stock Performance

Since 2009, Newsweek magazine has published an annual ranking of the top 500 largest publicly-traded companies in the US based on their level of environmentally friendly practices, i.e., their "greenness". With more and more consumer groups calling for companies to be more environmentally friendly, these rankings have the potential to impact a company's overall success; furthermore, they can serve as an indicator of the quality of corporate governance.

Using historical stock prices from 2009 through 2016 of the companies on the Newsweek US Green Rankings, we examined the relationship of the risk-adjusted returns of the companies and the changes in the rankings. We focused on whether or not changes in these ranks in the time periods of 2010 to 2014 and 2014 to 2016 are associated with changes in a company's returns and whether the changes had any predictive power for returns.

In both periods of study 2010-2014 and 2014-2016, we found that companies that increased rank from the Top 500-101 group to the Top 100 group exhibited superior returns, on average, to those that fell from the Top 100 to the Top 500-101 group. It appears that changes in the relative greenness of a company are associated with the relative level of performance of their stock. These are initial results, but they serve as the basis for future, more thorough investigations into the relationship of the level of environmentally friendly practices of a corporation and its risk-adjusted performance.

Impact of covenant violations on the capital structure of firms in the petroleum industry

With its history of booms and busts, the oil industry has recently been in its biggest crisis. Several companies have faced financial distress, including bankruptcies and violations of financial covenants. We seek to investigate a sample of such firms to understand the impact of the violations on the firms' capital structures and on their strategic management. The findings will give us an additional layer of insight into the functioning of these companies and the relationship with their lenders while providing institutional and retail investors with invaluable financial knowledge to make more efficient investments. We first search the SEC filings of companies to obtain a list of the violators. After recording details about the number, nature and dates of the violations, we select a sample of firms. We then examine their earning call transcripts before and after the violation and evaluate the firms on the following parameters: capital expenditure, credit, debt, mergers and acquisitions, to observe changes and trends taking place around the violation. The knowledge about the types of covenant violations would supplement the firms in understanding their shortcomings. This study would also shed more light on the value of earnings call transcripts - a data source which has seldom been investigated with depth - in research on corporate finance.

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Covenant Violators in the Oil Industry

Most businesses finance their operations through debt. However, when debt is involved there are certain requirements, called "covenants," that a firm must comply while the debt is being repaid. If a firm violates these covenants, it puts itself in an insecure position with the creditors. The creditors can indirectly impact the firm as certain rules are set in place that overlooks how a firm is utilizing its money.

In recent years, many firms in the oil industry have violated covenants, in part due to the volatility of oil prices that caused a lack of stability among firms, investors, and creditors. My research examines this instability and concentrates on what happens to firms in the oil industry once they violate a financial covenant. While looking at annual and quarterly filings that were reported through the Securities and Exchange Commission (SEC), I identify the occurrence of a violation and document the evolution of firms' finances before, during and after the violation. Through an examination of the violating firms' cash flow used for investing and financing activities, I examine the correlation with the firms' available borrowings to discover trends and patterns within the industry. With these results, it is possible to hypothesize the amount of value that creditors give to the firms in the oil industry through the use of implementing covenants.

Leveraging Knowledge Sharing in Nonprofits

Estimates are that Fortune 500 companies lose, in aggregate, $30 billion annually, simply through failure to share knowledge within their organization (Quast, 2012). Knowledge sharing has become a crucial component in the business world today. Researchers have dissected the determinants of knowledge sharing and the role of knowledge sharing in management, but none have considered what happens after the sharing occurs.

We believe that there is a significant gap in the knowledge sharing literature - specifically the lack of connection between knowledge sharing activities and strategic gain within an organization. Our research aims to develop a new construct to explain how knowledge is leveraged for strategic gain in the organization.

Through this term, we have worked to refine existing literature reviews of the question of knowledge leveraging and reviewed the outcomes of a Pilot quantitative study. Initial feedback from the Pilot Study suggests the value of a piece of knowledge and the degree of control an individual feels affects an individual's choice to act on knowledge.

This research will make an immediate and important impact on the association community by furthering its understanding of this key construct and increasing dialogue on the topic, holding the potential to answer questions that managers grapple with including: Which employees are most likely to act on a piece of knowledge? Who really should be asked to work on the most important projects?

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Development of IoT Readiness Index

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Countries are embracing the economic and social potential of the Internet of Things (IoT)--- the intelligent connection of people, processes, data, and things. The review of the literature indicates that there is no framework to evaluate a nations IoT readiness services upon which their digital future and growth depend.

This study developed an IOT readiness index for 65 countries. The IRI measures the degree of preparedness of a nation to participate in and benefit from the IoT. The IRI measure comprised of five sub-indices namely, economy, network, privacy standards, technological infrastructure and data protection laws. The index consists of over 100 separate quantitative and qualitative criteria. The development of such an index based on multiple measures could greatly aid in assessing a nations readiness to IoT. The index potentially will improve country inter-connectivity, which in turn will further the safe use of upcoming devices in IoT.

This holistic approach to evaluating IoT readiness demonstrates the importance of a cohesive strategy that includes government regulation and enforcement, as well as market-based incentives and economic levers to focus nations attention on a secure and prosperous digital future. This can all happen if more countries were on the same level of inter-connectivity, which can eventually improve international data laws.

A People-Centric Data Protection Framework for the Smart Workplace

The emergence of the Internet of Things (IoT) has led to the rapid development of the smart workplace. The smart workplace is a workplace that is characterized by connectivity and collaboration through the IoT. IoT devices such as smart badges and RFID are enabling organizations to capture data about the work and social behavior of employees during working hours. This data is stored and analyzed for the purpose of performance measurement and increasing productivity of workers. The data collection results in the increased likelihood that it could be breached or misused. Consequently, employees must be aware of how such data can be protected. This research paper discusses how employees can protect themselves, how employers can protect employees, and how the law protects employees.

In order to generate my findings, I researched the current IoT technologies used in the workplace and the risks involved with them. I then researched the precautions people can take to protect themselves from security breaches. Lastly, I analyzed how these precautionary measures can be tailored to the IoT specifically.

Previous research has studied the ways in which the smart workplace will evolve in the future, the many benefits and risks associated with the increase in IoT technology, and current data breach laws. However, there is little research on these new technologies in conjunction with protection mechanisms. We provide a framework that protects employees in the smart workplace.

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CEO Communication Effectiveness Research

One of the greatest tools to be an effective leader is clear communication. Chief Executive Officers of firms are important public figures to the business world, but we seldom look at whether or not they are effective communicators. Our research looks closely into the theatrical execution of Fortune 500 CEO's and how it correlates directly to either positive or negative performance within their firm. Upon conclusion, this research will identify the most effective ways to communicate within the business world in terms of efficiency and leadership. Elements of rhetoric, facial expressions, and overall mannerisms are all considered within this study. In order to collect data, we sent out a survey to the general public that featured 20-second videos of selected CEOs and an evaluation scale based off of the Smith-Semantic Differential Scale for Theatrical Performance. Our survey included a randomly selected group 75 CEOs from Fortune 500 firms. The measurement scale includes 14 different items, all of which are measured on a seven-point semantic differential scale. The overall results of this long-term research project can be of use to CEOs, equity analysts, academic researchers, and students.

Leveraging Slack Human Capital to Investigate New Technological Opportunities

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Technological innovations can have significant impacts on organizations, industries, and societies. Human resources management often allows firms and other organizations to leverage human capital in order to drive innovation and boost performance. This is often achieved through increased productivity, the integration of new technologies, and other techniques, which may involve the use of slack human capital. Slack human capital is defined as potentially utilizable resources that can be diverted or redeployed for the achievement of an organization's goals. Using a resource-based view, this study explores whether a firm's use of slack human capital to investigate new technologies is affected by its social technological structure. Based off of data gathered from 847 biotechnology firms, slack human capital has been determined to have an inverted curvilinear relationship with the exploration of new technologies. Furthermore, the decentralization of control, a high degree of collaboration, and a broad technological domain moderate the relationship, which strengthen the positive effect at low levels of slack human capital and weaken the negative effect at high levels. This study offers a theoretical redirection for research, extending the resource-based view and human capital theory.

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Marketing

Does it pay to be good? The impact of country reputation on foreign direct investment

The purpose of this research is to examine the relationship between country reputation and foreign direct investment (FDI). FDI involves the transfer of assets between countries in the form of capital, investment, or loans. As FDI can bring in advanced technologies and managerial knowledge, contributing to economic growth in the host nation, many countries invest resources in improving their reputation in an effort to attract foreign investment. A good country reputation can serve as a way to reduce some of the uncertainty involved in investing abroad by reassuring foreign investors that they will earn a high return on their investment. The country reputation measure used in this research is the Good Country Index (GCI), which shows how selfless and generous a country is to the outside world. A nation with a positive global impact might hence be perceived as particularly attractive to foreign investors since the country is developing within , in addition to providing benefits to the rest of the world.

Predicting the Success of Super Bowl Advertisements Based on Native Language using Functional Near-Infrared Spectroscopy (fNIR)

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The Super Bowl (SB) is the most viewed annual televised U.S. event with concurrent viewership reaching 114.4 million. Advertisements aired during the SB are primarily in English while they are viewed by millions of people who are not native speakers of English. SB ads are uploaded online and amass millions of views from around the world. Prior research indicates that viewing ads in one's non-native language can cause a decrease in text comprehension with 40% of text not being understood. It is therefore critical for marketers to understand the differences in evaluation of SB ads between users with diverse linguistic backgrounds.

Traditionally, advertising effectiveness has been measured through self-report survey items, which exposes the study to biases. We go a step beyond and employ functional near-infrared spectroscopy (fNIR), a safe, non-invasive, user-friendly and portable optical imaging technique for determining the neural correlates associated with evaluation of SB ads. We use USA Today Ad Meter ratings to shortlist thirty advertisements from SB events from 2013-15 and study – a) how Ad Meter ratings for top and bottom ranked ads correlate with more established self-report measures from the advertising literature, b) how the Ad Meter ratings and our self-report measures align with neural correlates obtained through fNIR, and c) how native English speakers differ from non-native English speakers in their evaluation of SB ads across self-report and neural measures.

Gender Differences in Brain Activation for Super Bowl Commercials: Insights from Functional Near Infrared Spectroscopy (fNIR)

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The Super Bowl is the most watched television event of the year in America with over 100 million viewers. Men and women watch this event and the commercials with equal interest. For this reason, Brands invest a major component of their advertising budget in the Super Bowl airtime. There is general consensus in the literature as to the evaluation of advertising stimuli on each gender. However, to the best of my knowledge, there is no research that evaluates the physiological differences in reaction to Super Bowl ads between men and women. In this study I use an emerging neuro imaging technique - Functional Near Infrared Spectroscopy (fNIR) to measure how men and women evaluate ads. Neural measures, when interpreted with traditional measures, add more insights. 9 male and 9 female subjects watched 30 Super Bowl ads selected from 3 years (2013-15). Participants watched while their brain activity was measured and answered survey questions. The purpose was to understand a) the differences in brain activation patterns while watching highly and poorly rated ads (determined by USA Today Ad Meter Ratings) in men and women, b) correlation of brain activation with traditional measures of effectiveness, and c) uncovering patterns that traditional measures cannot. This data helps us understand which ads were liked more by which gender. Insights can be drawn from this data through future research of the content of ads that were liked the most and least by subjects from the two genders.

The Curious Case of American Horror Story

Do you become intrigued to see the premiere of a TV show when you see its teaser trailer? Are you eager to learn more about the story when the episode ends on a cliffhanger? Consumer curiosity has been widely used in the entertainment industry, particularly for TV shows and movies, to create consumer motivation, increase brand popularity, and cause the desire to discover more information. However, it is still unclear how curiosity drives viewership and popularity through different stages of a TV show. Our research studies this question by focusing on American Horror Story, an American anthology horror TV series. We examined secondary data from social media sites and view count/rating sites to study its viewership. From this data, we observed patterns of viewership at different stages through multiple seasons, and made hypotheses on how (un)satisfied curiosity drives such patterns. Through our data analysis, we found that certain stages of the TV show consistently display the most viewership. Further, viewership at each stage is driven by a different question that triggers consumers' curiosity. Moreover, we suggested that popularity is largely determined by curiosity-related consumer activity at the teaser stage of the TV show. Finally, we linked our multiple results together and demonstrated the causal relationship between consumer curiosity and viewership, which uncovers our curious case of American Horror Story.

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Unpacking Consumer Curiosity in X Days?

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Is your curiosity instantly piqued when you see a llama trying to paint the next Samsung smartphone on a canvas in the commercial? Do you still keep your curiosity high after watching seven similar commercials like this? Teaser campaigns are a series of small, cryptic advertisements designed to elicit consumers' curiosity about a new product launch. However, the length of the campaign is usually difficult to decide, as consumers might become either uninterested if the campaign is too short or bored if it is too long. This research focuses on finding the optimal length for a teaser campaign through the use of Samsung's Seven Days of Unboxing campaign. This research is important since a good length of the teaser campaign is crucial to effectively engage consumers. Through Samsung campaign's viewership data, I observed a mid-campaign slump. In order to find the optimal length of the campaign, I conducted an experiment with a one-factor design (original vs. abridged). Specifically, one group of participants watched the original seven-teaser campaign, while the other group watched an abridged four-teaser campaign. Based on my results, the abridged version of the teaser campaign is more effective than the original one. The practical implication of this research is that marketers should keep in mind sometimes long teaser campaigns might not work as effectively as anticipated to keep consumers engaged.

Anuran Community Structure at Warren Grove Gunnery Range in the Pine Barrens, New Jersey

The New Jersey Pine Barrens is a globally rare ecosystem where the biota is well adapted to acidic, nutrient poor soil and water, and frequent wildfires. The Pine Barrens support ~14 species of anurans (i.e frogs and toads). Because anurans face a worldwide decline as a result of habitat loss and deforestation, it is important to understand the impact of water quality disturbance on anuran assemblages. I compared the difference in local species richness along a wetland disturbance gradient at the Warren Grove Gunnery Range to elucidate the effects of landscape change on anuran community structure. Anuran presence/absence, fire frequency, and water quality data were collected from ponds (n=23) from March - July 2016. Anuran community composition was correlated among environmental variables to determine the strength of relationships. Understanding the relationship between anuran species composition and abiotic parameters associated with land-use change will be imperative for the long-term conservation of these bio-indicator species.

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Prevalence of Haemosporidian Parasites in Northern Saw-whet Owls

Avian malaria is a common infection among many bird populations. Although the birds are often not visibly ill, the infection can be caused by many Haemosporidians in the phylum *Apicomplexa*, including *Haemoproteus*, *Plasmodium*, and *Leucocytozoon*. The purpose of this research study was to further understand the prevalence of Haemosporidian parasites in the migratory Northern Saw-whet Owl (*Aegolius acadicus*). Prevalence of infection across a set of samples can be estimated by screening DNA extracts from hostblood samples for Haemosporidian DNA. I screened approximately 384 samples for Haemosporidian DNA using specific polymerase chain reaction (PCR) primers and a nested PCR protocol, which amplifies an approximately 477 base pair fragment of the cytochrome b gene of the three target Haemosporidian genera from the DNA extracts of the infected hosts. After the PCR, samples were electrophoresed on an agarose gel along with a positive control to screen for positive amplifications. All malaria-positive PCR products were then Sanger sequenced and compared to a database of cytochrome b Haemosporidian sequences for generic and sometimes species-level molecular identification. Overall, there was a very high prevalence of Haemosporidian parasites in the population sampled (67%), with Leucocytozoon occurring most frequently (82%). It is likely that local prevalence of vectors on the breeding grounds play a role in the differences in prevalence of the three Haemosporidian genera.

Odor stimulation regulates olfactory sensory neuron activation in a Fragile X Syndrome model

Fragile X Syndrome (FXS) is a genetic disorder caused by transcriptional silencing of the FMR1 gene, leading to the loss of Fragile X Mental Retardation Protein (FMRP), a translational regulator. FXS, the most common cause of autism, is characterized by developmental delays, impaired cognition and sensory hyper-sensitivity, including in the olfactory system. Olfactory sensory neurons (OSNs) are located in the olfactory epithelium where they detect and respond to olfactory stimuli perceived through smell. Previous evidence from our lab has indicated that in a mouse model of FXS, OSNs exhibit an increased response to odors. Here, we set out to determine whether this increase reflected a larger number of cells responding. To test this hypothesis, we exposed wild type and Fmr1 null mice to odorants for one hour. We then measured the number of OSNs activated (as assessed by expression of the immediate-early gene c-Fos) as a percentage of the total number of OSNs (as assessed by expression of olfactory marker protein).

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Mapping Fragile X Granules in the Mouse Spinal Cord

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Fragile X Syndrome (FXS) is the most common inherited cause of intellectual disability. FXS patients exhibit symptoms including impaired motor development and hypersensitivity to sensory stimuli.

This is caused by the lack of Fragile X Mental Retardation Protein (FMRP), a critical protein synthesis regulator within the brain. In axons within the brain, FMRP exists in Fragile X Granules (FXGs) which are expressed during developmental stages of robust synaptic plasticity. In addition to FMRP, FXGs contain Fragile X Related Protein 2 (FXR2P), mRNA, and ribosomes. In contrast to our understanding of FXG expression in the brain, it is not known whether FXGs are found in the spinal cord, which is responsible for relaying all sensory and motor information between the brain and the rest of the body. Here, we examined the presence of FMRP and FXGs in the spinal cords of mice at various stages during postnatal life. We also investigated whether FMRP regulates these FXGs by looking in spinal cords from FMRP knockout animals. Initial investigations show that FXGs are present in motor axons across all examined ages. Our findings suggest that dysregulated axonal protein synthesis in spinal motor neurons contributes to the motor deficits observed in FXS patients.

Tackling Urban Food Deserts with Indoor Hydroponic System

Food deserts are defined as urban areas where residents have very limited access to fruits and vegetables. Plant-based foods can be expensive, a major problem for the impoverished people who live in such areas. A frequent solution is for residents to start their own gardens. This is sometimes not an option because urban areas tend to have very little available open space for gardens. In addition to nutritional benefits, access to green spaces has been shown to increase overall wellness of urban dwellers. URBN STEAM lab is developing a soil-less way to grow food in an indoor urban setting. Our strategy involves innovating a hydroponic system where plants access nitrate, an essential nutrient, from cyanobacteria. We used 3D printing to generate prototypes of our indoor hydroponics systems. These prototypes will be used to grow and select strains of cyanobacteria that work best with the hydroponic system. Our designed prototype will have separate compartments for the plants and cyanobacteria, with a system that allows the nutrients to flow between the two. We have designed and will present a table model that holds the cyanobacteria in an enclosed dome with a tunnel that leads to the growing plants.

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Designing Cyanobacteria-Based Hydroponic Systems That Will Combat Food Deserts

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Food deserts, such as parts of West Philadelphia, are a direct consequence of the increase of urban population and lack of equitable development. Therefore, developing a system that allows people to obtain fresh food is of great importance. Hydroponic systems for plant growth are a soil-less agricultural method that have been widely used. Cyanobacteria (blue-green algae) are photosynthetic organisms that can convert nitrogen from the air to nitrate. This ability allows cyanobacteria to facilitate plant growth in soil-less environments by providing nitrate, an important component for plant growth. Our work involves one such cyanobacterium, Anabaena PCC 7120, a nitrogen-fixing cyanobacterium that grows readily in laboratory conditions. The objective of this study is to design in-home structures that Anabaena can grow easily in and that are aesthetically pleasing. We have designed and 3D printed different structures, inspired by laboratory equipment used for cell growth. Anabaena was then grown in all of them in order to determine the optimal shape for cyanobacterial growth. Future studies will focus on testing plants with the cyanobacteria in the designed structures. This work will help people living in urban food deserts lead a healthier life by providing them with a strategy to grow fresh produce indoors.

A Novel TNFR2 Agonist Increases OPC Proliferation and Locomotor Recovery After SCI

Spinal cord injury (SCI) results in axonal damage and oligodendrocyte death, causing demyelination and paralysis. Oligodendrocyte precursor cells (OPC) are responsible for remyelinating injured neurons after SCI. Tumor necrosis factor (TNF) is a signaling molecule with two forms that stimulate two receptors. When soluble TNF stimulates TNFR1 in CNS injury, it leads to apoptosis; when membrane bound TNF stimulates TNFR2 it plays a role in neuroprotection and remyelination. Our goal was to determine the effect of a novel TNFR2 agonist molecule both in vitro on OPC proliferation and differentiation and in vivo on locomotor recovery following SCI. In vitro our data shows that stimulating TNFR2 significantly increased proliferation of OPC, as measured by EDU incorporation; inhibiting IRE, a protein believed to be associated with the TNFR2 pathway, abrogated the effect. To determine potential therapeutic uses for TNFR2 agonist, we used a mouse model of SCI and delivered the agonist to the site of injury via a pump. Locomotor recovery was measured with the Basso Mouse Scale. After 6 weeks the mice were sacrificed and an area of spinal cord centered on the lesion was collected for Western Blot analysis of neuronal/myelin proteins thought to be affected by the TNFR2 pathway. Preliminary data shows locomotor improvement in mice receiving TNFR2 agonist compared to saline controls. Together, our data suggests that this TNFR2 agonist could be a promising treatment for SCI.

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HATs and HDACs in normal and neurodegenerative brains

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Neurodegenerative disorders are caused by the impairment of different epigenetic mechanisms. Histone Acetyltransferases (HATs) are essentially responsible for histone marks within the brain. A decrease histone acetylation is linked to Alzheimer's. It was found that the gene accountable for this disease, APP, is closely associated to Tip60. Tip60 is a HAT that is expressed in the human brain, and is essential to the development of Drosophila. In recent discoveries, Tip60 has played a role in protecting neuronal functions from degenerating. Our research used drosophila to figure out how Tip60 can play a neuroprotective role under the neurodegeneration of the gene APP. However, it is unclear if in a normal brain the balance of HATs and HDACs is disrupted. It is assumed that in a neurodegenerative fly brain that there would be less Tip60 and more HDAC1. It is still unknown whether Tip60 is decreased and HDAC1 is increased in APP flies. We used a GAL4- UAS system to induce APP, or APP;Tip60 expression in order to compare the differential expressions of HATs and HDACs with Western blots.

Loss of Tip60 HAT Activity Affects DLG Localization at Drosophila NMJ

Neurodegeneration encompasses the loss of structure and function of neurons and eventual neuronal cell death. Currently the most common type of neurodegenerative disease is Alzheimer's Disease (AD). Neuronal damage and associated gene misregulation have strong effects on cognitive function. To maintain proper cognitive functions epigenetic modifiers such as histone acetyltransferases (HATs) play a significant role. HATs acetylate lysine amino acids on histone proteins, which leads to the transcriptional activation of genes. Tip60 is one such important HAT that has been extensively studied by our lab. It has been associated with various neurodegenerative disorders, including AD. Tip60 has been shown to play a crucial role in regulating expression of essential cognition-associated genes, which are misregulated in AD brain. One such gene is Discs Large (DLG), a synapse-associated scaffolding protein. Misregulation of this gene has been associated with defects in cognitive functions. This project investigates the presence of DLG in drosophila brains through the utilization of immunostaining, an antibody-based process that allows for the detection of a specific protein. We will test the changes in expression of DLG in our APP fly brain as well as APP flies with excess Tip60. This research can provide a better understanding of how alterations in gene expression contribute to neurodegenerative disorders and the neuroprotective role of excess Tip60 under such conditions.

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Neuroprotective Role of Tip60 Against Apoptosis in the Drosophila Alzheimer's Disease Model

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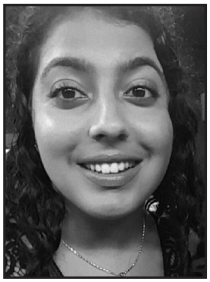
The epigenetic histone modification code controls chromatin packaging in the nucleus. Post translational modifications occur on AA residues on the N-Terminal tails of histone proteins. These changes are carried out by specific enzymes known as Histone Acetyltransferase or HATs. At the same time, these modifications are thought to be flexible as they can be undone in a similar manner by Histone Deacetylase or HDACs. Uncondensed chromatin caused by the function of HATs allows reader proteins to access the DNA and ultimately transcribe the gene. The fine balancing act between the two classes of enzymes can be disrupted and lead to apoptosis, the cause of many neurodegenerative diseases. In fact, increases in histone acetylation appear to be related to learning while decreases correlate with aging and memory loss.

The aim of the project is to determine if Tip60 HATs expression is decreased in fly AD model and restored by Tip60 overexpression. It is already known that Tip60 exhibits a neuroprotective role in the APP model. It is thought that Aβ, a toxic product of the APP protein, is critical for apoptosis in neurodegenerative diseases. To test the neuroprotective effects of Tip60, it is necessary to generate a fly line that can overexpress tip60 in the Aβ model. Balancers are introduced to help recognize phenotypes that indicate the genotype of flies. Once the Aβ;Tip60 fly line is obtained, overexpression of Tip60 will determine whether it can rescue the apoptosis caused by Aβ.

Tip60 and Rpd3 Expression in Larval and Adult Drosophila Neurodegenerative Brain



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Neurodegenerative diseases, such as Alzheimer's Disease (AD), result in the deterioration of cognitive function over a period of time due to several factors including gene misregulation. Neurodegeneration can occur due to epigenetic modifications which can lead to changes in gene expression. One such important modification associated with cognitive function is histone acetylation, which is maintained by the antagonistic activity of histone acetyl-transferases (HATs) and histone deacetylases (HDACs). HATs are typically involved in the processes to decondense chromatin and to activate gene transcription. Tip60 is a HAT that our lab has found to have an important role in AD. HDACs are involved in the repression of gene transcription, and previous studies have found that certain HDACs, such as Rpd3, have an increased presence under neurodegenerative conditions. The purpose of this experiment is to investigate the changes in gene expression of Tip60 and Rpd3 in larval and adult fly brains under neurodegenerative conditions. We used qPCR in order to test the changes in gene expression in two fly lines: APP flies and APP: OE flies (with excess Tip60). The results of this research will provide a greater level of understanding regarding how alterations in gene expression of HATs and HDACs can contribute to neurodegenerative disorders.

Genomic characterization of bacteriophages ShiaLabeouf and Superphikiman

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Bacteriophage are viruses that infect bacteria cells. They are the most abundant and diverse entities on Earth. Microbiologists have estimated the number of bacteriophage on planet Earth to near 10^{31} which are currently classified into 56 different clusters. The SEA-PHAGES program is a yearlong Honors Biology lab course where students isolated bacteriophages able to infect *Mycobacterium smegmatis* from soil samples. Nine different bacteriophages were sequenced. Of these nine sequenced bacteriophages, ShiaLabeouf and Superphikiman have the largest genome, over double the size of the 7 other genomes isolated by the 2015-16 Drexel phage hunters. During the spring term and completed this summer, annotation of the ShiaLabeouf and Superphikiman genomes was performed using a combination of bioinformatics programs. DNA Master, GeneMark, Glimmer, and Starterator were used for gene prediction of putative open reading frames, while the databases of NCBI Blast, HHPred, and Phamerator were queried using PECAAN for putative gene functions. From this analysis we found that Superphikiman is a cluster J bacteriophage with a length of 109799 base pairs, 238 putative genes, and a GC content of 61%. While ShiaLabeouf has a genome length of 154471 base pairs, 233 putative genes, and a GC content of 64.7%. These C and J cluster phages are less common than the other clusters which we isolated. In conclusion, this research has expanded our genomic and evolutionary understanding of mycobacteriophages.

Phage Phriends: Genomic annotation of Cluster B bacteriophages Phergie, PhenghisKahn, PhrodoBaggins and Virapocalypse

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Bacteriophages are viruses which infect bacteria. With the current challenges relating to antibiotic resistance, bacteriophage biology is a growing area of interest due to the ability of phages to lyse bacteria. The Drexel Honors Biology SEA-PHAGES program isolated 48 mycobacteriophages (phages that infect mycobacterium) from soil samples.Mycobacterium smegmatis, a bacterial species that is closely related to Mycobacterium tuberculosis, the pathogen responsible for tuberculosis, was used to isolate these phages. Nine of the isolated phages were sequenced and their genomes annotated over the course of the 2016 Winter quarter and 2016 Summer. To annotate the genomes DNA Master, Genemark, Glimmer, and Starterator were used to predict genes present in the phages' genomes. The gene functions were predicted using NCBI Blast, HHPred, and Phamerator. Of the 9 phages, 4 were classified as being from cluster B. When comparing these Cluster B genomes: PhrodoBaggins has a genome length of 68873 bp, 104 putative genes and GC content of 66.4%. Phergie also has a 68716 bp genome, 104 putative genes and 66.3% GC content. PhenghisKahn has a genome length of 68727 bp, 105 putative genes and 66.3% GC content. Virapocalypse has a genome length of 68682 bp, 100 genes and a 66.5% GC content. Given the similarity between these cluster B phages and that this was the most commonly isolated cluster under our laboratory conditions, we have a better understanding of this cluster and its context.

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Impairment of Immune Cells in Mice with Acute and Chronic Spinal Cord Injury

Spinal Cord Injury (SCI) is a common disorder endangering the health of people. Approximately 280,000 persons in the United States suffer from SCI with an additional 17,000 cases every year. The largest threat to their lives is infection, indicating a possible impairment of the immune system. However, research on immune response in patients with SCI is quite limited. In this study, we investigated the effect of acute and chronic SCI on immune cells, particularly T cells and B cells. SCI was induced in C57BL/6 mice on the 9th thoracic vertebrate through direct impact. One and six weeks after SCI, splenocytes were isolated, stained with antibodies, then acquired using flow cytometry for analysis of the lymphocytes. Similar trends appear in the number of T cells and B cells measured at weeks 1 and 6. The number of CD4 T cells, CD8 T cells, and B cells all decreased considerably by week 1. By week 6, all the values increased to just under the levels of uninjured mice. Interestingly and importantly, inhibitory molecule PD-1 expressed on both CD4 and CD8 T cells increased by week 1, but by week 6 had similar levels to those of uninjured mice. PD-1 ligand (PD-L1) on B cells increased by week 1, and continued to increase by week 6. These findings indicate that lymphocytes may have been impaired at both quantity and quality levels after SCI, and this study has important implications for understanding the potential mechanisms of why patients with SCI are more susceptible to infection.

Exploring HDAC inhibitors' effects on CHARGE Syndrome using Drosophila melanogaster as an In Vivo Model

CHARGE syndrome is a genetic disorder that affects human development, leading to a variety of visible defects starting in childhood. Most CHARGE cases are caused by a haplo-insufficiency of the CHD7 gene, which is a chromatin remodeling protein. The fruit fly Drosophila melanogaster has a homologue of CHD7 called Kismet which shares 63% protein identity. Our lab has shown that ubiquitous loss of Kismet is a good model system for studying CHARGE syndrome. The goal of this project was to screen a series of drugs on CHARGE flies in order to determine their effectiveness in treatment. The drugs used were HDAC inhibitors, which prevent the functioning of histone deacetylase. HDACS are important for chromatin remodeling during transcription. Chromatin is composed of DNA wrapped around histones, and how tightly bound the DNA is determines whether it will be transcribed. HDACs tighten DNA-histone complexes, inhibiting transcription. Thus, it is thought that HDACi's will prevent this tightening, allowing transcription of CHD7 target genes. CHARGE flies exhibit motor defects similar to symptoms observed in human CHARGE. Therefore, larval crawling assays for motor function were used to determine the effectiveness of 7 different HDACi's on the fly CHARGE model. Understanding how these drugs affect symptoms in fruit flies will potentially allow for a study of the drugs in mammalian models.

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How the Sonic Hedgehog Signaling Pathway Affects APP Metabolism

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Alzheimer's Disease is a neurodegenerative disease that has been associated with the improper cleavage of amyloid precursor protein (APP), resulting in accumulation of β-amyloid peptide (Aβ). Cyclopamine is a steroidal alkaloid known to inhibit the sonic hedgehog signaling pathway (Shh). Recently, our lab has shown that inhibition of hedgehog signaling by cyclopamine affects APP metabolism, causing an increase in APP C-terminal fragments (CTF's) and reduction in Aβ accumulation. To further study the relationship between hedgehog signaling pathway and APP cleavage, we plan to silence the different components of the Shh pathway and follow the effect on APP. Gli1 is a transcription factor important in the Shh signaling pathway. In order to study the effect of Gli1 silencing, Myc-Gli1 plasmids were created using site-directed mutagenesis. Once successfully mutated, these plasmids will be transfected into HeLa cells to further investigate the connection between Gli1 and APP. Understanding the relationship between the proteins in the sonic hedgehog signaling pathway and APP processing can open a new avenue to Alzheimer's research.

Exploration of the Therapeutic Potential of Valeric Acid in a Drosophila melanogaster Model of Alzheimer's Disease

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Alzheimer's Disease (AD) is a neurodegenerative disease characterized pathologically by neurofibrillary tangles and senile plaques, and causes behavioral degeneration including memory loss, delusions, and loss of motor function. Current treatment options are all palliative, serving only to slow progression of symptoms for a short period of time. There is no disease-modifying drug available for AD treatment.

Our lab created a Drosophila melanogaster model of AD, which expresses human Amyloid Precursor Protein (hAPP695) and human beta-secretase (hBACE1), with the goal of creating a system able to rapidly and accurately screen for new AD therapeutics. A mutant external morphology of crumpled wings and necrotic plaques on the proboscis and abdomen are used as a proxy to determine the effects of drugs on the model.

Following a screen of 264 GPCR-binding ligands previously untested in the Drosophila model, some, such as estradiol valerate, showed significant decreases in mutant morphology, indicating possible therapeutic potential. Estradiol valerate is known to metabolize into 17-B-Estradiol and valeric acid (VA). Preliminary data showed VA to have the greatest suppressive effect on mutant morphology and it was subsequently recommended for further study. The goal of this project is to characterize the therapeutic potential of VA by determining the optimal dose, the lethal dose, and the mechanism of action within our fly AD model.

Rho kinase prevents lamellipodia formation in primary human fibroblasts

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The movement of cells in three-dimensional (3D) extracellular matrix is responsible for a plethora of actions, from wound healing to metastasis. It is important to learn and understand the mechanisms by which cells migrate in 3D in order to create medical interventions that can prevent the spread of cancer cells, abnormalities in morphogenesis and improve overall tissue repair. Rac1 and RhoA are two proteins that play a major role in 3D cell migration. Rac1 is responsible for the production of sheet-like lamellipodia at the front of the moving cell. In comparison, RhoA increases actomyosin contractility to generate pressure-based lobopodial protrusions through its downstream kinase (ROCK). It is currently unclear how RhoA and ROCK prevent lamellipodia from forming in high-pressure cells. We hypothesize that high cytoplasmic pressure caused by the contractile force along actin stress fibers prevent Rac1 from creating lamellipodia. To test this hypothesis, human fibroblasts on 2D were co-transfected with constitutively active forms of Rac1 and RhoA to generate high-pressure cells, treated with a ROCK inhibitor (Y-276832), and analyzed for its affect on actin cytoskeleton. ROCK inhibition diminished stress fibers and increased lamellipodia formation; suggesting actomyosin contractility suppresses lamellipodia formation in cells with active RhoA and Rac1. Future work will quantify stress fiber loss and measure changes to intracellular pressure following inhibition of ROCK.

Control of Protrusion Identity by the Small GTPase RhoA

Cell migration is responsible for various functions like prenatal development, wound healing, and immune surveillance. Two specific GTP-binding proteins, Rac1 and RhoA, are primary regulators of remodeling the actin cytoskeleton which drives cell motility. Rac1 governs actin polymerization in lamellipodial protusions. RhoA activates actomyosin contractility to build-up intracellular pressure and prevents lamellipodia formation. Importantly, it is unclear why lamellipodia do not form in high pressure cells. We hypothesized that either the high pressure downstream of RhoA activity physically prevents lamellipodia formation, or alternatively that RhoA signaling inactivates the Rac1 pathway. To distinguish between these two possibilities, primary human fibroblasts expressing constitutively active RhoA and Rac1 constructs were permeabilized with streptolysin O and stained with rhodamine phalloidin to visualize the actin cytoskeleton. Cells expressing active RhoA and Rac1, lack apparent lamellipodia even with streptolysin O treatment. These data suggests that increasing membrane permeability (and decreasing intracellular pressure) does not increase lamellipodia formation. This further indicates RhoA prevents the formation of lamellipodia through signaling rather than physical mechanisms. Future experiments will confirm the efficacy of streptolysin O for increasing membrane permeability and decreasing intracellular pressure.

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Investigating Ephrin B3 Ligand-Induced Clustering of EphB3 and EphA4 Receptors

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Dependence receptors are trans-membrane receptors which, when not bound by their respective ligand, signal for cellular apoptosis. EphB3 and EphA4 are examples of such receptors, existent in oligodendrocytes of the central nervous system as regulators of axonal growth. While previous studies have identified the receptor tyrosine kinases EphB3 and EphA4 as dependence receptors, the mechanisms by which these receptors induce cell death are not entirely clear. In order to understand such mechanisms, the relationship between these two separate receptors must be elucidated. It should be established whether or not EphB3 and EphA4 can induce apoptosis on their own, or if an interaction between the two receptors is necessary. We utilized co-immunoprecipitation, to identify whether EphB3 clustered with EphA4 upon binding to their common ligand. After immunoprecipitating EphB3 and running a western blot for EphA4, bands were seen at molecular weights indicative of EphA4, supporting the first part of the hypothesis that EphA4 and EphB3 interact with one another to regulate cell death. The mechanisms by which these dependence receptors mediate cell death could lead to the establishment of new therapeutic paradigms for central nervous system trauma through prevention of oligodendrocyte degeneration.

Examining the Role of DART Motif in EphB3-Dependent Cell Death

Spinal cord injury leads to detrimental disabilities in many people, and part of this damage is due to the oligodendrocytes cell death. EphB3 receptors are part of the largest receptor tyrosine kinase family and work as dependence receptors. Dependence receptors mediate cell death in the absence of their ligand. Previous researchers have found that after spinal cord injury, the oligodendrocyte (OLs) cells undergo apoptosis caused by the expression of the EphB3 receptor that lacks the ligand EphrinB3. The only common feature among dependence receptors is a sequence located in the transmembrane domain named the DART (Dependence-Associated Receptor Transmembrane) motif. However, the function of the DART motif has never been studied. We started to analyze the role of the DART motif in cell death regulation caused by the EphB3 dependence receptors. The HEK293 cells were transfected with the pcDNA3.1-V5, pcDNA3.1-EphB3 or pcDNA3.1- EphB3 ΔDART plasmids to analyze the effects on cell death. Our preliminary data suggest that the absence of DART motif may impair the pro-apoptotic activity of EphB3 receptors. More experiments will be carried out to clearly assess the role of DART motif in EphB3-dependent cell death.

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Regulation of the neuronal transport of the Amyloid Precursor Protein (APP)

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Defects in intracellular transport lead to a variety of neurodegenerative diseases such as Alzheimer's disease (AD). The amyloid-beta precursor protein (APP), which gives rise to amyloid plaques in AD, is transported into neuronal axons by the microtubule (MT) motor KIF5B. Septins are GTP-binding proteins associated with MTs and have been shown to aggregate in the neurons of patients with AD. Our lab has recently discovered that the MT-associated septin 9 (SEPT9) localizes preferentially in the dendrites of hippocampal neurons. However, whether septins affect the transport of APP is unknown. Here, we use SEPT9 overexpression and knock down approaches to assess the distribution of KIF5B and APP in hippocampal neurons. Quantitative analysis of neurons expressing fluorescently tagged KIF5B-GFP revealed that KIF5B is primarily in the axon in control and SEPT9 overexpressing cells. However, KIF5B shifts towards dendrites upon SEPT9 knock down. Similarly, APP localization to dendrites increases after depletion of SEPT9. Overall, these results suggest that SEPT9 impedes KIF5B motility into dendrites and therefore, promotes the targeting of KIF5B and APP to neuronal axons. We hypothesize that aggregation and mislocalization of septins during AD may alter APP transport and thus, affect the location of amyloid plaque formation. Future work will explore this possibility.

Gentrification: Myths, Realities, Solutions

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Gentrification is a highly politicized and misunderstood issue. The variety of misconceptions around it include that it displaces people, gives no benefit to the people who already live in the area, and yields no net benefit to the community or city. Research done to examine these claims reveals that the notion of displacement is largely based on a premise that those with limited means are relatively immobile, which is not the case. Data shows that much of the mobility of lower income populations would be occurring with or without the presence of gentrification. The research also reveals that those who stayed in the gentrifying area received financial benefits, as did those who left, though to a lesser extent than the stayers. Research then shifted to determine the real issues around gentrification. This issue is the increasing concentration of extreme poverty into fewer areas of the city, isolating the poor and further decreasing their standard of living. Analysis also showed that gentrification occurs on economic, not racial, lines. The racial components here are a byproduct of how race and economics interact in America (mainly in cities). While there are many ways to address this issue, my proposal is to require X number of affordable section-8 low income housing units per Y amount of area to exist in every census tract in the city. This should help deconcentrate poverty and allow for greater integration and standard of living for those at the bottom of the income ladder.

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The Decomposition of Lincomycin Hydrochloride using Dielectric Barrier Discharge Non-Thermal Plasma.

With antibiotics being dumped in the wastewater by hospitals, farms, and many companies, antibiotic-resistant bacteria are starting to flourish and populate our rivers and lakes. This could prove to be detrimental to our health and environment. Removal of antibiotics from the wastewater is crucial to prevent further infestation of antibiotic-resistant bacteria in the waters. Although regulations of dumping antibiotics into the waste is starting to take effect, the antibiotics that are already in the waters as well as any new antibiotics being dumped into the drain pipes need to be removed. Plasma is known to decompose amino acids and thus the purpose of this study is to test whether plasma can decompose antibiotics. A Dielectric Barrier Discharge (DBD) non-thermal plasma generator was used to treat Lincomycin (Antibiotic) solutions at various duration, pulses and frequencies to try to decompose the compound. The products of the decomposition of the antibiotic after the plasma treatment were characterized by ^{1}H NMR and Mass Spectrometry. A frequency of 3500 Hz with a duty cycle of 90% and a 5 μs pulse width was found to be the most efficient settings that results in full decomposition of Lincomycin with a 20 minute plasma treatment. Further analysis will be conducted using ^{1}H NMR, LCMS and GC-MS for the kinetic studies of the decomposition reaction.

Learning Chemistry Through Climate Change

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This research was focused on freshman Chemistry majors, who completed activities based on climate change, and its relation to chemistry during the winter terms of 2014 and 2015. The purpose of this research was to determine if students understand the chemistry content and know how to apply it to climate change situations. Process-Oriented Guided-Inquiry Learning (POGIL) was used in these classes so that students not only received the information they needed for the course, but also developed skills, such as thinking, problem solving, and teamwork. Videos of selected groups were viewed, transcribed, and coded using the Toulmin Argumentation Method for thorough examination. The activities, quizzes, and exams scores of the recorded students, were also analyzed to determine whether they understood the material from the activities. Results suggest that, of the recorded students, those who just gave answers throughout the duration of the video were more likely to perform well on content related questions on the quizzes and exams, while students who gave explanations were more likely to do well on the climate change application questions. In 2014, the recorded students had an average of 74.6% in quizzes and 78.5% for activity related exam question results. In 2015, students had a quiz average of 77.7% and an activity related exam result average of 83%. These averages show that students were able to retain much of the information from the activities.

The Origins of Experimentation and Other Scientific Methodological Concepts in the Alchemical Works of Jabir ibn Hayyan

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In this work, I will discuss the historical origins of modern scientific methodology - in particular, that based on systematic, organised, laboratory experimentation, as it developed in the field of alchemy. Central to this story is the alchemical works of the ninth century Abbasid alchemist Jabir ibn Hayyan (Geber). I will analyse Jabir's techniques for chemical experimentation (including calcination, sublimation, etc) as well as his methodological framework and its emphasis on experimentation - a new practice in the field of science at the time. Jabir's practice of alchemy - for example, the transmutation of base metals into gold - were based on the theory that, by understanding the nature of a particular substance, one could "perfect" or "purify" that substance into its most divine form. Here, we can come to understand how Jabir understood science, and its purpose and practice, by examining his alchemical experiments. Crucial to this story is how scientists, whether ancient or modern, translate broad philosophical and religious holistic worldviews of nature into practical laboratory investigations. For example, Jabir saw no division between the study of natural and the supernatural worlds, and sought to divine the character of the latter through learning the workings of the former. The alchemical works of Jabir show an attempt to reconcile esoteric Islamic occultism, orthodox Islamic theology, and Aristotelian theory, through the development of modern laboratory methods.

Methods for determining periodicity in coupled ordinary differential equations

Ordinary differential equations (ODE's) are equations relating at least one of the derivatives of a single variable function to that function or variable. They often appear as solutions to problems in subjects ranging from astrophysics to biology. In many cases, however, these equations have no analytical solutions, so they can only be solved using numerical estimates. Our goal was to study periodic solutions in a specific set of differential equations relating to the surface of fluid films. Periodic solutions were found by plotting the phase-space normal between initial and final positions for varying initial conditions. In particular, it was found that these plots can often have complex and fractal-like behaviors for even very simple differential equations.

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Tiling Problems in Combinatorial Geometry

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Mathematics

Combinatorial geometry is a branch of mathematics that deals with combining the fields of combinatorics and geometry it deals with combinatorial properties of geometric figures.

In my research I studied a variety of tiling problems which are problems that have regions and pieces and these pieces must cover the regions without overlapping well also following any constraints put upon them. For one problem we show that an equilateral triangle cannot be split into two non-overlapping parts, consisting of finitely many polygons, in such a way that one part is a translated and rotated copy of the other. For the second problem we show that a square can be tiled in such a way that the tiles can be put together in multiple ways making the same square, but the graphs representing the solutions will be distinct. The last problem we worked on dealt with tiling a rectangle with unit squares with the constraint that each square was neutrally charged and each side length was either positive or negative the goal was to find an equation that told us how many possible ways there were to tile this rectangle given the number of each type of tile.

A Recursive Formula For Hikita Polynomial

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Mathematics

Catalan numbers are endemic in discrete mathematics; for example, counting the total number of legal pairings of n sets of parenthesis. In the early 1990's Garsia and Haiman introduced the q, t-Catalan polynomial, symmetric function generalizations of Catalan numbers which have since been shown to have interpretations in terms of algebraic geometry and representation theory. Catalan polynomials can be realized as a fundamental type of parking function, which are studied in abstract algebra, combinatorics, physics, statistics, and computer science. By utilizing the set of all parking functions, in 2012 Hikita introduced a further generalization of Catalan polynomials, which arise in the study of diagonal harmonics. Since then a great deal of research has been spent toward understanding these Hikita polynomials. In our research we discovered that Hikita polynomials with at most 3 rows have a recursive description involving lower-order rational Catalan polynomials. This means that Hikita polynomials can be described in terms of Catalan polynomials, which have been studied to great extent. This result suggests that such recursive formulas exist for higher order Hikita polynomials.

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Association of p-tableaux to acyclic orientations of incomparability graphs

Mathematics attempts to translate abstract, complex objects into more concrete and simpler ones. In this project, we attempt to further several decades of work to simplify and concretize an aspect of quantum mechanics. In 1979, D. Kazhdan and G. Lusztig introduced the Kazhdan-Lusztig basis, which corresponds to representations of important quantum mechanical operators. In 1996, R. Stanley introduced a generalization of the chromatic polynomial of a graph called a chromatic symmetric function (csf), which was later shown by S. Shelton and M. Skandera to correspond the Kazhdan-Lustig basis in certain cases. Since that time, people have sought a further simplification of the csf in order to more simply describe those quantum operators. Our project continues that search.

For incomparability graphs, P-tableaux can be used to expand the csf in the s-basis. Many have sought similar objects to expand the csf in the e-basis, but as of yet, none have found success. The coefficients of the csf in the e-basis are somehow parameterized by acyclic orientations, though exactly how is not yet known. Since there are natural connections between the s-basis and the e-basis, we have introduced an algorithm that associates a P-tableau to an acyclic orientation of an incomparability graph, hoping to find a parameterization of the coefficients of the csf in the e-basis. This algorithm brings us one step closer to a further simplification of those quantum operators.

PROSPECT Neutrino Detector Design Study

In particle physics, there is a lot of mystery that surrounds the neutrino particle. Because neutrinos have an extremely small mass and no electric charge, they are very difficult to detect. In fact, when trying to detect neutrinos from nuclear reactors, fewer neutrinos are detected than expected. This is known as the Reactor Flux Anomaly, a leading problem in neutrino physics. To address this, the PROSPECT collaboration seeks to explain the deficit of neutrinos in detection. PROSPECT will soon construct its full-size detector close to the High Flux Isotope Reactor at Oak Ridge National Laboratory. The design is being optimized through simulations of particle reactions testing various parts of the detector. "Pinwheels" are types of connectors within the detector. I addressed how the size of the pinwheels affects detector performance. Through running simulations for different particle energies with varying pinwheel size, I determined that PROSPECT may keep the current design for pinwheel size without having to sacrifice performance. Looking forward, PROSPECT will soon begin construction of the detector and begin to understand the Reactor Flux Anomaly.

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Physics

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A Control System for Growing a Radiation Detector at Low Temperature

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Low temperature liquid xenon detectors are have become a popular technology in physics. A variety of experiments such as EXO-200 and LUX use liquid xenon detectors as a way to search for super rare events that could lead to answers relating to the nature of neutrinos and dark matter. Our research explores the possibility of using solid xenon detectors which may expand further upon the detection capabilities of liquid xenon detectors.

Current work at Drexel involves the development of a vacuum chamber to grow solid xenon crystals at very low temperatures. For this experiment, where slight deviations in pressure and temperature are important, proper control and monitoring are essential for both analytical and safety reasons. My work focuses on developing a slow control system to efficiently log data coming in from several instruments in the crystal growth apparatus that monitor the pressure, temperature, and gas flow. Such a system will provide local and remote monitoring of system runs while storing all of the information needed for later analysis and will aid in determining the feasibility of large crystal growth for future experiments.

Photolysis Test of a Novel Sickle Hemoglobin Polymer Structure

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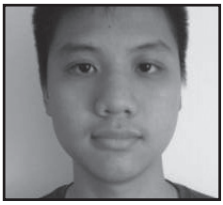
Sickle cell disease (SCD) affects millions of people worldwide, and is particularly common in sub-Saharan Africa. SCD is caused by the polymerization of sickle hemoglobin (HbS) that differs by one amino acid from normal hemoglobin. An approach for development of a treatment to SCD is to curb polymer formation. This research aims to better understand the structure of HbS polymers to this end.

We hypothesized that different contacts are present in the polymer structure of HbS than customarily assumed, and that this situation of multiple forms of contacts represents that of a spin glass, with alternating metastable alignments. To test this, we are collaborating with Dr. Loll in the CoM to obtain site-directed HbS mutants, that specifically affect its structure on polymerization. The varying structure of Hb is expected to change its polymerization kinetics. The technique used to induce polymer formation in HbS is laser photolysis of carboxyhemoglobin, the kinetics of which gives the rate of polymerization.

The research involved restoring an apparatus previously used for this purpose, which included aligning optics and programming, in C, the experiment that captured the kinetics of polymer formation. Due to computer failures, and inability to handle the camera card, we switched operating systems. Dr. Aprelev reprogrammed the experiments in LabVIEW, with further analysis in MATLAB. After completion of the setup, we are eager to collect and examine data to test our hypothesis.



Tuong Lam

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Auto-Correlator

Ultrafast electron diffraction is a technique based on use of femtosecond lasers to excite samples and probe the changes in lattice structure using electron pulses synchronized with the laser source. The instrumentation produces a series of diffraction patterns each with a specific time stamp indicating arrival time of the electron pulse relative to the laser pulse; in effect functioning as a 'molecular camera'. For the technique to resolve interesting condensed matter dynamics, the laser pulses must be <100 femtosecond in duration. Thus, characterizing the laser pulses is an important diagnostic for the experiment. The goal of this project was to design and build a laser autocorrelator. An autocorrelator measures the pulse-durations of ultrafast pulses, as standard devices like oscilloscopes are incapable of performing femtosecond measurements. The autocorrelator first splits the laser into two arms, via a beam-splitter. Mirrors are then used to redirect the paths for each laser arm. One path is fixed, while the other path consists of mirrors on a motorized stage. Both lasers are finally redirected into a second-harmonic generation crystal producing UV radiation from each individual arm. If the laser pulses overlap in space and in time, a third UV beam is generated. A power meter is used to measure the intensity of the third UV output as a function of change in position of the motorized state. The laser pulse duration is derived from the generated auto-correlation trace.

The Effect of Initial Stellar Binary Percentage on Rogue Planet Population

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One of the more interesting phenomena in the field of planetary astrophysics is the concept of rogue planets: sub-brown dwarfs that have no parent star(s). While their exact formation process is currently unknown, the leading theory is that the majority of the population come from planets that were ejected from their host system while the former host was still associated with a young open cluster. Previous simulations have shown the effect of star-star scattering to be a promising mechanism for this theory. To explore this avenue in more detail, we launched a study of the effects of a cluster's initial binary fraction on the number of rogue planets detected. Using the AMUSE software framework, we simulated 11 stellar open clusters for binary fractions ranging from 0-40% over the course of several hundred megayears; observing the change of orbital parameters changes for the 1000 mock-Neptunes placed around cluster members. The number of planets that escaped their host star or significantly altered their orbit increased proportionally to the binary percentage, but the number of planets that switched host stars showed no relation.

Accuracy of using Effective Area plots to calculate event density in the IceCube detector

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The IceCube Neutrino Observatory is a detector on the south pole that observes weakly interacting particles that come through the Earth and southern atmosphere from extraterrestrial sources. To approximate the efficiency of the detector at different zenith bands and energy ranges, IceCube collaborators create effective area plots which theorists use to calculate the expected number of events that IceCube will detect in a certain amount of time. Depending on the binning that is used to make the effective area plots, the approximation can be close or very far. This analysis seeks to understand and compare how good this approximation is with different possible binning. The results can either strengthen or invalidate calculations from already published effective area plots. Theorists will know how much they can rely on effective area plots for their interpretations. A simulated Monte Carlo Point Source data set was used to compare true event density with reconstructed event density from effective area plots of various binning. The analysis uses Python code to make ratio plots. It finds that larger binning contributes to inaccuracy at the edges of the detector range (north and south poles, high and low energies). It also provides a parameterization for effective area that represents true event density more accurately than the smallest binning of normal effective area plots.

Optical Calibration Testing for the PROSPECT Detector

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The PRecision OScillation and SPECTrum Experiment (PROSPECT), is a two-phase, short baseline, reactor neutrino experiment focused on measuring the flux and energy spectrum of antineutrinos emitted from nuclear reactors to find an explanation for the neutrino flux deficit in past neutrino experiments. The PROSPECT detector uses photomultiplier tubes (PMTs) and a segmented design to detect photons emitted through neutrino interactions. Reflector panels, held together by pinwheel-like connectors, segment the detector into cells. To accurately calculate the location and energy of neutrino reactions, we must develop a calibration system that reaches the PMTs in each cell of the detector. Part of this system involves optical calibration which uses short laser pulses to mimic the signals we expect to see in the detector. Some pinwheels will be modified to act as light diffusers for its adjacent cells to transfer pulses from a known location in the detector. We performed various tests on single-mode, optical fibre, splitters; an attenuator; and a prototype pinwheel diffuser. These tests were used to understand the effects of environmental factors, the difference in glass and plastic fibre, and the distribution and loss of light through a pinwheel diffuser.

LSST Quasar Identification

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We present an investigation into how well quasars with similar 'colors' but different redshifts that would otherwise appear degenerate in redshift can be distinguished using the differential chromatic refraction, or DCR, effect and the baseline observing plan for the upcoming Large Synoptic Survey Telescope or LSST project. Quasars are galactic nuclei that are actively accreting matter into the supermassive black hole at their centers. Continuing the work done by Dr. Christina Peters, our aim was to identify conditions under which the DCR method would be ineffective at distinguishing quasars. When the LSST project begins, the astrophysics community will need to be ready to begin analyzing the data immediately. Our work will allow us to know if the data we receive can be interpreted or not. By simulating random noise, we created a realistic distribution to represent the behavior of a theoretical quasar. Then, we utilized two statistical tests, the Kolmogorov-Smirnov and Student's-t tests, to determine from the simulated data whether two theoretical quasars would be distinguishable. These tests produce probabilistic expressions of how likely it is that the two quasars are the same. In our investigation, we show that, over the full 10 year run of the LSST, the DCR method is effective at distinguishing quasars of similar 'colors.'

Implicit Solvent model for Lipid Bilayer membranes

Lipid Bilayer is a thin polar membrane, made of two layers of lipid molecules. It is a part of the cell membrane of almost all living organisms. Membranes represent a diffusion barrier between intracellular and extracellular environment for transport of ions and proteins.

In this abstract, a simple method for modelling and simulating coarse grained lipid molecules is introduced using an implicit solvent. Lipids are represented by one head and two tail beads.

The stabilization of the lipid is due to the potential width between the tail beads, Simulations on 10,000 lipid molecules were carried out over 10 potential widths, and 10 temperatures for each potential width. Efficient Discrete Molecular Dynamics was used to carry out the simulations. For each simulation we recorded the energy vs time graph and the final state of the lipid bilayer as depicted by the Visual Molecular Dynamic software. The results can be used to determine characteristic properties of lipid bilayers as phase transitions between gel and liquid phases over a period of time. These preliminary simulations will be used as a control for developing a more sophisticated lipid model which can be combined with a protein model to study protein-membrane interactions.

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Do YLS Scores Predict Recidivism in Youth?

Many juvenile justice agencies administer risk/needs assessments to newly referred youth to identify their risk for reoffending and rehabilitative needs, and to inform intervention decisions. These agencies frequently utilize the Youth Level of Service Inventory (Hoges & Andrews, 2002) (YLS), a widely accepted measure of youth's needs and risk for reoffending; however, recent research indicates mixed support of the instrument's ability to predict recidivism (Rennie & Dolan, 2010; Chu, Goh, & Chong, 2015). The current study utilized data from 77 youth (76.60% male) discharged from probation in 2014 to further examine the relationship between YLS scores and subsequent juvenile court referrals, with the expectation that higher total YLS scores would be associated with a greater number of subsequent referrals. An OLS multiple regression revealed that total YLS score (b = .04, p < .05), was a significant positive predictor of number of subsequent juvenile court referrals, when controlling for gender and age at examined referral. These results support the inventory's predictive accuracy in a juvenile justice sample; however, further exploration of gender differences may be warranted. Additional implications, limitations, and future directions will be discussed.

An Analysis of Strategies to Improve Emotion Regulation and Reduce Emotional Eating

Emotional eating, characterized by eating in response to emotions, is an eating behavior that is associated with both obesity and eating pathology. Emotional eating, which may arise due to poor ability to regulate emotional states, can have undesirable outcomes, including weight gain and poorer outcomes in behavioral weight loss treatments. Prior research has indicated that participation in comprehensive emotion regulation treatment programs has yielded reductions in emotional eating, however, ambiguity lies in the effectiveness of the individual component strategies and skills that comprise emotion regulation. This study breaks down the core facets of emotion regulation into three component strategies, Distress Tolerance (DT), Emotional Awareness (EA), and Down Regulation of emotions (DR), in order to determine the individual effectiveness of each strategy as it relates to improvement of emotion regulation and reduction of emotional eating. Participants were assigned to one of three behavioral treatment workshop described above and asked to track their eating behaviors and emotional experiences over the course of two weeks. Data collection is still ongoing, but the initial findings of the study will be discussed in the poster presentation. Determining the effectiveness of the individual components of emotion regulation allows for future refinement of emotion regulation-focused therapy and increased efficacy of treatment outcomes for emotional eating.

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Coding Mind Minded Statements: A Study of Parents and Children with Down Syndrome

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Down Syndrome (DS) is a neurodevelopmental disorder occurring in 1/691 live births (Parker et al., 2010). Characterized by impaired cognitive and social functioning, children with DS often have intellectual disabilities and developmental delays, including impairments in executive function (EF). EF is an umbrella term referring to higher-level cognitive skills crucial for carrying out complex behaviors (Miyake et al., 2000). The majority of research on EF skills in DS focuses on child characteristics, with little attention paid to social factors that influence EF development. One such factor is parenting style. While there is a large body of research on the relationship between EF and parenting style in typically developing youth, there is no research that explores this relationship in DS or other groups with intellectual disability. Such research may provide useful insights into parenting behaviors that may be the target of intervention to help to improve cognitive outcomes in youth with DS. In the current research, we will be investigating the relationship between EF in children with DS and parent use of mind-minded comments, comments that explicitly refer to the child's internal state (e.g., "You remember going to the farm.", "You'll like this book.", "You're excited."). In this poster, the coding scheme to be used to quantify parental mind-mindedness will be presented.

Maternal Sensitivity: A Summary of Coding Measures

"Executive functioning" (EF) is the term used to describe a set of cognitive processes such as working memory, planning, and problem solving (Miyake et al., 2010). Impairments in EF result in difficulties performing activities of daily living. For children, EF problems may manifest as difficulties beginning and completing schoolwork or chores at home. Research on typically developing children has noted relations between different parenting behaviors and EF (Bernier et al., 2010). One such parenting behavior is maternal sensitivity, which refers to "the reactions to young children parents display in the context of everyday dyadic exchange" (Bornstein, 2007, p.190). Despite research suggesting ties between maternal sensitivity and EF within the context of typical development, research with children with Down syndrome, a group of individuals who have well-documented EF deficits (Lee et al., 2011), is scarce. The goal of this study is to understand relationships between maternal sensitivity (and other parenting behaviors) and EF skills in children with Down syndrome. My project is focused on reviewing the existing literature on maternal sensitivity coding schemes and determining which measure will be most appropriate for future use. Once measure selection is finalized, I will prepare a manual and coding forms to be used for the ongoing study.

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Power Up: Privatization, Politics and PGW

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Discussions to privatize the Philadelphia Gas Company (PGW) began in 2005, but did not come to the forefront until 2014. Opening its doors in 1836, PGW is the largest, city owned gas company in the United States. Through archival research and content analysis of media stories, government documents, organizations' public statements, and press releases, the full story of potentially privatizing PGW unfolds. Organized labor, green organizations and city council were all against the sale, citing concerns about workers' jobs and benefits, and environmental impact. Mayor Nutter and other gas companies, such as UIL, were in favor of privatization, highlighting economic benefits. The media coverage of the sale of PGW peaked in 2014, focusing on a lack of public hearings and the effect it would have on citizens. This study demonstrates how political processes are enacted. Although municipally owned, there were no public hearings about the utility's sale. Moreover, city council effectively used a backburner technique, ending the deal by letting the timeline run out and refusing to put the issue to a vote. Finally, although not highlighted in the media coverage, the attempt to privatize PGW would have supported the expansion of Philadelphia's role in the fossil fuel market by giving it access to resources, power, and a vision of a larger market and lay the foundation for attaining public utility status and furthering gas line production.

HIV/AIDS and Race in U.S. News Media Coverage, 1981-2015: Content and Textual Analysis

Previous researchers have shined a critical light on the print media's coverage of HIV/AIDS within America. During the 80's and 90's there was a tradition amongst researchers of studying segments of print media coverage and critiquing the disease discourse for moral, cultural and political themes. Even as HIV/AIDS rates steadily increased among racial minorities in the U.S., such scholarship has waned. There has yet to be a longitudinal study of print media coverage of HIV/AIDS particularly centering representations of race. Existing research has failed to track, analyze and correlate for changes pertaining to how the media uses race in discussion of the disease over the now 35-year epidemic in the U.S. As part of our larger project that charts and examines the salience of race over the course of the HIV/AIDS epidemic in the United States, we've been conducting a content and textual analysis of The New York Times, The Washington Post, The Atlanta Journal Constitution and The Philadelphia Inquirer. We're particularly interested in tracing and contextualizing their representations of black Americans, relative to HIV/AIDS.

Turo Boyiri

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Global Studies: Justice & Human Rights

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HIV/AIDS Education for the Casual Hookup Generation

The problem that this study addresses is the lack of conversation surrounding HIV/AIDS in our millennial-driven casual hookup culture. The purpose of this study is to pragmatically explore the potential ways to make millennials, especially on college campuses, more aware of HIV/AIDS transmission. To collect data, there will be a case study on Drexel University's campus surveying students on four things: their knowledge of HIV/AIDS and other STDs; their estimated likelihood of contracting a STD, versus the reality; the education they receive on sexual health at Drexel University; and their experience with hookup culture, specific to their college campus. In addition, the survey will request the gender, sexual orientation, ethnic background and, if relevant, greek affiliation. After the data is collected, the surveys will be analyzed to determine the campus' sexual health education, or lack thereof, the trend group that seems to be the least informed, and the student's trend opinion on hookup culture. If the results demonstrate a lack of education it will help to determine what can be done on Drexel's campus to prioritize the conversation surrounding HIV/AIDS, as well as other sexually transmitted diseases common to college campuses.

Agent control loop and execution monitoring on hybrid domains

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Robotics research is mostly focused on solving mechanical and lower level control issues, but robots also need refined reasoning skills to interact effectively with the environment. Cognitive robotics aims at endowing robots with such abilities by uniting research on robotics and artificial intelligence (AI). Research in AI has yielded the ability to reason about changeable environments, including planning series of actions and explaining unexpected observations. These features have been integrated in control loops for agents, also called agent loops. However, the gap between such loops and implemented robots is still considerable.

Recent efforts by researchers have focused on bridging this gap. However, researchers still rely on many simplifying assumptions such as the environment only changes due to the robot's actions or that the attributes of the environment can be heavily discretized. These assumptions render the resulting robots inaccurate in the real world. The aim of this project was to take a step towards lifting these assumptions. We studied the state of the art in agent control loops and execution monitoring for robots. We achieved our goal by researching on leveraging recent advances in planning systems to develop an agent loop capable of handling environments where changes occur spontaneously and which require reasoning about attributes with continuous domains. We tested the agent loop on the Pioneer robot and conducted experiments to demonstrate its abilities.

Applying TableILP to the Question-Answering Pipeline

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Natural language processing is a field of computer science that aims to develop algorithms capable of understanding human language. Question answering (QA) is a natural language processing task that uses computer algorithms to answer natural language questions.

There are several core tasks that a QA system must perform; this sequence of tasks is often referred to as the QA pipeline. Quails is a modular QA framework under development at Drexel University. Quails breaks down the QA pipeline into individual modules that the user can customize to prototype end-to-end QA systems.

The goal of my research was to develop an answer selection module for Quails. I studied and adapted an approach recently proposed by researchers from the University of Illinois and the Allen Institute for Artificial Intelligence. The approach, called TableILP, answers multiple-choice questions, by reducing the task to that of solving an integer linear program.

When fully integrated in Quails, the module will use the natural language question and the candidate answers produced by other modules in the Quails pipeline to construct an equivalent multiple-choice question that can be processed and solved using techniques derived from the TableILP approach.

My work during the research period involved familiarizing myself with natural language processing and the Quails QA pipeline. I also studied the TableILP algorithm, implemented it within the pipeline, and conducted experiments to test effectiveness.

Automated Visualization and Evaluation of Experimental Plan Recognition Data

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Plan recognition is a research area which falls under Artificial Intelligence and is defined as identifying the actions and goals of one or multiple number of agents based on a series of observations of the agent's actions. Dr. Geib and his team of graduate students work on plan recognition system called Engine for LEXicalized Intent Recognition (ELEXIR). The use of this software results in the output of files containing thousands of explanations. The fact that each explanation consists of initial and final states (before and after running the software), as well as the likelihood statistics and roots for that explanation, makes it very difficult for a human to manually differentiate between multiple explanations.

Therefore, I have developed an application that aids the visualization and analysis of data output from ELEXIR. The application displays the most crucial information about each explanation in separate units, making the data easy to visualize. The application will be able to sort the explanations in order of their likelihood so that the most relevant ones can be accessed quickly. It will also allow the team to search among explanations for certain patterns and highlight the differences between two or more explanations. With this application in hand, the team will be able to use the results from ELEXIR in a more efficient manner.

College of COMPUTING & INFORMATICS

Adversarial Stylometry

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Some of the major problems of our academic and corporate environments include plagiarism, copyright infringement, and intellectual property disputes. Source code authorship attribution has immediate implications for the security community, particularly in its potential to significantly impact applications like software forensics, plagiarism detection, and determining software ownership. While work on stylometric attribution has achieved great results attributing system and application programming languages, other types of languages such as scripting languages used for client-side web developments remain in need of further exploration. In this work, we will present a technique for authorship attribution of source code written in the common scripting language JavaScript, such as can be acquired through web page source code. We will perform authorship attribution using features derived from the abstract syntax trees, and will show that the techniques developed for attributing code written in languages such as C++ are generalizable to other types of programming languages.

Interacting with J-Bob

Guruansh Singh

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This project develops a tool and explores strategies to assist students in learning how to derive formal proofs about software systems. Modern society relies on computer software to function and the correct operation of software systems is essential. Computer bugs can have costly consequences and are difficult to detect and fix. Traditionally testing, running programs with different inputs and operating scenarios, is used to find errors in software; however, since there are infinitely many cases to test, systems can not be verified through testing.

Alternatively, it is possible to provide mathematical proofs that a software system is correct. The adoption of such strategies has been limited due to the difficulty in applying formal proofs to real-world software systems, the lack of good proof tools and the fact that students have not been trained to use such techniques. However, recent progress in the underlying theory and the development of tools called proof assistants has enabled these techniques to be applied to real-world software and taught as part of a standard undergraduate CS curriculum. In this project we develop an interactive tool, based on the J-Bob proof assistant, that allows students to more easily derive and explore inductive proofs about properties of recursive functions. The proof tool will be evaluated in the course Mathematical Foundations of Computer Science (CS 270), taken by CS majors at Drexel in their sophomore year.

Assessing Computer Interfaces to Enhance Creative Thinking

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The Drexel Advanced Interaction Research (AIR) Lab has been working to evaluate how computer systems can stimulate creative thinking in users. The AIR Lab is most interested in the different brain states that appear based on how actively an individual is generating new ideas as he or she performs a creative brainstorming task. This data is gathered using a lightweight, non-invasive brain imaging technology called functional Near-Infrared Spectroscopy (fNIRS). The fNIRS device can track oxygen levels in the bloodstream, which then give insight into how the brain behaves given the current state of the subject. The task is completed on a web interface that allows users to ask for more "inspirations" when they need a new idea. It also logs the timing of user interactions, such as when the "inspirations" button is clicked or how frequently ideas are submitted. By pairing this rich log data with fNIRS and other sensors that monitor the heartrate and eye movements of the users while they perform this task, the AIR Lab seeks to paint a complete picture of what happens during creative thinking.

The ultimate goal of this study is to improve interfaces so that they drive users to generate creative ideas that are richer in both quantity and quality. While computers and creativity have not always been intuitively associated with one another, the AIR Lab hopes to demonstrate that a finely tuned interface can prove useful to users who want to think creatively.

Using fNIRS to Study Brain Processes During the Use of Personalized Learning Environments

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Functional NearInfraredSpectroscopy (fNIRs) is an optical neuroimaging technique that has been used to measure brain activity in a noninvasive and portable way. Light sources and detectors are placed on the subject's forehead. Near infrared light travels through the bone and tissue into the cortex of the brain and is absorbed by oxygen within the blood. Some unabsorbed light reaches the detectors back on the surface of the head. The measurements of light can be used to calculate the oxygenation level, which directly correlates with brain activity and function. This technology enables the brain to be studied in realistic settings.

The goal of this project is to use brain data along with other biosensor and computer log data to analyze the way a student processes and understands problems to improve human-computer interaction. While using a computer tutoring system, the student completes math problems as fNIRS data is collected. By collecting information on the brain activity as students encounter and solve problems, the Drexel AIR Lab aims to improve personal learning environments and enable them to change according the needs of the student.

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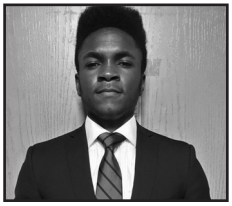

Enioluwa Segun

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Live Streaming and Analysis of Biosensor Data to Improve Human-Computer Interaction

Brain-computer interfaces and biosensors are now widely available, and could provide valuable information to an interactive computer, enabling it to better support the user's changing cognitive state. The goal of this project was to live-stream and analyze physiological data from a subject during studies in the Advanced Interaction Research Lab as he/she performs activities at a computer. The purpose is to determine how the brain reacts to tasking activities via changes in body variables. These include brain activity, heart rate, skin temperature, galvanic skin response (GSR), and eye movement. Understanding how the brain works during peak periods would help to create better systems that maximize user performance.

My task was to develop software tools that stream the data as it is collected, converging it into one database. I worked specifically with the Microsoft Band, which provides sensors for GSR, skin temperature and heart rate. Working with Java, Android SDK, and Band SDK, I built an Android app that directly taps into the Band data stream and sends the acquired data as Unicode over TCP/IP to a server program running on a PC. The server then uploaded to the database which ran queries to visualize the data side-by-side across time for easy analysis

Probabilistic Information Retrieval

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In today's digital world, we are constantly involved in the seeking, consumption, and generation of information. To satisfy our information needs, we need effective mechanisms to help us sort through billions of documents and identify the relevant. Information Retrieval (IR) is the research field focused on finding relevant information for users. Classic IR models include the Vector Space Model (VSM), probabilistic models based on the Probabilistic Ranking Principle, and their variations. These models have been shown in prior research to be effective and have been widely adopted in academia and industry.

In this research, we implemented a workflow to parse and index hundreds of thousands of documents from a benchmark TREC (Text Retrieval Conference) data-set and integrated three classic models, namely TF-IDF, BM25, and Divergence from Randomness, to experiment with their retrieval results. This implementation is based on a Java search engine library called Apache Lucene. Ultimately, we are creating a variation of BM25 based on a term weighting scheme derived from the Least Information Theory (LIT) and plan to compare its effectiveness with existing classic models.

Merlin Cherian

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Designing a collaborative system to improve family-school partnership in special education

Family-school partnership has been linked to better student outcomes in special education. Effective partnership includes communication, sharing perspectives, and empowering parents to participate in decision-making. School staff members have traditionally used paper reports to communicate with parents. However, preparing individualized reports is time consuming for school staff. On the parents' part, they find that these reports are not detailed or reliable enough to help them understand their child's progress.

The goal of this research is to develop a web application to foster family-school partnership. We are extending Lilypad, a data collection and analytics tool for school staff, with a parent-side application which will support family-school partnership in three ways: (1) consistent e-delivery of reports aiding long-term progress monitoring, (2) detailed behavioral reports with easy comprehension and (3) instant messaging for effective communication.

Our user-centered design approach involved a literature review on family-school partnerships, the existing methods of communication and information exchange, and their challenges and barriers. Using inductive thematic analysis, we compared our findings with data from five interviews with parents of children in special education. We also performed requirements elicitation with two school staff members to understand the school perspective. Our emergent themes led to an informed ideation of features to address the needs of family-school partnerships. The result of this work is a functional prototype, Lilypad Home, which has been developed following expert usability evaluation, and will be used in future deployment studies.

SbSI Microrods as a Ferroelectric Solar Cell Absorber Material

Solar photovoltaic energy is a clean and renewable source of electricity that has been researched heavily over the past 30 years. However, cost, toxicity, and rarity of precursor elements still limit widespread implementation of current technologies. Solution processing of these materials, such as hydrothermal synthesis, is desirable due to its low cost and scalability. Yet, these methods generally produce materials of lower electronic quality with defects and impurities that can limit carrier collection. Ferroelectrics may be able to withstand such drawbacks because of an internal electric field that can effectively separate carriers to reduce recombination rates. Antimony Sulfoiodide (SbSI) is a relatively unstudied ferroelectric with promising properties for solar cell absorber applications.

In this work, the semiconductor SbSI was synthesized hydrothermally to produce crystals that were 650 microns long and 30 microns in diameter on average. These microrods were synthesized from a published procedure, but had variances in pH and seeding, where a decrease in pH increased crystal size. Scanning electron microscopy (SEM) showed SbSI is highly crystalline, while X-ray diffraction (XRD) confirmed the phase purity. Diffuse reflectance measurements for Tauc plots estimated an indirect band gap of 1.85 eV. Current work on measuring the carrier lifetimes and mobilities via ultrafast terahertz spectroscopy will help evaluate further pursuit of SbSI as an absorber material.

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Carrier Dynamics in $LaFeO_3$ Thin Films

With the continuing depletion of nonrenewable energy sources, the demand for solar energy is rising. Perovskite oxide thin films are a promising material system that could advance technological progress in solar cell design, as little is known about their photovoltaic properties. They have a band gap in the visible range and are composed of non-toxic and chemically stable elements. These perovskite films are grown via molecular beam epitaxy by Prof. Steve May's group (Drexel MSE). The carrier lifetimes and recombination mechanisms were studied by using ultrafast optical probe-pump spectroscopy. This method uses a single wavelength pump pulse which is fired into a material to excite charge carriers (electrons) across the band gap. A probe pulse is fired after a time delay to study the relaxation of photoexcited carriers. The data is obtained in terms of energy-resolved change in the reflectivity of the sample after excitation and then fitted to a recombination-diffusion transport model. In the model, parameters were set to study surface, trap-assisted and Auger recombination that occur in the material. Surface recombination limited carrier lifetimes in the thinnest films (~5 nm), but lifetimes of nanoseconds could be achieved in films with thicknesses >40 nm. Despite surface recombination being the limiting factor, increased research into perovskite oxide thin films could lead to possible solutions on how to increase carrier lifetimes and improve solar cell performance.

Cesium Lead Iodide Perovskites

Perovskite-phase cesium lead iodide is a potentially low cost, easily manufactured alternative to current solar cells. To fabricate these photovoltaic materials, glass slide is first spin coated with a thin film of cesium lead iodide. Initially, it is in a yellow, amorphous, nonconductive phase. After annealing at 350 °C the material crystallizes into a black, polycrystalline, conductive phase. One objective of this work is to optimize electron transport in the film by increasing the size of crystal grains and their connectivity. To achieve this, the spin sped and temperature of deposition are optimized. It is shown that cesium lead iodide grains are most continuous when spin casted at 1000 revolutions per minute at room temperature. A second objective is to better understand the known metastability of the desired black, perovskite phase, which at room temperature can spontaneously convert to a non-conductive, yellow phase under ambient atmosphere. This metastable phase can be reached by rapidly cooling the thin film while in black phase. Through in situ spectroscopic monitoring at elevated temperature, it is determined that the metastable black phase changes back into yellow phase at 150°C.

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Electrophoretic Deposition as a Method for Manufacturing Solar Cells

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First used commercially in the automotive industry, electrophoretic deposition (EPD) is an established, scalable method for applying coatings to conductive substrates via an applied electric field. When paired with colloidal semiconductor nanocrystals, EPD is an environmentally and economically advantageous method for large-scale manufacturing of photovoltaic cells due to its reduced waste and higher throughput compared to alternative methods. However, EPD typically uses high voltages in order to increase the electrostatic force and rate of deposition. This is problematic for semiconductor nanocrystals as high voltages may damage the depositing nanocrystals. Our research focuses on engineering the surface properties of copper zinc tin sulfide nanocrystals and the EPD bath composition in order to lower the process voltage, thus preserving the semiconductor. A new reactor was designed and implemented in order to directly observe the deposition process in situ. An automated amperometry apparatus was made to quantitatively measure the current that goes toward depositing the films during EPD. Theoretically, this current directly corresponds to the number of nanocrystals deposited. Therefore, by integrating the recorded current and comparing it against film thickness, we quantified the efficiency and the presence of additional electrochemical side-reactions that accompany the EPD process.

Studying Effect of Electrospinning Polymers for Organic Photovoltaics in Nitrogen Atmosphere in Handcrafted Glove Bag

Organic photovoltaics (OPVs) are promising alternatives for traditional photovoltaics due to their higher flexibility, low material cost, and simple solution processing. OPVs are yet to be industrialized on the same scale as silicon PVs due to challenges in controlling the structure of the active materials (most commonly studied, P3HT:PCBM). For optimized OPVs, the nanoscale architecture requires: 1) P3HT and PCBM phase separation on the order ~20 nm for charge-separation (converting light energy to free electrons); 2) continuous pathways of each phase for charge collection (to generate electricity in external circuit). Conventional methods provide no control over this architecture. Electrospinning is a simple nanofiber fabrication technique that can yield architectures with nanoscale phase separation and induced crystallinity (improves electron transport). The fiber morphology is dependent on factors such as voltage, atmosphere, and concentration. To understand these process-structure relationships, we first electrospun a simple polymer, polyacrylonitrile (PAN). For the second part of our work, we studied the effect of electrospinning in nitrogen atmosphere on fiber morphology. To do so, we built an electrospinning system within a glove bag to isolate from atmosphere and filled the bag with nitrogen gas. We characterized these materials using scanning electron microscope and X-ray diffraction for morphology and optical absorption spectroscopy for optical properties.

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Enhancing Oxygen Kinetics through Surface-Electrolyte Reactions

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The greatest loss of efficiency in batteries is due to slow oxygen catalysis. The ability of this catalysis to speed up is limited, because even an ideal catalyst operates only at 80% efficiency. This project aims to study the interactions between surfaces and electrolytes in hybrid aqueous/nonaqueous electrolytes as a potential method to enhance oxygen kinetics. For this STAR project, $LaNiO_3$, $LaMnO_3$, and $LaCrO_3$, were synthesized in order to test their performance for the oxygen reduction reaction (ORR) and oxygen evolution reaction (OER). Catalyst ink formulations and electrochemical testing methods were optimized. Resultantly, it was discovered that electronic conductivity is limiting for the aforementioned catalysts and that in initial testing methods the catalyst was reacting instead of oxygen/water. The effects were analyzed using cyclic voltammetry aided by the implementation of the Python-based module, Catalysis Microkinetic Analysis Package (CatMAP). This module was used to understand the effects of catalyst binding energy on rate and coverage. These tools allowed for better observation of the specific roles that the surface and hybrid electrolytes, such as acetonitrile, play in this reaction. Improving oxygen catalysis will improve fuel cells and batteries with many environmental benefits.

Synthesis, Characterization, and Performance of Carbonaceous Electrode With Functionalized Carbon Surfaces

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There is an urgent need to develop a new energy storage system beyond Li-ion batteries. Sodium-ion batteries have high potential to perform as reversible intercalation compounds based on earth-abundant elements. However, the problem lies on the current lifetime and stability of sodium-ion battery. This can be improved if the electrolyte degradation products form a passivating interfacial layer (SEI). Therefore, this STAR project investigates potential methods to engineer the surface chemistry of carbonaceous electrode that will improve the stability of sodium-ion SEI.

Two projects were performed to aid the advancement of this endeavor. The first project was to deduce electrochemical stability of different carbon surfaces in Sodium-ion battery system. The result shows that none of the working electrode forms electrochemically stable products. Second was the synthesis of carbonaceous electrode and modification of HOPG surface chemistry through oxidation using HNO3 with varying pH levels. Cyclic voltammetry tests were conducted on all three samples. However, none of them produce any passivating effect. On the contrary, as the charge and discharge cycles repeat, the surface of the working electrode becomes increasingly rougher.

Out of all the tests, HOPG without any modification is shown to be the most electrochemically stable system, followed by HOPG oxidized with moderately acidic HNO3 with NaOH treatment, then HOPG oxidized with highly acidic HNO3 without NaOH treatment.

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Scaling up a High Density Bioreactor for the removal of nitrogen compounds

A High Density Bioreactor (HDBR) was used to cultivate a community of bacteria and algae that can remove nitrogen compounds from wastewater for growth. For this project, a synthetic mixture comparable to wastewater was used. Previous research showed that in a 1 L HDBR, algae aggregate and form a dense biomass zone, making it easier to harvest. The goal of this project was to scale up the HDBR from 1 L to 2 L and 5 L and investigate the effect of scaling up on nitrogen removal by the algae. Scaling up the HDBR to larger volumes is necessary to implement it at full-scale wastewater treatment systems.

The project entailed designing and building a 2 L and 5 L HDBR. The 1 L (R1) and 2 L (R2) HDBRs were made from modified glass graduated cylinders. The 5 L (R3) HBDR was built using a 34 in clear PVC pipe with a 4 in diameter. R1, R2 and R3 were inoculated with algae. R1 and R2 were operated in batch mode and after a 6-week start-up period, stable biomass in each reactor was formed. R3 was operated in continuous mode to aid in start-up. Future studies are planned to determine if the larger R3 operates similarly to R1 and R2.

Daily liquid samples from R1 and R2 were analyzed to measure the change in the concentration of nitrogen compounds during operation. Weekly biomass samples were taken to measure algal growth. Thus far, R2 shows more growth than R1 when the initial nitrogen concentration is similar.

Modern Methods of Bridge Inspection and Structural Condition Evaluation

This presentation will comprise an overview of Non-Destructive Evaluation (NDE), and various techniques used for testing bridges. Techniques included are Ground Penetrating Radar (GPR), Impact-Echo (IE), and Ultrasonic Surface Wave (USW) testing. More invasive testing methods such as taking cores or in other words drilling holes in a bridge can create focal points for damage at a later point in time, and necessitate further testing. As a result non-destructive methods have been adopted for inspections across the nation. The data sets presented are derived from testing performed on a bridge located in Mossy, West Virginia. Testing was performed to determine the degree of degradation; particularly delamination (separations within a bridge deck resulting either in the formation of separate weakened layers of concrete, or development of stresses due to the expansion of reinforcing steel due to corrosion). The purpose here is to elaborate on some of the various non-destructive methods and provide general knowledge of these techniques including execution, analysis, and results, as well as to consider possible actions to be taken in the future by local authorities overseeing the maintenance of this bridge.

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Energetic and Environmental Sustainability Analysis of Fuels & Vehicle Systems

Vehicles are the primary source for transportation across the globe. The majority of them are powered by the combustion fossil fuels which emits greenhouse gases and affect our environment. Before the introduction of the alternative fuel propulsion systems, it is necessary to know whether these new systems are more efficient and cleaner than the most common vehicle on the market- the ICE vehicle.

The objective of this project is to evaluate multiple vehicle-fuel energy systems (Conventional Gasoline, Diesel, PHEV, BEV, High Octane Fuel & Biodiesel) on a life cycle basis to compare their environmental performance. We analyze multiple vehicle propulsion systems along with the fuel (energy source and fuel type) on a functional unit basis of 1km driven and 1 MJ of "propulsion" energy and compare emissions of greenhouse gas and air pollutants, CO,PM_{10} , NOx and SOx content. Life cycle models were developed using data from literature and the life cycle assessment (LCA) tool known as the (The Greenhouse Gases, Regulated Emissions, and Energy Use in Transportation) GREET model developed by Argonne National Laboratory. For ethanol blended fuels, the GREET model evaluated different feedstock pathways used for ethanol production to analyze the most suitable feedstock which emits the fewest emissions in the vehicle operation stage. The project also studies the effect of different percentages of ethanol blends on the efficiency of high octane fuel (E25 & E40) vehicle systems. The goal of the two analyses is to find the most efficient and cleanest vehicle amongst a given size class.

Utilizing Autonomous Systems in the development of Textile antenna

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Despite the extensive research that has been carried out in textile antennas and wireless wearable sensors as well as the promising results that have been obtained, this field still holds great potential for new innovations. At Drexel, researchers are working to create a commercially viable biomedical sensor using textile antennas capable of monitoring subtle physiological activities like respiration and contractions. A significant challenge to this task is creating a wearable device that did not contain batteries and would also fit seamlessly into most attire. To accomplish this, the project encompassed theories and applications of RFID tags integrated into wearable fabric such that changes in the physical state of the device resulted in variations of signal transmission.

However, with any research, for there to be any practical applications that result into products there has to be reliable and accurate data collection and testing. Thus, this STAR project focused on creating an autonomous stretching mechanism and positioning system that could simulate human respiration and movement on the prototypes made in the lab. This testing apparatus will automate design evaluation and greatly facilitate the rapid testing of new wearable prototypes in a controlled manner. Overall this project has resulted in the expansion of knowledge and expertise in the area of wearables as well as the development of several prototypes.

BeamViewer Virtual Buttons (Augmented Reality)

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Augmented reality has changed the way humans view the world as it displays new information onto the existing world. BeamViewer, an app developed by the Drexel Wireless Systems Lab, helps users visualize how an electronically beam-steerable antenna works using augmented reality. The app controls the steerable antennas by linking with their respective radios in the cloud. Then it uses a phone's camera view to show the current direction of the electromagnetic signal. There are two possible directions that could be displayed: omnidirectional and directional. Omnidirectional is when the antenna radiates signals in all directions whereas, directional is when the antenna radiates signals in one single direction. The user could change the direction at which the antenna transmits signals manually. This project focused on using Unity to develop virtual buttons which the user could use to change the direction on the camera view itself. When the app is launched and the screen is pointed towards a marker, the virtual buttons will appear on the marker. The buttons act as toggles and change color when they are pressed. Wireless research and educations are often impeded from further progress by the fact that RF electromagnetic signals are invisible. BeamViewer helps users visualize the radiation patterns of the reconfigurable antennas in real time.

Packaging and Computer Controlled Challenges of Frequency Synthesizers over X- and K-bands using the Self-Injection Locked Phase-Locked Opto-electronic Oscillator Topology

An extremely low phase noise oscillator for telecommunication applications is being addressed through forced oscillation techniques. The forced oscillation technique used in this extremely stable oscillator is by combining self-injection locking (SIL) and self-phase lock loop (SPLL) as a Self-Injection Locked Phase-Locked Loop (SILPLL), where fiber delay lines are combined to cancel the spurious oscillation side-modes generated. A tunable frequency stabilized opto-electronic oscillator (OEO) is used through fiber delay lines and a high Q factor tunable microwave filter using Yittrium-Iron-Garnet (YIG) and optical transversal filter. The low loss from the optical fibers are needed for the required performance at microwave frequencies. The less phase noise in a system the better, because phase noise represents the power level of the sideband frequency that appears in the close-in and far away to the carrier, where the strongest signal power is obtained. The goal of this research is to have a 19 inch rack-mountable oscillator produce a frequency tunable clock oscillator signal within 9-11GHz (X-band for remote sensing) and 18-22 GHz (K-band for satellite communication).

Research done focuses on integration of electrical (for power and low frequency control), radio frequency (RF), and optical components in a mechanical housing using a number of commercially available products. Computer control enables frequency selection of the SILPLL based synthesizer for the user of the system.

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Holographically Formed Polymer Dispersed Liquid Crystals

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This research is focused on the fabrication, production, and optimization of holographically-formed polymer dispersed liquid crystals (HPDLCs). The HPDLC device is a filter for nanometer wavelength radiation such as the visual and ultraviolet bands of the EM spectrum. In other words, an HPDLC is a photomask; it finds usage in the semiconductor industry for photolithographic production of silicon substrates, as well as in areas requiring precise detection of specific wavelengths. The HPDLCs can be stacked in order to make several photomasks, preventing alignment error in the production of integrated circuits, or to select several wavelengths for detection, with a single device.

To accomplish the filtering, a liquid-crystal-state material is trapped in a polymer matrix, then cured and cross linked via lasing and exposure to UV radiation. In order to create this material, a mixture of several chemicals including the polymer and liquid crystal, a photoinitiator, and solvent, must be mixed together thoroughly. The mixture is then spin-coated onto a very clean glass substrate, and placed on a prism, which is exposed to a 5W laser. The research being performed involved the fabrication of these HPDLCs, testing for optical quality, and experimenting with new or improved methods of production.

Fellowship Application Manager

The Drexel Fellowship Office supports students across Drexel University in developing strong, competitive applications for merit-based or international fellowships. While the Fellowship Office is effective in assisting students, most help can only be given during designated drop-in hours, or in scheduled meetings. The Fellowship Office staff sought a better, more consistent method of tracking and giving feedback to applicants throughout their application process. With the assistance of the Drexel App Lab, a web application was developed to allow the Fellowship Office to track applicants' progress, access fellowship databases, and recommend resources such as peer reviewing and writing guidelines. The website is separated into two parts: a student portal for applicants and a faculty portal for Fellowship Office staff. Through the student portal, users are able to monitor their progress during the preparation of fellowship applications using a productivity tool. This tool allows users to mark completed tasks for the specific fellowship they are applying for, and access resources useful for certain application requirements (i.e., personal statements). Through the faculty portal, staff members are able to see a student's completed tasks, track application progress, and send appropriate feedback. Currently, the student portal of the site is in the final stages of development, and the next steps are to begin work on the faculty portal.

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Drexel University's 125th Anniversary Podcast

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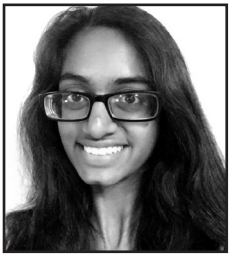
To celebrate Drexel University's 125th anniversary as an educational institution, Drexel's Department of History conducted interviews with various alumni, faculty members, and other notable figures. The Department of History partnered with the Drexel App Lab to create an engaging experience with these interviews, in the form of a podcast and accompanying website, for the Drexel community. A podcast is a series of audio files presented in a style similar to talk radio and made available on the Internet. Transcripts from each interview were annotated to outline audio clips that should be included. These clips were then rearranged into an order that aligned similar subjects and developed a narrative. The podcast is planned to be published in fall 2016 on the website SoundCloud. The website accompaniment will be hosted on WordPress, a website content management system. It will supply additional visual content for each episode pertaining to topics discussed during the podcast. Portions of the audio will also adapted for a Pearlstein Gallery exhibit, which will discuss Drexel University and its interaction with the surrounding neighborhood.

Design of Robotic Instruments



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Most research in robotics is applied in scientific disciplines, or aims to improve the efficiency of human labor. However, expressive robotics at the ExCITe Center strives to emulate and better understand human behavior and creative expression. This project explores the application of robotics in musical expression, enhancing the performance of music. My goal was to design and optimize a self-playing musical instrument using an Arduino, an open-source hardware platform for controlling physical devices. I created a self-playing tambourine and a xylophone with two robotic mallet-arms, both capable of playing MIDI (Musical Instrument Digital Interface) input through the use of a third-party software known as Hairless MIDI. This software can control multiple instruments at once, allowing for a synchronized performance. In addition, I programmed an Arduino-based microcontroller with a built-in accelerometer, called a LightBlue Bean, to recognize a burst of acceleration through a high-pass filter, which detects sharp changes in motion. This allowed for the development of a remote-controlled drum, which is hit when the Bean is shaken. All three of these instruments provide many opportunities for further development, whether the concepts are scaled up into a full robotic orchestra, or refined and mass-produced as musical toys for children.

Mobile Application for Drexel Recreation Center

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The Drexel Recreation Center is the fitness center servicing the students of the university and the surrounding Philadelphia community. In the past, members were unable to ascertain the availability of rental equipment until they were physically in the gym. In an effort to address this, an iOS mobile application was designed in partnership with the Drexel App Lab. The app will provide users with a convenient way to check the availability of equipment prior to their arrival at the center, and also make reservations for rooms and equipment. My main focus was on designing and developing the equipment availability functionality. The framework of the app was developed such that the user is able to view the availability of each equipment organised by sport. This will be followed by integrating an Application Program Interface(API) from InnoSoft Fusion which is a secure management software that monitors and reports analytics of equipment utilization at the Recreation Center. This provides an efficient way for the app to communicate and share data with the center's equipment management system. With continued development, this application will provide the users with a convenient method of accessing important information about the gym and improve a member's overall experience.

Citizen Scientist

Citizen Scientist is a Drexel affiliated project that allows a community of people, all from different backgrounds, to participate in scientific research regarding environmental conditions of remote sites in New York City. Participants' collected data is submitted through a website that enables users to upload information including water level measurements and observations of plant life for analysis. The focus of my project was to provide an update, which would yield a better user experience and improve the quality of the data submitted. One of the challenges with the website was that the there was no method in place to notify the scientists when a participant submitted new data. To address this, a notification system for administrators to be informed of new data submissions was implemented. Another issue was the limitation of only allowing participants to upload a single photo with their data. Additionally, the photographs that were uploaded by participants were placed in a single folder on the website. Therefore, a better photograph submission system allowing for multiple uploads, as well as improvements to the file organization were implemented. The results of these tasks, along with others, made the website more user friendly and enhanced the data submission process.

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Functional Leakage algorithms for FPGA

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Field programmable gate arrays (FPGAs) are reconfigurable circuits that implement a wide range of digital logic. There has been an exponential growth in the use of FPGAs in the past 10 to 15 years because of the re-configurability provided. Due to the widespread application of FPGAs in the digital field, there has been an increase in attacks that aim to reproduce and/or modify the logic implemented on the FPGA. The attacks require access to the bitstream for functional duplication and specialized equipment for invasive reverse engineering. There are several methods to counter attacks on the bitstream, including encryption and the use of non-volatile memory.

Our research explores a novel threat to FPGAs based on functional leakage, as well as corresponding counter measures. No knowledge of the bitstream is required for the execution of the attack. Access to the physical device is assumed as knowledge of the inputs and outputs is required. The aim of the attack is to recreate the functional netlist of the logic implemented on the FPGA based on knowledge of the inputs and outputs, structure of the given FPGA and the algorithms for logic placement and routing of the look up tables (LUTs). The attack algorithm is based on input to output recursive mapping of the LUT network for each output.

The goal is to explore the vulnerabilities of an FPGA with a protected bitstream and investigate attacks that are not based on bitstream manipulation. Based on the determined attack vectors, corresponding techniques to secure the FPGA will be developed.

Advanced Clock Tree Synthesis for Low power Systems

The clock tree for synchronous integrated circuits is a major determining factor in terms of both performance and power usages. Clock skew limits the max clock speed while the clock tree uses a large portion of the IC's overall power. Buffers are used in the clock tree to reduce the slew (rise time) of the clock signal but at the cost of more power consumption. To achieve proper and more efficient operation of the circuit, the slew needs to minimized. The novel approach explored is relaxing the slew constraint at the inputs of buffers. This method would require less buffers in the clock tree and therefore less power. Using a slew driven CTS algorithm with the relaxed buffer slew constraint, the amount of buffers needed was significantly reduced, up to 35%; however, this was achieved at the expense of using ~10% more wire. Using simulations, the overall power used by the tree was compared to the slew drive CTS algorithm alone. Reducing the power consumption of high frequency low power devices introduces significant implications for improving current technologies, from personal electronics to medical devices.

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Comparing Energy Recycling Logic for Speed and Efficiency

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Computing is ubiquitous, present in almost all aspects of life. Lower power processing with less heat generation is a constant goal which allows for faster, more energy-efficient computer chips. This is particularly true for mobile devices and embedded applications which have limited energy sources and heat dissipation capabilities. Energy recycling (adiabatic) logic is one way of achieving this ultra-low power, low heat operation. Traditional logic simply dissipates the energy used for calculations as heat. Energy recycling logic is reversible, allowing it to return energy back to the source to be reused in multiple calculations, reducing overall power draw and heat generation. The use of energy recycling logic is not widespread, however, because these benefits are generally limited to operation at low frequencies and speed is a major requirement of modern computing. The goal of this research was to simulate and compare several families of energy recycling logic using a 65nm process. The logic families were examined to determine their maximum speeds and to quantify their power savings compared to traditional CMOS logic at various frequencies. Maximum power savings of over 99% were recorded at 170 MHz for a single gate with continued power savings up to a speed of 4.25 GHz with average inputs.

High-Frequency Clock Tree Synthesis

With the incredibly high clock speeds desired in today's integrated circuits, any improvements in the clock tree's design can make a significant impact on the chip's maximum operating frequency. The clock tree distributes the clock signal to millions of points on the chip, which makes it computationally complex. Two main factors must be considered: that the time offset between the signal reaching different destinations, called the skew, and that the signal's rise and fall time, called its slew rate, are both low enough by the time the signal reaches its destination. Most previous works focused on skew at the expense of slew. Better designs can be found by calculating a permissible placement region that satisfies both slew and skew constraints for each node of the clock tree. These advancements will lead to integrated circuits that are both faster and more power efficient.

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Spin Coating and Characterization of Select 2D MXene Films

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MXenes are a family of 2D solids consisting of multi-layered or individual thin metal carbide or nitride sheets, that show promise for use as materials for batteries and supercapacitors, water remediation, hydrogen storage among many others. The different types of MXene are classified by their chemical formulas, generally taking the form of M_nX_{n+1}, where M is an early transition metal, and X is carbon and/or nitrogen. In this STAR project, different types of MXene of the form M_4X_3 and M_2X were synthesized with an acid etching process, and attempts were made to deposit these MXenes as thin films on glass slides via a process known as spin coating. Previously in literature, spin coating has been successfully done with Ti_3C_2 . In this project, spin coating of different M_2X1 and M_4X_3 MXenes that contain other transition metals, such as niobium instead of titanium, was attempted. Spin coated films of MXene have much in common with their bulk forms, but have a unique combination of electrical, optical, and mechanical properties. They are highly conductive, semi-transparent, hydrophilic, and when coated on a flexible substrate, even bendable. This may allow them to find use in the electronics industry as a material for flexible sensors.

Alkylammonium Cation Intercalation in Spincast Ti_3C_2 Films

Two-dimensional transition metal carbides, known as MXenes, are materials of much interest, especially in the area of intercalation (insertion between layers) of ions, with applications in batteries, capacitors and more. In this study we investigated the intercalation/diffusion of alkylammonium cations into Ti_3C_2 MXene spincast films on glass substrates. The films were submerged in solutions of two alkylammonium ions—tetramethylammonium (TMA) and dodecyltrimethylammonium (DDTA)—for various lengths of time ranging from 15min to 24h. Time dependence was examined with TMA; using X-ray diffraction (XRD) we found a slight but steady increase in the c lattice parameter (c-LP; MXene layer separation) over time. It was so slight, however, that the variance may have been due to initial c-LP differences between samples. Without further work, this relation is inconclusive. The spatial dependence of the intercalation was examined with DDTA. A slide soaked for 5h was probed on its edge and middle, showing a significant difference in c-LP, while a control and a film soaked for 24h in the same solution were uniform. This shows that ions diffuse from the edges of the film toward the center, rather than through pores or pinholes on the surface of the films. This technique can in principle be used to probe the uniformity and quality of MXene films.

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Mechanisms of cell recruitment in scaffolds using in vitro models

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Recently, porous biomaterial scaffolds have been used in situ to recruit and modulate immune cells for cancer therapy. However, the factors affecting cell recruitment and differentiation remain to be elucidated. This study aims to understand the mechanism of differing cell recruitment and differentiation within different scaffolds using in vitro models. In order to determine whether monocytes are recruited into scaffolds and then differentiated into dendritic cells, and how biomaterials affect these processes, both methacrylate-alginate (MA-Alg) scaffolds and methacrylate-hyaluronic acid (MA-HA) scaffolds were prepared and loaded with human monocytes to observe the generation of dendritic cells and any possible differences induced by scaffold materials. The scaffolds were fabricated via cryogelation in order to form a macroporous structure. Consequently, pore sizes of around 100 μm were observed using confocal microscopy. In the MA-Alg scaffolds, 45.1% of monocyte cells differentiated into dendritic cells, whereas the MA-HA scaffolds had a differentiation rate of 31.4%. These rates indicate the potential for monocyte differentiation within scaffolds. By determining crucial properties of scaffolds that allow for higher degrees of immune cell recruitment and differentiation, observations from this study will help to contribute to the anti-tumor efficacy of scaffolds in the future.

A supercapacitor-like Electrochemical Actuator Based on Titanium Carbide (MXene)

With a growing interest into robotics and potential biomedical applications of robotic assemblies, the need for more inexpensive and reliable materials grows to match the ever rising cost of such products. One of the major steps to making efficient robotics is to develop materials with robust actuation properties. Electrochemical actuators (ECAs), in particular, utilize an electrochemical reaction to as a stimulus to drive actuation.

ECAs based on two dimensional (2D) materials, such as graphene, are attracting numerous attention due to such unique properties and structures. However, electrical conductivity and bendability of pure graphene films are challenges that limits their performance.

2D based titanium carbide, discovered at Drexel in 2011 and known as MXenes, is one of the most promising candidates for ECAs. In contrast to graphene, MXenes films are not only highly flexible but they are metallically conductive.

In this research a supercapacitor-like ECA based on two MXenes films separated by an aqueous solid-gel electrolyte are designed and used as ECAs. Surprisingly, MXene showed a displacement of 1.5 mm and 4 mm at small applied voltages $\pm$0.2 and $\pm$0.4V respectively. This displacement are ten times higher than graphene based materials and opens a new venue of developing micro-robotic arms or micro-cranes that can be powered at low voltages.

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The Application of MXenes toward Future Development of a Wearable Artificial Kidney

Chronic Kidney Disease (CKD) is a debilitating problem that currently plagues more than 10% of the global population. CKD occurs when the kidneys are unable to properly filter out the body's naturally produced metabolic wastes and may develop into end-stage renal disease (ESRD), whereby total and permanent kidney failure occurs. Limited kidney transplant availability entails kidney failure treatment through Continuous Ambulatory Peritoneal Dialysis (CAPD), whereby blood is artificially filtered over a 4-hour duration for 3-4 days of the week.

Since CAPD results in restricted mobility for patients, the development of a Wearable Artificial Kidney (WAK) that would enable continual dialysis while providing patient mobility, has been long regarded as the fata morgana of kidney nephrology. Current WAK models have focused on adsorbing a metabolic waste product known as urea. Urea is difficult to adsorb since it is chemically unreactive, and typical materials such as activated carbon and graphene nanoplatelets have been used with little to no effect.

However, the Drexel Nanomaterials Institute's (DNI) discovery of a family of 2D materials known as MXenes, can help solve this problem. My project focuses on the MXenes' urea adsorption properties using Nuclear Magnetic Resonance (NMR) spectroscopy as qualitative analysis and quantitative determination using urea assay kits. This study may accelerate the development of an efficient miniaturized wearable artificial kidney in the future.

Redox Active Hybrids for Energy Storage Applications

Supercapacitors and batteries are effective energy storage devices. Batteries usually rely on inorganic materials which are mostly expensive and not an ecological option for the future. While inorganic electrode materials already demonstrate superior performance for energy storage applications, electrochemically active organic compounds are gaining recognition in this field as well. This is mainly due to their low cost, sustainability, structural diversity and compatibility with conductive substrates.

The challenges, however, with organic molecules are their poor conductivity, low capacitance retention, and tendency to dissolve in organic electrolytes. The idea of this STAR project was to incorporate organic molecules on 2-D conductive substrates to produce high capacity electrodes to combat these very problems.

For the purpose of obtaining results within the given time frame, certain bounds were placed to narrow the focus of the project. Thus, this project was carried out with the intention of studying the electrochemical properties of one out of multiple commercially available organic molecules. This organic compound was combined with two different kinds of conductive substrates - titanium carbide (MXene) and graphene and tested with both coin and Swagelok cells in different ratios. Though improvements were seen in charge storage capacity of the hybrid material in a sodium ion battery, degradation due to dissolution of the active material was still observed.

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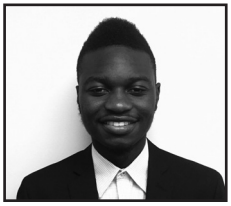

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Improving Electrochemical Capacitors using Multivalent Ion Electrolytes

As the world changes, technology changes with it. These changes in technology have brought about faster, more powerful systems like airplane doors, transit buses and cranes that have special energy needs. Such energy needs include high cycle life or charge/discharge times of 1 second, or less. There has therefore been need to move from the traditional means of energy storage, the lithium Ion battery, to a more efficient means than can satisfy these requirements - electrochemical capacitors (ECs).

Due to increased demand for high performance electrochemical capacitors, there is a need to improve the amount of charge stored by ECs. One way being investigated to achieve this is the use of multivalent ion electrolytes in place of the much accustomed monovalent ion electrolytes. Faraday's law states that an increase in the valence number of ions leads to a corresponding increase of charge, which is directly proportional to capacitance. In theory, this would result in an increase in charge stored by electrochemical capacitors, improving the total energy possibly stored in these devices.

Admittedly, there has not been much research in this area, but the attention being given to it is encouraging. This work is therefore aimed at improving electrochemical capacitors using multivalent ion electrolytes, or providing an explanation for any possible deviation from what is expected theoretically.

Recycling energy from heat

Development of new methods of energy generation for meeting the growing energy needs of our society is an active area of research in the energy conversion and storage field. A relatively unexplored method of energy generation is the conversion of low-grade heat into electricity. Thermoelectric devices based on the Seebeck effect (the generation of electrical current when a temperature gradient is applied to dissimilar semiconductor materials) have been explored for this application, but thermoelectrics are expensive and time consuming to manufacture. Carbon materials are abundant and easily processed to have properties tailored to specific applications. Using carbon for such energy conversion devices could make them more suitable for use in electricity generation. Carbon can be casted into films that can generate current via the electrokinetic (EK) effect. The EK effect is created by the flow of polar solvent molecules through a material which causes electrical charges in the material to move with the solvent. This flow of charge induces a streaming potential which can be used for useful work. The EK effect is driven by the transport and evaporation of the solvent from the material, this effect can be enhanced using a temperature gradient, similar to the Seebeck effect. This project aims at optimizing porous carbon films to make them suitable for energy generation. Various compositions for the films were tested in order to achieve an optimized device.

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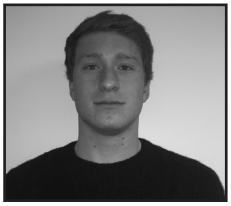

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Dynamic Damage Evolution of MAX Phase Ti_3SiC_2 in Lateral Confinement

Titanium silicon carbide (Ti_3SiC_2) is a member of a family of ternary carbides called MAX phases that exhibit both metallic and ceramic properties. Due to their nanolayered heterodesimic structure, MAX phases exhibit a unique failure mechanism of kink band formation via delamination and dislocation-based nonlinear elastic kinking. This study investigates the role of lateral confinement on the rate-depending compressive strength and damage mechanisms of fully dense Ti_3SiC_2). A standard material test frame is used at $10^1 s^{-1}$ for quasi-static investigation, and a Kolsky (or split-Hopkinson pressure) bar at $10^3 s^{-1}$ is used for dynamic investigation. A novel planar lateral confinement device is used to induce a low (150 MPa) and high (450 MPa) static compressive stress orthogonal to the test loading direction. High-speed imaging with a Shidmazu HPV-X up to 5 million frames per second, combined with digital image correlation (DIC) using MatchID software and a 3D printed material speckle pattern is used to track in-situ stress and strain evolution, and post-mortem scanning electron microscopy (SEM) is used to determine the magnitude of active microstructural deformation and failure mechanisms per loading configuration.

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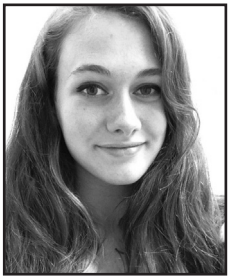
Pseudocapacitive Behavior of Bilayered $Na_xV_2O_5$ in Aqueous Cells

Owed to their high energy density, lithium-ion batteries have become a prevalent form of energy in the rechargeable battery industry. Since lithium is a material of limited abundance, beyond-Li energy storage devices are being explored. A hybrid of supercapacitors and batteries, pseudocapacitors are able to achieve high power and high energy density. Bilayered vanadium oxide is of interest in aqueous-based pseudocapacitors because of its achievable capacities in other beyond-Li energy storage systems.[1,2] Vanadium oxide typically dissolves partially in water, causing a reduction of electrochemical performance over time. The goal of this work was to stabilize the active material to prevent it from dissolving. Post-synthesis treatment methods and the effects of pH were investigated. Cells were run through 50 cycles and evaluated by their highest capacitance on the 2nd cycle, as well as percent capacitance retained after 50 cycles. Highest initial capacitances, above 160 F/g, were achieved for cells that were aged and annealed, while highest retentions were achieved for aged films. Cells performed better in more acidic electrolytes, which was in agreement with previous studies.[3] This work demonstrates the feasibility of post-synthesis treatment and electrolyte tailoring to increase stabilities of aqueous pseudocapacitor electrodes.

[1] Clites et al. J. of Mat. Chem. A 2016, 4 (20).
[2] Tepavcevic et al. ACS Nano 2015, 9 (8).
[3] Lee et al. J. of Solid State Chem. 1999, 148.



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Chemical insertion of Nickel and Cobalt ions into Alpha Manganese Oxides

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Portable electronic devices and electric cars have become increasingly popular over the years, and this has increased the demand and thus the price for Li-ion batteries. Therefore, alternative energy storage systems that are inexpensive are actively being investigated. One alternative system is Na-ion batteries because it functions via a similar ion intercalation mechanism to Li-ion batteries, and there's an abundance of sodium raw material that can be easily obtained. However, the challenges of Na-Ion Batteries are lower capacities and shorter cycle lives, which are caused by the larger size and weight of the Na^+ ions compared to Li^+ ions.

In this work, various chemical treatments such as hydrothermal treatment, aqueous solutions, and nitrate melts were used to intercalate Ni^{2+} and Co^{2+} ions into α-MnO_2 nanowires to improve their electrochemical properties as Na-ion battery cathodes. Manganese oxides are of interest for batteries because they are low cost and environmentally friendly materials that can be used for numerous electrochemical applications. After chemical treatment, X-Ray powder diffraction (XRD) and Energy-dispersive X-ray spectroscopy (EDS) validated that $Ni^{2+}$and Co^{2+} ions were inserted into α-MnO_2 structure while maintaining the crystal structure. This work provides methods for chemical doping of α-MnO_2, which can potentially lead to the enhancement of performance in Na-ion batteries.

Electrospinning biocomposite keratin-based nanofibers for heavy-metal filtration

Keratin, a cysteine-rich protein primarily extracted from human hair and wool, has been proven to have heavy-metal absorption properties due to the potential for disulfide bonds from the cysteine. Electrospinning is a facile technique to produce nanofibers for applications such as tissue scaffolding, wound healing, drug release, energy storage and filtration. While keratin has been electrospun previously with synthetic polymers such as poly(ethylene oxide) and poly(vinyl alcohol), keratin cannot be successfully electrospun on its own. Here we investigate using natural polymers (NPs) gelatin, chitosan, alginate and pectin in NP-keratin blends in varying weight ratios to yield biocomposite nanofibers. The results show that NPs that are basic on the pH scale, gelatin and chitosan, aided in fiber creation and showed good uniformity in fiber morphology. Trends show that as the concentration of keratin is increased, the average diameter of the nanofibers increased from approximately 140 nm to 180 nm. However, the acidic NP-keratin solutions did not form fibers, possibly due to the inability of alginate and pectin to spin independently. This knowledge provides potential to reuse natural byproducts of commercial industries (such as the hair, wool and feathers from which keratin is derived, crustacean shells from which chitosan is derived and orange peels from which pectin is derived) as environmentally-friendly and cost-effective materials used in water filtration and purification.

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Electrospun Nanofiber Composites: MXene with Chitosan, Polyethylene Oxide, and Polyvinyl Alcohol

Electrospinning is a straightforward method of synthesizing nanoscale non-woven fibers from a viscous polymer solution. Electrospun nanofibers have a high surface-to-volume ratio and form porous mats, making them promising candidates for various applications including filtration, wound dressing, cell scaffolding, and for military defense. MXene is a two-dimensional transition metal carbide particle with high mechanical strength and electrical conductivity. This study explored for the first time the synthesis of polymer MXene composite fibers via electrospinning. Chitosan (CS), polyethylene oxide (PEO), and polyvinyl alcohol (PVA) solutions were electrospun with MXene particles. Fourier transfer infrared spectroscopy (FTIR) and energy-dispersive X-ray spectroscopy (EDS) were used to determine whether or not the MXene was electrospun with the fibers, and scanning electron microscopy (SEM) was used to determine the fiber morphology. The results show that MXene was successfully electrospun into the CS nanofibers. The results for the PEO MXene and PVA MXene composite nanofibers are promising and additional tests will be carried out to confirm the location of MXene in the nanofibers. Further studies will also be conducted to determine the percent distribution of MXene in the fibers and to analyze the mechanical and electrically conductive properties of these novel composite nanofibers.

Computational Analysis of Mg/Nb Nanolaminates

Hexagonal close-packed magnesium (HCP-Mg) has been experimentally shown to undergo a phase transformation to body-centered cubic (BCC-Mg) when combined with BCC niobium (Nb) in alternating layers within metallic nanolaminates. Computational studies have developed models to predict the approximate Mg layer thickness where this phase transformation occurs, and limited experimental evidence supports these findings. However, despite knowing the exact Mg layer thickness, there is a lack of fundamental understanding of the mechanisms that drive the phase change and what unique properties could arise from harnessing this transition. Using atomistic simulations and a newly developed embedded-atom method (EAM) potential to define the interactions between atoms, we investigate the governing processes and structure-property relationships within Mg-Nb nanolaminates, as a function of composition and layer thickness. Finding the layer thickness where BCC Mg is more favourable to HCP, and thus the thickness at which the phase change would occur, could possibly be found from several different metrics calculated from the simulations. Experimental evidence suggests that the interface between the Mg and Nb layers drives the transition in Mg as layer thickness continues to decrease. Our computational studies are aimed at uncovering the fundamental structure-property relationships within Mg-Nb nanolaminates and elucidating the interfacial influence on properties in nanoscale layers.

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Characterizing the Rheological Behavior of Novel Biomimetic Proteoglycans

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Proteoglycans (PGs) found within the body are responsible for encouraging cell growth, influencing collagen fibrillogenesis, and regulating skin tensile strength. These macromolecules are composed of protein cores with attached glycosaminoglycan (GAG) chains. With aging, enzymes responsible for breaking down PGs become more active, reducing the overall concentration of PGs in the body. Therapy designed to increase the concentration of PGs in the body is challenging because natural PGs introduced into the body are still susceptible to enzymatic degradation. Biomimetic proteoglycans (BPGs) can be created using an enzymatically resistant polyacrylic acid (PAA) core with covalently attached natural chondroitin sulfate (CS) bristles that mimic the three dimensional bottlebrush architecture and hydrating properties of natural PGs. In this project, the rheological behavior of aqueous solutions of CS and BPGs was characterized using small amplitude oscillatory shear on a DHR-3 rheometer in order to better understand the flow behavior and molecular structure of BPGs in solution. Experimental variables include the concentration of CS and BPGs (10 mg/mL, 50 mg/mL) dissolved in aqueous solution, ionic strength (0.1X PBS, 1X PBS), and two different PAA sizes (PAA10kDa-CS, PAA250kDa-CS). An improved understanding of the underlying molecular structure and flow behavior of BPGs in solution would enable us to better predict how these solutions will behave when introduced into the body.

Unmanned Aerial System for Infrastructure Inspection in GPS limited Environment

The United States has 611,845 bridges that require inspections at least once every two years. The traditional form bridge inspection is performed through visual monitoring by inspection personnel. This process is often time consuming, expensive, and provides qualitative data with subjective conclusions. In the near future, unmanned aerial systems (UAS) could provide another tool for inspection to make it faster and cost efficient. The focus of this research was on the position hold of a UAS in a laboratory setting without GPS in order to capture clear images of simulated structure. An optical flow camera and ultrasonic sensor were used to hold position using ground texture. This prevented the UAS from drifting during flight allowing for the capture of clear images. A quadcopter using a Pixhawk flight controller was leveraged to perform indoor testing. Qgroundcontrol and the PX4 flight stack were used to program the Pixhawk and integrate the optical flow camera. After achieving stable hovering, a GoPro was mounted on the UAS to obtain images. The images were corrected for lens distortion and processed to obtain data depicting the deformation of a simulated structure and compared to the results obtained by a string potentiometer.

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Analyzing Drop Impact Experiments on Lubricated Surfaces

Drop impact is relevant to natural processes such as rainfall and industrial applications such as combustion, cooling, and self-cleaning technologies. In particular, liquid infused surfaces (LIS) show promise for their repellent applications. However, the physics of drop impact on LIS are currently not well understood. In this study, the rebound dynamics of oblique impacts (45°) were examined through multiple experiments. Glycer-in-water solutions (20% - 100%) were dropped from various heights onto oil films (1000 cP) in order to produce varying velocities. The results of the experiments show that a droplet with low Weber number (0 - 4) and low Reynolds number (0-400) tended to bounce off the substrate. Droplets with high Weber number (10 - 38) and low Reynolds number (0 - 400) or with low Weber number (4 - 7) tended to deposit on the substrate. Jetting occurred for droplets with high Reynolds number (400-950) and intermediate Weber number (7 - 25). From this setup, the ratio between a droplet's impact velocity and maximum spread was also investigated, where for a lower Weber number (0 - 30), the droplets followed a universal scaling law, $^{R}max/R \sim We(1/4)$, where R_{max} is the maximum spread length of the droplet at impact, R is the initial drop radius, and We is the Weber number. However, for higher Weber number droplets (30+), the maximum spread broke away from this scaling. By understanding the complex nature of drop impact, we can create an ideal liquid repellent surface.

Airborne Self-Stabilizing Launch Pad

In mid-2017, Mechanical Engineering and Mechanics Department at Drexel University plans to host a student design competition that requires an airborne horizontally stabilized platform to deploy vehicles designed by high school and college students at the height of a 30-story building. Cars on the ground go on paved roads, which serve as a platform to provide a fast track. Unlike cars on the ground, these airborne vehicles are constantly affected by high wind due to the attitude. But like cars, these vehicles can be assisted by a platform to remain horizontal despite the constant high wind. The scalable 2-foot-by-2-foot Airborne Self-stabilizing Launch Pad is built to serve as a platform for air vehicles (payloads). Its two main purposes are to maintain both the payloads and the platform itself horizontally level in the midst of windy conditions and sudden gusts as well as being able to release the payloads individually via a radio controller. This is achieved by customizing the existing open source unmanned aerial vehicle (UAV) hardware and software platforms, also known as Ardupilot and Mission Planner, respectively. Pull-type linear solenoid actuators are used in conjunction with a bracket to hold the payloads in place and release them electronically. The lightweight carbon fiber platform, enclosed electronics, and payloads weigh less than 16 pounds in total, making it possible for the whole structure to be lifted by a single high-attitude balloon.

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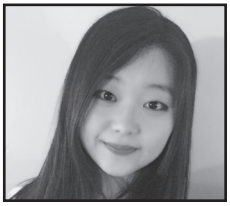

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Transformable Drop-Vehicle Design

The intent of this project is to design a 15 cm cube-shaped vehicle. When released from about 250 feet altitude, it would change its shape and autonomously land safely at a specified target. The initial purpose of the vehicle is to efficiently drop care packages to the precise destination as well as decrease the duration of the entire process. The drone is created from an original design, which is solely based on genuine ideas. Researching for parts and mechanisms of a drone for countless hours resulted in a basic knowledge of drones and how they operate. This allowed gathering parts and assembling the drone together in a more feasible manner.
The process begins with the cube mounting onto a platform that will deliver the vehicle to 250 feet above ground. Once the vehicle is released, the parachute attached at the top of the vehicle will launch itself, while deploying four propeller-mounted arms simultaneously, transforming the cube into a drone. As the parachute is launched, it will assist reducing the speed of the fall. The propellers on each arm will stabilize the drone as well as control the direction of its flight course. The drone is coded beforehand using software such as Mission Planner, which allows the user to assign a specific location for the drone to fly to as a target. The drone first operates autonomously; however, in case of any malfunction, the user then can switch to manual and fly the drone back to the home base or any desired location with the controller.

A Proof-of-Concept Example of Next Generation Ion Propulsion - It's Like a Warp Drive, Right?

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While unfortunately not a warp drive, Field Emission Electric Propulsion (F.E.E.P.) is a developing form of ion propulsion, and is considered an efficient means of controlling satellites' position via small, precise adjustments. That is, this is a thruster conceived to be used as a rudder rather than a sail, due to low thrust output, but high controllability. This type of propulsion works by taking advantage of the phenomenon of Taylor Cone formation. A Taylor Cone is the result of an electric field tearing at the molecules at the surface of an ionic liquid. Consider a small droplet. It will "stretch" as the field pulls on it, and eventually will rupture at a threshold voltage, as the force of the surface tension of the droplet has been overcome. At this point, a jet of charged particles will eject itself from it. On a larger scale, as is the case for this project, the liquid will form a cone shape, at the tip of which lies the ejection point of the propulsive jet. This is the method by which F.E.E.P. creates thrust.

While a finished thruster utilizes thousands of emitter needles, this project, as a proof-of-concept, uses only one. Measurement of this needle's output, via mass flow rate and current collected from the ejected ions, will provide thrust and efficiency data, as well as offer insight into the best paths to developing a thruster suitable for use on satellites, especially small satellites called CubeSats, which are becoming popular at universities.

Origami Solar Panel Deployment

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Cubesats represent one of the most promising areas of development in the spacefaring world as they can be commissioned for a fraction of the cost of full-sized satellites while still proving information and a platform to conduct tests. The understanding that power in space is limited by the surface area and availability of solar panels, our group set out to create an array that would maximize the power outputted without infringing on the space inside the Cubesat designated for the research equipment. Building off the research from a past senior design team, our group focused on fixing the actuation of the solar panels to ensure that they would deploy exactly when desired by means of a truss circumscribed around the solar panels. This truss, when paired with a central motor, will hold the panels rigid when deployed ensuring that the maximum solar energy is harnessed. Centripetal force will be utilized to go from the stowed state to the deployed one and will function off of the assumption that the apparatus will be weightless in space so no other support material is necessary.

Transformative Drop Vehicles

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Unmanned aerial vehicles and drones are used to carry payloads, as well as to navigate to a desired destination. This project is intended to produce a proof of concept of the idea of a drop vehicle that is of a cube shape to transform into a drone during free fall. The vehicle and payload are dropped off of a High Altitude Balloon platform where they will perform the transformation based on the force of air resistance from the deployment of a parachute counteracted by the acceleration of the free falling drop vehicle and payload. The purpose of this project is to design, manufacture, and test the drop vehicle and its practicality. As far as the design goes, the vehicle, and all components must fit within a 15-centimeter cube, and there is a parachute that is attached to all four arms holding the motors, which attach to the body of the drone by a hinge mechanism. When the parachute deploys, it pulls the arms upward, locking them into place on the frame of the drone. After the arms are locked into place, the drone is able to navigate to its final destination. The foreseeable applications that this project is intended to have include care package delivery, as well as simple home delivery drones. These applications use the payload carrying ability along with an eventual implementation of an autonomous autopilot feature that allows for GPS coordinated to be used to control the flight, however, there is currently a pilot on the ground with a radio that navigates the drone.

Field Emission Electric Propulsion

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Field Emission Electric Propulsion, or F.E.E.P, is an ion propulsion experiment that uses a strong electric field to quickly accelerate ions from a liquid to produce a small thrust. This project serves to redesign and improve an existing proof of concept and run multiple tests to see if F.E.E.P could be a good candidate for satellite propulsion.

Ion thrusters are currently being used for long duration, small-scale satellites called CubeSats. But they need a high voltage and a high current to operate, requiring excessive power. However, because of its unique design, F.E.E.P only requires a high voltage to produce a thrust. This is done by storing the ionic liquid at the tip of a sharp needle, and having an accelerator plate a close distance away. When a voltage is applied, the electric field between the two objects becomes so strong that the molecules in the liquid begin to get pinched into what is known as a Taylor cone. Once the surface tension from the needle is overcome by the electrostatic forces, the ions from the liquid are shot out at a high velocity, creating the thrust. This proof of concept study uses a single needle; if this study provides good results, it can be made into a fully functional F.E.E.P engine holding thousands of microscopic needles which would maximize its thrust and efficiency for CubeSat propulsion in the future.

Folding Satellite Array

The goal of this project is to create a model for a foldable set of solar cells to be placed on a CubeSat satellite as a continuation from a previous senior design project. The main focus is deploying the solar cells without causing them to tear the solar paper used. The cells must be folded to fit into a puck with a radius of 6cm and a height of 4cm while still providing sufficient surface area for absorbing light energy. A deployment method is also needed to deploy the array once the satellite reached space. The fold used in the final design is known as a hanaflex fold, which involves many vertical and horizontal folds and is the folding technique used in most similar projects. When folded there is a diameter of 6cm but when expanded the solar array has a diameter of about 31.75cm, and has a surface area ratio of 5.5:1 from deployed to stowed area. To deploy the solar cells, an electric motor is set up to be placed in the CubeSat and connect to the center of the array. The ends of the cells would be weighted so that when the motor spins centripetal force would unfurl the folded solar array. A frame made from 3D printed parts is wrapped around the fold, and when the array unfurls the frame expands. The frame then locks into place when it is expanded to ensure the solar cells remain open. This method is expected to work well in a zero-gravity environment and shouldn't cause damage to the array when it is deployed.

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Evidence Based Training: Developing an opioid overdose prevention and intervention training

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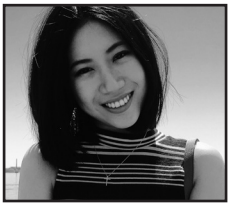
Since 1999, the U.S. has been suffering through an opioid epidemic. This epidemic is marked by a quadrupling in the rate of death from overdoses caused by prescription painkillers/heroin. Delaware County, PA has seen a 382% increase in opioid related deaths across a 5 year period, making it the county with the 4th highest number of overdoses in the state. In similar areas, it is crucial to train emergency responders in the use of the life-saving overdose antidote called naloxone. While this training is available, no research exists to ensure that it is effective, nor that it is having a true impact. This long term research goals aim to prove that training emergency responders, community members, and behavioral health specialists in naloxone administration and opioid overdose intervention does decrease successful overdoses, while the short term goal is to create an evidence-based training that can inform opioid overdose trainings regionally. Data is to be collected through qualitative focus groups conducted with emergency responders, behavioral health professionals, community members, providers of training, and individuals who have recently overdosed. The researchers' goals are to gain significant feedback about effective training objectives and education needs which will be used to update and standardize the opioid intervention/prevention training in Delaware County to ensure maximum effectiveness, and subsequently see a decrease in successful overdoses in Delaware County.

Attributes used in ads in a metropolitan newspaper's weekly health section to promote hospital services



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Although newspaper print advertising has waned given the general decline in newspaper readership, hospitals are steady advertisers in metropolitan newspapers. To identify, categorize, and account for the frequencies of attributes used by hospital marketers in print advertisements to promote their services. A content analysis of primary and secondary attributes that hospitals used in a daily metropolitan newspaper, Sunday health section, was made for a three-year period. We identified the range of attributes, determining a "typology" of six attributes (patient, health professional, branding, health services, procedure, and technology) and an "accounting" of the frequencies for these six attributes and the primary/secondary place that images and words had in the ads. The study shows that patients are most frequently used as primary attributes, followed by health professionals; whereas, branding is most frequently used as a secondary attribute. Technology and procedure are the least primary attributes of the six. When combining images and words, branding is the most common attribute. Pictures are far more commonly used as primary impressions; whereas, words are used as secondary impressions. Hospitals are true to the marketing objective to "win the hearts of healthcare consumers" by using patients as the main model in ads. Given patients and health professionals are the two most common attributes in ads, hospitals still hold dear to the patient/health professional relationship.

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Incidents of Violence Among Psychiatric Patients: Biological and Environmental Modifiers

Incidents of violence in psychiatric care are recognized by mental health clinicians as a significant challenge that leads to safety risks for patients and staff and increased costs and length of stay. Because mental illness alone does not lead to an increased risk of violence, it is important to examine the various factors that interact to result in aggression. The purpose of this study was to examine select biological and environmental modifiers and determine if they associate with episodic violence on a psychiatric inpatient unit. The biological modifier was patient sex, and environmental modifiers were location and time of incident. This descriptive study used data previously collected from a medical record review. The sample was patients aged 18-75 years, admitted to the psychiatric medical care unit at Hahnemann University Hospital between January 1, 2011 and December 31, 2014, with a length of stay up to 7 days. A descriptive statistical analysis showed that males were more likely to be violent than females and that in general, more violent incidents occurred during the morning shift than during the night shift. In addition, significantly more incidents occurred in the hallway, an area of higher traffic on the unit. These results offer an important foundation for risk assessment techniques. Further research will be critical to better understand these factors, ultimately allowing for a reduction in violent behavior on psychiatric units and improved quality of care.

Comparison of Publicly Available User Feedback of Consumer "Smart Cup" Products

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Entrepreneurship and innovation is predicated on how adapted a venture is to the current marketplace. Real-world user experience (both positive and negative) is critical for successful product development. The purpose of this project was to identify consumer feedback on three commercially available "smart cup" consumer products sold on Amazon.com to inform future development of a medical device to track and monitor food and fluid intake. Consumer product reviews (N=668) posted in the public domain on Amazon.com for 3 "smart cup" devices between March 22, 2007 and July 5, 2016 were analyzed. The following data elements were abstracted from each review and imported into an excel spreadsheet: author of review, title of review, review, date published and star rating. The content of each individual review was then coded as positive or negative for 13 product characteristics (e.g., fragility, customer service, lid functionality, battery functionality). Data were analyzed using descriptive statistics (IBM Statistical Package for the Social Sciences (SPSS)). Inter-rater reliability was performed to ensure accuracy of coding product reviews.

Of the 668 product reviews, 45% were positive and 55% were negative. Consumers most often reported problems with accurate tracking of liquid consumed. Other negative features included physical characteristics (lid positioning and fragility) and software resetting. This real-world user feedback can inform future research and development efforts.

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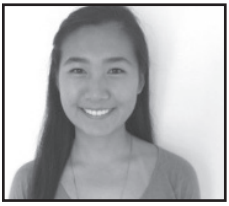
Mobile Health Hospitals Adoption Survey

Researchers are developing various mobile health applications and digital health technologies targeting patients and consumers to support chronic disease self-care management. Reports are emerging on positive health outcomes from mobile health technologies, yet it is unknown what barriers prevent wide-spread adoption. The purpose of this online survey is to identify barriers and facilitators perceived by hospital nurse executives to the adoption of mobile health technologies for chronic disease self-management. Identifying perceived barriers and facilitators can lead to a better understanding of systems that are needed to support new mobile health technologies, with the ultimate goal of improving patient outcomes. The Mobile Health Hospitals Adoption Survey (MHHAS) was developed using a Modified Delphi methodology. Since there are no surveys on adoption of new mobile health technologies in hospitals, we adapted previously developed surveys and research findings to create a survey that addresses these issues. After several drafts of the survey, the MHHAS survey was reviewed by four content experts. Based on their feedback, the final 37-item MHHAS was developed. The online survey, developed on Qualtrics: Online Survey & Insight Platform, will be launched once approved by IRB. Chief Nursing Executives across PA, NJ, NY and DE will be invited to participate in the survey. In the future, the survey can be administered to a larger national sample of chief nursing executives.

Housing and Health: A Qualitative Investigation in Mantua



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In the last decade, illnesses such as asthma and depression have been on the rise worldwide. The increase in these adverse health outcomes may be linked to poor housing conditions. The Home Preservation Initiative (HPI), a project sponsored by Philadelphia LISC, delivers home repairs with Habitat for Humanity and Rebuilding Together for residents living in Mantua. HPI aims to improve the physical conditions of owner-occupied homes in an effort to simultaneously improve the neighborhood itself by raising housing stocks, sustaining homeownership, and beautifying the area. Additionally, the improved housing conditions are believed to improve health and quality of life.

The goal of the current study is to examine the health and experiences of home-owners who have been approved or have received HPI repair services. This qualitative study enrolled 54 eligible residents (76% participation rate) and conducted in-depth interviews in June-July 2016. Interviews lasted on average 20 minutes and included questions to assess the residents' perception of home and neighborhood, perception of health due to their housing and neighborhood, and changes in quality of life resulting from the repair services. In this study, results will be used to evaluate the effectiveness of the HPI program to then support applications for increased funding to continue serving neighborhoods in need. Additionally, the goal is to use these findings in support of beneficial policies regarding housing and health.

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O-GlcNAcylation controls cancer lipid metabolism via SREBP-1 regulation

Altered metabolism remains a distinctive feature of cancer cells, as their constant growth surpasses the availability of nutrients. As explained by the Warburg effect, cancer cells undergo aerobic glycolysis to support the demand for nutrients in their accelerated growth. Increasing glucose uptake and production of lactate, cancer cells rely on glycolysis for a fast incorporation of carbon despite adequate oxygen levels present. Recent evidence shows the nutrient sensitive posttranslational modification O-linked β-N-acetylglucosamine (O-GlcNAc), similar to phosphorylation, is a key factor in modified cancer cell metabolism. Our lab has shown O-GlcNAc along with O-GlcNAc transferase (OGT), the enzyme responsible for this modification, are both elevated in breast cancer cells and are critical for cancer cell growth. Metabolic profiling revealed suppression of OGT leads to decreased lipid metabolites. Here we show OGT and O-GlcNAcylation are essential for lipid metabolism in cancer cells through regulation of the sterol regulatory element-binding protein (SREBP-1) transcription factor. Suppressing OGT in breast cancer cells leads to decreased SREBP-1 protein levels via activation of AMPK, a cellular nutrient sensor. Uncovering the link between O-GlcNAcylation, lipid metabolism and SREBP-1 regulation suggest that OGT may be a potential therapeutic target in cancer treatment.

Full-Field Optical Coherence Tomography Imaging of Skin Specimens in Mohs surgery

Full-Field Optical Coherence Tomography (FFOCT) is a new imaging technique that enables fast tissue imaging on fresh tissue. FFOCT requires less training compared to the more complex and time consuming frozen section histology method. FFOCT creates a potential for fast and easy image processing and interpretation. Mohs surgery is accepted as the most effective technique for removing the two most common types of cancer: basal cell carcinoma (BCC) and squamous cell carcinoma (SCC). Mohs surgery has the lowest recurrence rates, highest cure rates, and the best cosmetic outcomes. In this FFOCT study, we correlated images from FFOCT to the traditionally prepared frozen section specimens and evaluated any artifact produced by the microscope. Additionally, we evaluated thawed frozen sections with FFOCT to better assess artifact. Thus, we were able to examine the changes on FFOCT images after tissue freezing and any imaging effects FFOCT may have on frozen sectioning. As FFOCT is being introduced into Mohs surgery, it is important for clinicians to recognize that freezing tissue before imaging will introduce artifact in the FFOCT image.

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Barriers to HPV Vaccination in Patients of Age 18-26

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Human papillomavirus (HPV) is the most common sexually transmitted disease affecting roughly 50% of people between the ages of 15 to 24. Scientists identified over 40 different strains of the virus. Although some strains can be resolved by a healthy immune system, many can lead to life threatening consequences if left untreated. Certain types of HPV cause an outbreak of warts in the genital area. High risk types of the virus can lead to cervical cancer, vaginal cancer, and vulvar cancer in females and anal cancer and oropharyngeal cancer in males and females. Since 2006, the FDA approved three vaccines for the prevention of HPV. The vaccines are recommended for administration in males and females at the age of 11 or 12 but can be received until the age of 26. Gardasil, the first vaccine created for HPV, protects against four strains and was newly refined to protect against nine strains of the virus. For protection against types that specifically cause cervical cancer, the vaccine Cervarix was developed for females. Recently, the CDC released a report stating that the percentage of cervical cancers associated with HPV increased by 17%. Despite the severity of this virus, the vaccination rates for HPV are among the lowest in the country. By gathering information from patients in the Dermatology and Women's Health Clinics at Drexel Medicine, we hope to gain an understanding behind the social and behavioral barriers to HPV vaccination and ultimately improve vaccination rates.

Development of a physiologic *in vitro* lung epithelial culture system to determine mechanisms of influenza infection

Influenza infections result in 3-5 million severe cases and 500,000 deaths world-wide each year. Influenza targets and preferentially binds to the surface of type II alveolar cells. This makes type II alveolar cells useful for studying influenza infection. Currently, the adenocarcinomic human alveolar basal epithelial cell line (A549 cell line) is commonly used to mimic influenza infection. However, A549 cells do not mirror true in vivo infection due to their 2D nature, lack of an air-liquid interface (ALI), and inherent cancer related anomalies. In order to better study the epithelial response to influenza, a 3D *in vitro* model was developed that better represents the ALI. To optimize this model, type II alveolar cells, which are typically found in the blood-air barrier, were harvested from adult mice. Animals' tracheas were cannulized and dispase was injected. Lungs were homogenized, filtered, and plated with CD45 and CD16/32 antibodies. This process isolated and purified the type II alveolar cells. Purity was determined by flow cytometry using the markers of CD45, CD324, CD326, and MHCII, and was consistently around 70%. In future studies, cells will be infected to determine the mechanisms of susceptibility to influenza infection using both adult and neonatal cells. This *in vitro* model will help to determine changes in cytokine production, and the neonatal innate immune response to respiratory viral infections.

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Neuropeptides in the thalamic paraventricular nucleus: sex and subregion differences

Neuropeptides of the paraventricular nucleus of the thalamus (PVT) are known to have a role in ingestive behavior; however, very few so far have been identified. Subregions of the PVT are known to have different functions. The posterior PVT (pPVT) has an important role in emotional behaviors while the anterior PVT (aPVT) plays a greater role in motivated behavior. In this study, we tested 8 neuropeptides to determine whether they were present in PVT neurons. In addition, we examined the difference in neuropeptide levels between male and female rats and between anterior and posterior PVT subregions. First, primers for qPCR were designed to target the intended genes and primer tests were used to ascertain the appropriate concentrations. Then, the primers were used to determine, on a semi-quantitative basis, the expression levels of each neuropeptide in the PVT subregions (n=6 females, n=4 males). Next, immunohistochemistry was used to image and count neurons that contained one of the identified neuropeptides, pituitary adenylate cyclase-activating peptide (n=5 males, n=5 females). We found that all neuropeptide levels are equivalent in males and females, and that there is higher expression in the pPVT than in the aPVT. The results identify the presence of neuropeptides not previously described in the PVT, show that males and females do not differ in their levels of these genes, and demonstrate that the neuropeptides have a heterogeneous distribution throughout this nucleus.

Responses to Deep Brain Stimulation in Parkinson's Patients

A fairly recent clinical option for patients with neurological motor disorders is Deep Brain Stimulation (DBS), a surgery consisting of implanting electrodes into the brain to create electrical currents.

The surgery is primarily used for patients with Parkinson's Disease, a progressive, neurological disorder in which neuron death and malfunction creates a deficiency in dopamine. Anti-Parkinson's drugs provide symptomatic relief for patients, but often result in motor side effects like dystonia and dyskinesia. The exact mechanisms of DBS are unknown, but it stimulates neurons in dopaminergic pathways of the Subthamalic nucleus and Globus Pallidus internus. Post surgery, doctors program DBS stimulation to reduce motor symptoms such as tremors, bradykinesia and stiffness by altering stimulation parameters.

In the patients I have profiled with DBS, almost all had remarkable improvement to tremor that most medications could not achieve without a "wearing off period" or motor side effects. However, I noticed a common trend of side effects such as decreased postural stability and diminished/slurred speech. I also studied the case of G.C., an atypical DBS candidate due to his cautionary MRI and concerning neuropsychology scores, who had great motor response, which open the window of treatment for other Parkinson's patients. By exploring the electrophysiology and anatomy of the brain, DBS side effects can be reduced and the pathology of Parkinson's better understood.

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Regulation of Proinflammatory Chemokine CXCL5 by microRNA hsa-miR-605

Complex regional pain syndrome (CRPS) is a disease characterized by chronic pain and inflammation. Recent studies on CRPS patients have sought to identify circulating biomarkers that can assist in diagnosis and serve as therapeutic targets. MicroRNAs (miRNAs) are small noncoding RNAs that can negatively regulate gene expression by binding to the 3′ untranslated region (3′UTR) of mRNAs. Specifically in CRPS patients, hsa-miR-605 showed a 22-fold downregulation in poor responders relative to responders prior to ketamine treatment. Here we investigated the functional significance of miR-605 downregulation. miR-605 is predicted to target CXCL5, a proinflammatory chemokine involved in the recruitment and activation of leukocytes. We hypothesized that the reduced expression of miR-605 in poor responders could contribute to an increase in CXCL5 expression. We observed a dysregulation of CXCL5 in blood samples from CRPS patients. Using in vitro approaches we investigated whether overexpression of miR-605 can decrease endogenous CXCL5 in multiple cell lines. While there was no significant effect in endothelial cells, we found a small but consistent downregulation of CXCL5 mRNA in miR-605 transfected neuroblastoma cells. Efforts are underway to determine if there are miR-605 induced changes in CXCL5 protein levels. Thus, investigating target mRNAs of differentially expressed miRNAs can provide important insights on aberrant gene expression that contributes to disease pathology.

K-Ras and HuR Corregulation and Activation in Pancreatic Ductal Adenocarcinoma

Pancreatic cancer is the fourth leading cause of cancer-related death. Pancreatic ductal adenocarcinoma (PDAC), a major histological subtype, constitutes over 90% of all pancreatic cancer. Currently, the treatment options are ineffective, as the five-year survival rate is only 8%. An approach to inhibiting PDAC progression involves understanding K-Ras, a small GTPase. A key player in many signal transduction pathways that control growth, DNA repair, motility, and other crucial cellular functions, K-Ras is hyperactivated in 95% of PDAC tumors. Our study investigates the relationship between K-Ras and HuR, an mRNA binding protein that stabilizes the expression of many pro-tumorigenic genes. HuR's ability to bind to mRNA is dependent on its expression, localization, and phosphorylation, which in part is influenced by active K-Ras. Our preliminary data show that persistent K-Ras signaling in PDAC regulates localization of HuR, which is critical for the stabilization of pro-tumorigenic transcripts. In stressful conditions, HuR can be cleaved and subsequently targets pro-apoptotic mRNA transcripts. We hypothesized that K-Ras silencing in PDAC cell lines would disrupt the amount of full length HuR and its activation due to increased cleavage. Because the pancreatic tumor microenvironment harbors a variety of stressors, we investigated if two relevant cellular insults, serum deprivation and gemcitabine (a standard PDAC chemotherapeutic), alter how K-Ras affects HuR function.

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The Proteins And Pathways Activated By Dopamine In HIV Infection Macrophages

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Human immunodeficiency virus (HIV) has been a rising epidemic disease for the last 30 years. More than 34 million individuals are currently infected globally. Although antiretroviral therapies (ART) have decreased mortality and improved the quality of life for HIV infected individuals, they are not a cure. HIV infection affects every organ in the human body in complex ways. Macrophages are the primary target cells for HIV infection in the central nervous system. A macrophage is a phagocytic white blood cell that protects the body from bacteria and other pathogens. Our laboratory has found that the neurotransmitter dopamine contributes to HIV infection in the central nervous system by increasing the number of macrophages infected with HIV. Dopamine receptors primarily signal via pathways that use cyclic-AMP. This molecule, cyclic adenosine monophosphate (cAMP), is a second messenger that plays a fundamental role in a number of biological processes, including dopamine receptor signaling. Activation of other messengers following the activation of cAMP, can lead to the activation or inhibition of different proteins. Determining how dopamine receptors mediate cAMP signaling and downstream protein activation in macrophages will further the understanding of how dopamine mediates its effects on HIV infection in macrophages. Identifying the proteins and pathways activated by dopamine in these cells could provide new therapeutic targets for use in the inhibition of HIV entry.

Alternative Drug Delivery Approach for Pediatric Applications: Double Sided Luer Lock Syringe

There are numerous means of drug delivery in pediatric subjects, including the use of Luer Lock syringes. A standard Luer Lock syringe operates by pushing the plunger to deliver the drug into the line, and thereafter into the patient. However, when a pediatric patient receives a certain amount of drug, the patient also receives a certain amount of saline. The quantity of saline is directly proportional to the amount of drug delivered; higher amount of drugs the patient receives, greater the amount of saline that gets into his/her bloodstream. Large amounts of saline can prove detrimental, and have been known to cause high blood pressure. Our research goal aims to improve the model by developing a double ended syringe. Autodesk Fusion 360 was used to design 3-D models of an adapter for use on syringes. The adapter has a Luer Lock acceptor tip on one side and a cylindrical part, containing the O-ring, on the other that fits inside the open end of the syringe, and is secured by twisting and "snapping" into place. The 3-D printed adapter fits securely on the syringe. It is tested using a syringe filled with saline that is connected, by a line, to the adapter end of the Luer Lock syringe. The tip of this syringe is connected to another syringe, which is open to the air. The plunger in the Luer Lock syringe prevents solutions from mixing, and is tested for this and presence of leaks. The adapter can help enhance the existing syringe based drug delivery model in pediatric medicine.

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Modeling TB-HIV Co-infection

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Tuberculosis HIV co-infection remains a large problem with 14 million people dually infected worldwide. Most people infected with TB do not develop active infection. However, HIV infected patients are much more susceptible to developing an active TB infection. Few models exist for the cell population dynamics in TB-HIV patients. The existing models do not adequately show progression to active tuberculosis. Instead they only show general trends in bacterial load and T cell count. The goal of this project was to design a mathematical model that can accurately describe TB-HIV co-infection using existing data. A set of differential equations was developed using existing models and known facts about both diseases. While some parameters were taken from existing models, others were calculated based on clinical data and data produced by other models. The equations were plotted using MATLAB. The model tested if active tuberculosis infection can be caused by a decreased effectiveness of HIV infected macrophages. The new model shows that when macrophages infected with HIV cannot control M. tuberculosis growth, the TB infection quickly progresses to active infection. In the future, the model can be used to determine optimal drug regimens for TB-HIV patients.

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Analysis of Electromyography Signals from Brachioradialis to Estimate Grip Force

Skeletal Muscles generate electrical signals during muscle contraction. Electromyography(EMG) is the procedure used to record this activity. It provides information about the state of the muscle. Estimation of grip force using EMG is generally carried out using multi-channel EMG. In this work, an attempt has been made to use single channel EMG to estimate the grip force. For this, surface EMG signals are recorded from Brachioradialis muscle of 3 healthy male volunteers at two different grip forces of 9.8N (1Kg) and 19.6N (2kg). The experiment consisted of 5 trials in each load condition. During the experiment the subjects were asked to stand erect with the forearm in neutral position and an elbow flexion angle of 0o. A Cantilever based strain gauge was given to the subject and they were requested to apply the forces. The surface EMG (sEMG) signals were recorded using Ag/AgCl surface electrodes with an inter-electrode distance of 2 cm. The sEMG signal and the force were measured simultaneously at a sampling rate of 1000Hz. The recorded sEMG signal was preprocessed and segmented into 1 second epochs. The RMS values were calculated in these segments and used for further analysis. These methods were developed for use in future studies regarding grip force estimation.

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In vitro Degradation Testing of a Bioresorbable Clip for Wound Closure

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Total Laparoscopic Hysterectomy is an operation that removes the uterus through the use of a camera and thin instruments. This procedure is done through incisions as small as 5 mm through which the camera and tools are inserted. Laparoscopic also known as minimally invasive surgery is in demand due to: faster recovery times in the hospital, smaller scars externally and internally, less discomfort post-operation and patient recovery. For Total Laparoscopic Hysterectomy, the most technically demanding step is to close the vaginal cuff with suture.

ZSX Medical is developing a surgical closure system that is designed to make difficult closures fast and easy for physicians, saving money for hospitals and improving outcomes for patients. The closure is completed using clips that are bio-compatible and bioresorbable meaning once the tissue heals the clips will be degraded by the body with minimal tissue reaction. The clips are in the Pre-Clinical phase meaning they are being thoroughly tested before receiving FDA approval. This project focuses on testing to observe the degradation of the clips in solution, to simulate how the clips would degrade within the body. Pilot testing was performed prior to the full experiment to determine the optimal conditions and materials. These experiments were designed and performed in accordance with standards set by the American Society for Testing and Materials, specifically protocol: F1635 - 11.

Assessment of Brain Adaptation During Flight Simulator Use

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Functional Near Infra-Red Spectroscopy (fNIRS) is a noninvasive, safe, low-cost optical brain monitoring method by which near infrared light is used to assess brain activation changes at the cortex level. Strategically placed light sources and detectors capture localized blood oxygenation changes within the monitored cortical area. The light intensity changes are used with the Beers-Lambert law to determine the oxygenated and deoxygenated-hemoglobin concentration changes in specific areas of the cortex, an indication of brain activity.

In this study, fNIRS will be used to monitor brain plasticity changes as participants practice fine motor control skills over a two week period to assess longer term adaptation. Participants will be trained to perform various functions in a flight simulator and practice with simulated challenges of increasing difficulty. The data received during training will allow for the upcoming training to be adjusted for the experimental group and the change in effectiveness of the training will be evaluated against a control group. Thanks to the relatively affordable and portable nature of fNIRS technology as well as its non-invasiveness, any techniques developed to improve training will be able to be implemented immediately in the field and or any naturally existing training environment settings.

Inter & Intra Tester Reliability of Motion Analysis of the Trunk

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This is a cross-section prospective study for inter/intra rater reliability of trunk motion using motion analysis. Motion analysis has been used for patients with scoliosis to assess trunk range of motion before and after a surgical intervention. Currently the lab is working towards creating data analysis and comparison values for these different movements. For the study their was a total of 10 healthy volunteers between the ages of 18 to 27. Markers were placed on the subject and their motion was captured using Vicon cameras and Nexus software. Calculations were completed using MatLab and inter/intra rater reliability was completed with SPSS. The inter rater reliability was fair for most measurements. The intra rater reliability was good for all measurements. Although the results demonstrate good reliability, the 95% CI are large.

The results show that their needs to be a better system for making sure that evaluators are placing the markers in consistent locations for more comparable data across different locations. The results of this study demonstrate good intra rater reliability of the trunk model currently being used in the motion lab. Future work would include collecting age specific norms to be compared to patients with scoliosis. Repeat reliability testing with a large age specific norms to improve the confidence intervals.

Examining Torso Belt Fit on a Mock D-Ring and the Optimal Positioning of the Upper and Lower Extremities on Human Volunteers for Future Studies

The National Highway Traffic Safety Administration referenced that the location of the torso belt correlates to the severity of injury sustained during a crash. In this study, a subset of a pre-crash scenario study, a seat belt donning procedure was created and assessed for its ability to place the torso belt in its optimal position. Adult human volunteers participated in experimental trials to observe how the donning procedure would affect the torso belt placement and fit on their body. Statistical software was used to develop a spectrum of optimal foot and arm positions, which reduced variability between the volunteers and properly positioned the lower extremity load cell and hand bracing structures needed for the pre-crash investigation. It was found through subject feedback that the belt fit, as a result of the donning procedure, was secure and comfortable; the procedure was modified based on the findings of this sub-study. It was also concluded that the range of mobility produced by the mock D-Ring provides the necessary range of motion. It was found that an optimal foot range would be contained in a 16" x 20" platform. This would allow for the volunteer to place their feet six inches apart and have a clearance of two inches on each side. Lastly it was concluded that with the arm position set at 90 degrees, the optimal positioning for the bracing structure is set an angle of 14 degrees.

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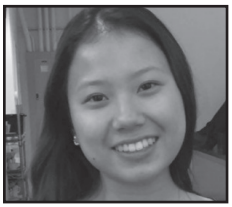

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Analysis of Normative Pelvis Morphology Using MATLAB-assisted Point Identification and Parameter Calculation

Adolescent Idiopathic Scoliosis (AIS) is a complex three-dimensional (3D) spine deformity that causes abnormal spinal curvature and vertebral rotation in children between 10 and 18 years of age. This mal-positioning can also affect the alignment and morphologic symmetry of the pelvis, which results in altered posture and lower back pain. Measurements such as pelvic tilt and sacral slope yield information about the severity of such pelvic deformity; however, at this time, no normative pediatric data for these measures or their change with respect to age can be found in literature. Hence, the objective of this study was to develop a method of quantitatively assessing pelvic morphology. For this purpose, a custom MATLAB [MATLAB R2015b, The Mathworks, Inc., Natick] code was written to automatically identify 15 pelvic landmark points that were used to quantify pelvic morphology and orientation. The code was tested on pelvis reconstructions from 15 retrospectively obtained computed tomography scans of skeletally normal children aged 10 - 18 years. Seven parameters, including pelvic width, pelvic incidence, and pelvic height were collected from each subject. With larger data sets and further refinement, these methods may be used to analyze differences between normative and scoliotic pelvis morphology, which could provide insight into AIS's influence on pelvic development.

Exploring the Effects of Different Media on Hydrogen Peroxide Production

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Plasma, ionized gas comprised of positive and negative particles, is being explored for medical applications like cancer therapy [1]. Recently, plasma activated liquid (PAL) was shown to have anti-cancer effects. Plasma treatment of liquid generates reactive oxygen and nitrogen species (RONS) that are responsible for cell death; the most effective is H_2O_2 [2]. To further develop PAL as a potential cancer therapeutic, the behavior of H_2O_2 generation by plasma was investigated in various liquids and plasma regimes.

To test the effects of buffers on H_2O_2 generation, deionized (DI) water, and PBS with and without serum was treated. The results indicate that higher frequencies resulted in higher H_2O_2 concentrations in DI water. Furthermore, PBS with serum had lower H_2O_2 concentrations compared without serum.

To test effects of uniformity of plasma on H_2O_2 generation, DI water was exposed to different plasma energies under uniform and nonuniform conditions. Results showed that there was no significant difference between H_2O_2 concentrations.

To compare effects of pulse parameters on H_2O_2 generation, DI water was treated using microsecond and nanosecond pulsed dischargers. The results established there were similar H_2O_2 concentrations as treatment time progressed.

Conclusion: 1) Buffers attenuate plasma capacity to generate ROS. 2) Energy is the most important determinant for H_2O_2 generation by DBD plasma.

References:
[1] Fridman, Gregory, et al. "Applied plasma medicine." Plasma Processes and Polymers 5.6 (2008): 503-533.
[2] Yan, Dayun, et al. "Principles of using cold atmospheric plasma stimulated media for cancer treatment." Scientific reports 5 (2015).

Function of Type III Collagen in Cartilage

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Collagen is a structural protein found in the human body as well as in many other animals. It is in fact the most abundant protein in the human body accounting for more than 25% of the protein count. Currently 28 types of collagen have been found, and they can all be separated into certain categories, such as fibrillary collagen. The word itself comes from the Greek word "kolla" which means glue, showing the importance of the substance in holding the body together. This structural protein can be found in several parts of the body including the skin, bones and connective tissues. Presently, not much is known of type III collagen. My research during STAR consisted of determining the properties and function of type III collagen in murine cartilage and meniscus. In order to complete this test a study was done, where two mice were compared. One being a wildtype and the other being genetically modified, in which gene segments that produced collagen III in one of its chromosomes were knocked out, thereby resulting in a mouse that only partially produced collagen III. From these mice the cartilage was taken through dissection and went through indentation testing through atomic force microscopy. Through the usage of the AFM, a comparison could be made in order to see the change in the biomechanical properties of the cartilage between the wildtype and the knockout, thereby indirectly demonstrating the impact of collagen III in cartilage.

Developing a Lab Model of the Human Head for NIRS Tests

Near-infrared spectroscopy (NIRS) utilizes the ability of light in the near-infrared range (600nm - 1000nm) to penetrate tissue non-invasively for the monitoring of changes in physiology and cognitive activity in the brain. The NIRS system used in this project detects cerebral hematoma (bleeding) and/or edema (swelling) by monitoring changes in water and blood concentration (deoxyhemoglobin, oxyhemoglobin, total hemoglobin). The goal of this research was to determine values for the absorption and reduced scattering coefficients (μa and μs'), differential pathlength factor (DPF), and thicknesses of the scalp, skull, cerebrospinal fluid (CSF), and brain for the development of realistic head models for infants, toddlers, adolescents, and adults. To derive the full data set, extensive literature review was coupled with mathematical modeling for calculating values outside the scope of the review. Mathematical modeling included regression analysis as well as a geometric model of the human head. Regression was utilized for acquiring adolescent scalp and skull thickness values as well as infant and adult head DPF values. The geometric model employed a spherical head model and, used the radius of the head and brain and thickness of the other layers to find values for toddler and adolescent CSF thickness. In the end, this project's data was used to create a realistic lab model of the head, which will later be used to test the reliability of the edema and hematoma detection systems.

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Evaluating Weight Support Device for Balance Tasks after Spinal Cord Injury

Nearly twenty thousand new spinal cord injuries (SCI) occur each year in the United States, and brain machine interface (BMI) experiments are one of many innovative approaches to the treatment of SCI. Experiments evaluating BMI for balance on a tilt platform are currently being conducted in the lab using a rat model of SCI. However, in order to perform these experiments on injured rats, an additional weight-support harness must be fitted to the platform and provide vertical support to the rats during tilting, as the SCI prevents the rats from fully supporting their own body weight. The aim of this project was to determine if the harness currently being used to support injured rats was interfering with the balance task by providing unwanted lateral support and allowing the rat to rely on the harness during tilting. In order to determine this, uninjured rats were placed on the platform and tilted both with and without the harness, and ground reaction forces (GRFs) were recorded and used to quantify their behavior. MATLAB programs were then designed to extract GRFs and center of pressure (CoP) variables from each trial. Statistical analysis of these variables was then used to compare the behavior of rats with and without the harness. These findings guided the design of a new weight-support harness, which would enable further studies of balance after SCI.

Meta-analysis of Microarray Datasets in Pain Disorders

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Meta-analysis of data generated from multiple gene expression studies holds the potential of finding expression profiles not directly available from the analysis of individual studies. Furthermore, these expression profiles can be utilized for drug repositioning, whereby drugs developed for other health conditions are repurposed for regulating affected genes and phenotypic outcomes. In this study, we focus on chronic pain disorders in order to find gene expression profiles and the affected biological networks and to also find drug candidates that can be used reverse the biomolecular mechanisms or symptoms of these disorders.

We have analyzed several publicly available datasets examining chronic pain disorders. These datasets were downloaded from Gene Expression Omnibus (GEO), a repository maintained by the National Center for Biotechnology Information (NCBI). We have developed a MATLAB program to find genes that are significantly differentially regulated between experimental conditions studied in these GEO datasets. These significant genes are then analyzed to find statistically enriched Gene Ontology (GO) terms and KEGG biological pathways. The Connectivity Map (cMAP) tool was used to find drug candidates for these differentially regulated genes.

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Sequential Delivery of Macrophage-Modulating Cytokines from Molded Gelatin-Methacrylate Hydrogels

A challenge in biomaterial design for tissue repair is achieving integration by vascularization after implantation. In normal tissue repair, innate immune cells called macrophages migrate to the wound, where they first adopt a pro-inflammatory (M1) phenotype and later transition to an anti-inflammatory, pro-healing (M2a) phenotype. Recent studies have shown that the sequential actions of these two phenotypes promotes the development of new blood vessels. *Thus, we aim to design a biomaterial to sequentially promote an M1-to-M2a phenotype to for enhanced vascularization.*

The proposed design is to incorporate a solubilized M1-promoting cytokine for rapid release and poly(lactic-co-glycolic acid) (PLGA) microspheres loaded with an M2a-promoting factor, for slow release, into a molded gelatin-methacrylate hydrogel (GelMA). In order to optimize drug loading and release, varying doses of methylene blue dye (MB) were used to model rapid, solubilized release and PLGA-loaded slow release, independently. Spectrophotometric analysis of MB release showed that 17% of MB loaded into GelMA was released after 24 hours *in vitro*. MB release from PLGA microspheres in GelMA is under analysis. In summary, we successfully modeled and quantified the release of MB from molded GelMA, which will aid in the creation of an immunomodulatory biomaterial. Future work will include introduction of pores into GelMA using 3D printing to facilitate biomaterial integration and vascularization

Microparticle-Induced Macrophage Polarization and Phagocytic Preference

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Macrophages, primary phagocytic cells of the immune system, play a central role in wound healing and tissue repair. They display a range of pro and anti-inflammatory behaviors in response to environmental stimuli. Microparticles, a drug delivery platform, are commonly used in the biomedical field due to their capacity to influence macrophage response and subsequent tissue health. Characterizing macrophage-microparticle interactions could have important implications for improving therapeutic microparticle efficacy aimed at tissue regeneration.

In this work, we aim to investigate two facets of microparticle and macrophage interaction, size dependent phagocytic preference, and macrophage polarization after phagocytosis. We first quantified differential uptake rates of 0.2 um and 1.0 um microparticles following macrophage exposure. Then, the effect of microparticle uptake on macrophage behavior was assessed in terms of secretion of the pro-inflammatory cytokine tumor necrosis factor-alpha (TNFa) and compared to secretion profiles of established macrophage phenotypes. Preliminary findings suggest that macrophages phagocytose smaller microspheres at a higher rate than larger particles. The data also indicate that phagocytosis of small and large particles combined elicits a larger inflammatory response than either particle alone. Thus, macrophage behavior can be modulated by altering microparticle characteristics; this could inform design of subsequent macrophage-based therapies.

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Microparticle Diameter Affects Macrophage Phagocytic Efficacy

Increasing the efficacy of drug-delivery microspheres is extensively studied because of their tunable release profiles, organ-specific targeting, small size, and ease of drug loading. However, drug-loaded microspheres tend to miss their full therapeutic potential because they are prematurely engulfed by macrophages, the primary phagocytic leukocyte in the blood, before they can reach their target organ. In order to better understand the preference of macrophages for phagocytosis of microspheres, we investigated how microsphere uptake by macrophages was affected by microsphere diameter. We hypothesized that macrophages engulf smaller particles at a higher rate than larger particles because macrophages show elevated levels of pro-inflammatory behavior upon phagocytosis of smaller particles.

In this study, small, large, or a combination of small and large fluorescent particles were added to human monocyte-derived macrophages (M0) and live cell imaging was conducted over the course of three hours using a Zeiss LSM700 confocal microscope to analyze macrophage-microsphere interactions. Videos were analyzed using image-based segmentation methods to compare the phagocytic rate of the microsphere. Preliminary results show that more small fluorescent particles underwent phagocytosis at earlier time points than larger particles.

Further characterization of macrophage phagocytosis of microspheres can inform the design of microspheres in therapeutic interventions.

Detoxing the Microbubble

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Ultrasound contrast agents are stabilized microbubbles that increase the acoustic impedance difference between tissues to enhance imaging. They can also be used for targeted drug or oxygen delivery. SE61 microbubbles have a stabilizing shell of the nonionic surfactants Span 60 and TPGS (water-soluble Vitamin E). We investigated the replacement of Span by polyethylene-block-poly (ethylene glycol) (PE-PEG) which is more biocompatible and has the required low HLB value (4 vs. 4.7) and high melting temperature. Seven samples of varying TPGS and PE-PEG proportions were tested. The acoustic properties of the resulting bubbles were measured using a custom-built testing setup. Two samples, 100% PE-PEG and 80% PE-PEG/20% TPGS, tested similarly in echogenicity to SE61, reaching approximately 25dB. For the remaining samples, the average maximum dB measurements were inversely proportional to the proportion of PE-PEG. SE61 has an in vitro half-life of approximately 8 minutes, while the PE-PEG microbubbles had half-lives of under two minutes. Light microscope images of each sample were obtained. For all samples, microbubbles had a similar size to the SE61 microbubbles. Unincorporated polymer was visible after manufacture for the 100% PE-PEG sample, possibly indicating inefficient processing. These results show that PE-PEG is able to substitute for Span 60, to produce echogenic microbubbles but they are too unstable to replace the Span 60 surfactant in the SE61 contrast agent.

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Testing Novel Strategies to Overcome Pancreatic Cancer

In the United States, nearly 53,000 people will be diagnosed with pancreatic cancer in 2016. Gemcitabine (GEM) is the gold standard treatment for pancreatic cancer, but it only increases survival by 6.8 months. Ultrasound contrast agents (UCAs) are micron-sized bubbles used to enhance an ultrasound image by increasing the impedance difference between adjacent mediums. GEM can be encapsulated in UCAs and its delivery can be localized. This project has two aspects: characterizing GEM-loaded UCA and determining the optimal cell culture conditions for *in vitro* testing using a human pancreatic cell line, M1A PaCa-2. For the GEM-loaded UCA, echogenicity, size, zeta potential, and encapsulation efficiency were found using *in vitro* acoustic testing, dynamic light scattering, laser doppler micro-electrophoresis, and spectrophotometry, respectively. To determine culture conditions to obtain 70% confluency after two days, M1A PaCa-2 concentrations ($2x10^4$, $1x10^4$, or $0.5x10^4$ cells per well), media type (10% or 20% Fetal Bovine Serum (FBS)), and plate type (cell culture treated plate or Nunc treated plate) were investigated. The GEM-loaded UCA had an echogenicity of 18 dB, size of 3.4 μm, zeta potential of -20.5 mV, and an encapsulation efficiency of 7.63%, exceeding the minimum requirements for successful UCAs. The M1A PaCa-2 cells reached confluency at 2×10^4 cells per well in 10% FBS media on cell culture treated plates. These results are vital for future *in vitro* and *in vivo* testing.

Whole Genome Structural Variation Detection through Optical Mapping

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Optical mapping allows for the imaging of very long (>=150 Kbp) single DNA molecules and provides information on the order and distribution of labeled motifs along these molecules for the production of whole genome maps. Due to the limitations of current sequencing technologies, the current human reference genome is incomplete and not representative of every individual [1]. Therefore, it is important to discern the variations between mapped human samples and the reference in conjunction with population studies which allow for the analysis of inter-individual variations and population-specific variations within complex regions. The preferential expressed antigen in melanoma (PRAME Region 1) is a complex region located on chromosome 1 from 12.95 Mbp to 13.25 Mbp, which contains indels, a 50 Kbp N-gap within the reference, and an inversion. The region contains several PRAME family member proteins whose functions include negative regulation of apoptotic processes, and cell differentiation. When analyzing individual genomes, it was found that there was a specific deletion in 23 genomes, which lies in the inversion. Within the reference, there are 2 motifs flanking a 50 Kbp N-gap, in which single molecules spanning this gap provide evidence of a true distance of 25 Kbp. These results demonstrate the power of optical mapping in resolving gaps in the human reference and comparing variations among individuals.

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Analysis of D4Z4 Repeat Regions Using CRISPR Cas9

Current sequencing techniques, which are mainly based on a short read concept, prove difficult when used to detect large structural variations in the human genome. Alternatively, Optical mapping allows for the imaging of very long (>=150 Kbp) single DNA molecules and provides information on the order and distribution of short motifs along these molecules for the production of whole genome maps. Optical mapping relies on the nickase Nt.BspQ1 to recognize a specific motif that can barcode the whole genome and detect large structural variations >5kb. The nicks generated by Nt.BspQ1 are fluorescently labeled and this labeled DNA is directed through nanochannels for linearization. However, other regions in the genome, such as the D4Z4 repeats, cannot be labeled with this nick labeling method because there are no nickase sequence motifs in such regions. D4Z4 is of particular interest because decreased copy number of D4Z4 repeat regions on chromosome 4q has been linked to the presence of facioscapulohumeral dystrophy (FSHD) in humans. We modified the CRISPR- Cas9 system using a mutant form of Cas9 (Cas9 D10A) to nick the D4Z4 repeat region, which was then fluorescently labeled. Simultaneously, the rest of the genome was labeled and mapped using the Nt.BspQ1 labeling method. The Nt.BspQ1 labels on the imaged molecules were mapped to the human reference genome to identify chromosome arm 4q and Cas9 labels were used to determine the length of the D4Z4 repeat region.

Characterization of Drug-loaded Polyelectrolyte Complexes to Modulate Inflammation Following Spinal Cord Injury

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Traumatic spinal cord injury (SCI) results in a significant loss of motor, sensory, and autonomic function. Following initial injury, inflammatory signals are dramatically upregulated in the tissue, further contributing to cell loss and severely inhibiting regeneration of the damaged tissue. Tumor necrosis factor (TNF) is a critical mediator of SCI-induced neuro-inflammation. Soluble TNF primarily signals through TNF receptor 1 (TNFR1) which mediates cell death, whereas transmembrane TNF preferentially signals through TNF receptor 2 (TNFR2) which has been implicated in neuroprotection. XPro1595, an inhibitor of solTNF signaling, can be used to selectively attenuate the detrimental effects of TNFR1 signaling but retain the beneficial effects of TNFR2 signaling. Previous work has shown that only central delivery of XPro1595 resulted in functional recovery following SCI. To provide a viable therapeutic approach, in this study we characterized a biocompatible, polyelectrolyte complex-based drug delivery system to locally deliver XPro1595 at the injury site. XPro1595 was loaded into polyelectrolyte complexes of oppositely charged polysaccharides. We varied the concentrations of polysaccharides and XPro1595, and obtained release profiles for each gel to characterize the delivery system and control both dose and duration of release. In addition to SCI, this release system has potential applications in other inflammatory neurological disorders.

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STEAM Education: Using Creativity to Teach STEM

It is common to see school districts cut budgets for the arts in favor of standardized test preparation and science based classes. However, by combining topics such as music, art, dance or game design with topics such as science, technology, engineering or math (STEM), educators can reach a broad range of students and expand interest in relevant fields through STEAM education. My research focused on designing and assessing curricula that integrate the arts into STEM education.

Specifically, I worked at the ExCITe (Expressive and Creative Interaction Technologies) Center to assist in producing two week long camps. The first, Summer STEAM, sponsored by the Malcolm Jenkins Foundation, served seven students entering middle school. The second, Summer Music Technology, served 20 students entering high school. At both camps, students created presentations, which were evaluated by a panel of Drexel students and faculty. These rubrics and student surveys indicated that, by the end of these programs, students from both camps had learned (or continued learning) the basics of STEM through the arts and left with a higher interest in pursuing STEAM fields. By broadening the range of students interested in STEM and the arts, we will be producing a generation of well-rounded and creative students that will be prepared to work in an increasing number of multidisciplinary fields.

Frances Velay Fellowship Program

The 2016 STAR Scholars cohort includes our first cohort of Frances Velay Fellows, thanks to the generous support of the Panaphil and Uphill Foundations. This cohort of 8 women in STEM have participated in the full STAR Scholars experience while also having the opportunity to engage in additional programming, including a book club and biweekly luncheons with other women in STEM from Drexel faculty, Drexel's graduate student population, and local industry professionals. Through this program, we were able to provide these exceptional young women the structure and time to reflect on what it means to be a woman in STEM, to help them build their identities as women in research, and to introduce them to others on campus and elsewhere in the Drexel network who support and encourage them in their current and future goals.

The Frances Velay Science Fellowships have been created in the memory of Frances Velay, a remarkable scientist, artist, musician, and citizen, to assist undergraduate women in the Greater Philadelphia area increase their opportunities to pursue science careers. This opportunity is provided to support individual research efforts in the hope the Fellowship recipients will embody the spirit and determination Frances Velay brought to her work and life.

We would like to thank the Panaphil and Uphill Foundations for their generous support of undergraduate research and women in STEM, as well as the faculty mentors, graduate students, and industry professionals who have come together to support these exceptional young women throughout the summer.

INDEX BY STUDENT LAST NAME

Each student's name is followed by easel location (indicated in parentheses) and the page on which their abstract appears.

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SPECIAL THANKS

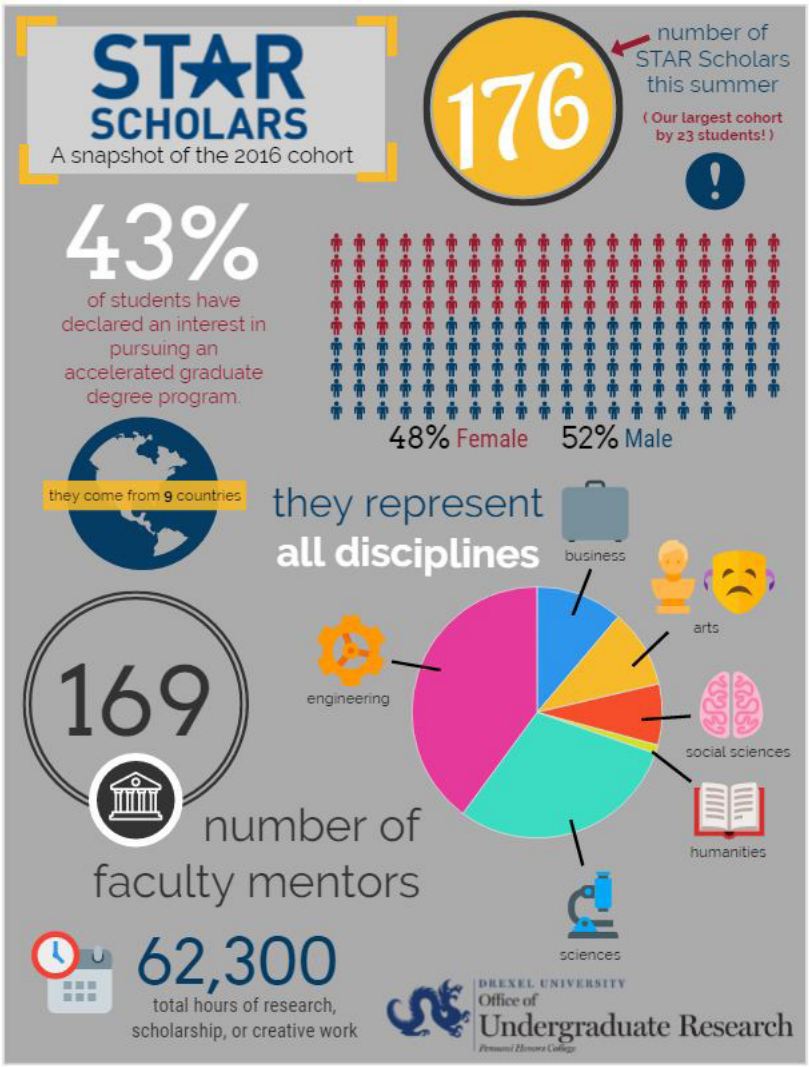
We would like to extend our sincere gratitude to all Faculty Mentors, Graduate Students, and others at Drexel University who have helped teach, guide, and mentor these STAR Scholars.

The STAR Scholars Program helps shape these students' academic and profesional futures for years to come, and it would not be possible without your participation.

We applaud and thank you.

DREXEL UNIVERSITY
Office of
Undergraduate Research
Pennoni Honors College

2016 STAR Cohort @ a Glance



STAR SCHOLARS

The STAR Scholars Program is
administered by the Office of Undergraduate Research,
a unit of the Pennoni Honors College.

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