18th Annual Gemstone Honors Program Thesis Conference

Friday, April 21, 2017
University of Maryland, College Park
Samuel Riggs IV Alumni Center

Gemstone Staff

Dr. Frank J. Coale, Director
Dr. Kristan C. Skendall, Associate Director
Dr. Vickie E. Hill, Assistant Director for Operations
Leah K. Tobin, Assistant Director for Student Engagement
Jessica Lee, Coordinator for Student Engagement

Please join us…

You are cordially invited to attend

The 18th Annual
Gemstone Citation Ceremony
Thursday, May 18, 2017
7:00 PM

University of Maryland Memorial Chapel
College Park, Maryland

Thesis Conference Schedule

Time	Team	Room
1:30-2:15 PM	CATTAILS	Ballroom A
	STRIDE	Doetsch (B)
	MORALS	Heise (C)
2:45-3:30 PM	NATURE	Ballroom A
	MTB	Doetsch (B)
	DREAM	Heise (C)
4:00-4:45 PM	SCOPE	Ballroom A
	VESSEL	Doetsch (B)
	INJECT	Heise (C)
5:15-6:00 PM	PIEZO	Ballroom A
	DIRE	Doetsch (B)
	MagNET	Heise (C)
6:00-7:30 PM	Please join us for a reception in the Rotunda	

Throughout the day, please view the work of our first-year students and junior teams, displayed in the Rotunda and in the hallway outside of the presentation rooms.

CATTAILS: Evaluating the Efficacy of Cattail (*Typha spp.*) Fiber for Oil Sorption

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Delaney M. Jordan, Materials Science & Engineering
Victoria L. Monsaint-Queeney, Environmental Science & Technology and English
Mitul P. Patel, Environmental Science & Technology; Law & Society: Environmental Law and Geographical Information Science minors
Aayush Thapa, Materials Science & Engineering
Jennifer L. Wall, Ecology & Evolutionary Biology and Environmental Science Policy
Debra S. Yee, Biochemistry and Microbiology

Faculty Mentor
Dr. Joe Sullivan, Professor and Associate Dean, Agriculture and Natural Resources

Librarian
Dr. Kelley O'Neal, University Libraries, UMD

Discussants
Ed Levine, Response Operations Supervisor, NOAA
Dr. Andrew Baldwin, Director of Undergraduate Programs, Dept. of Environmental Science and Technology, UMD
Dr. Gregory Schnaar, Lecturer, Dept. of Environmental Science and Policy, UMD
Dr. Carl Hershner, Director, Center for Coastal Resources Management, Virginia Institute of Marine Science
Dr. Bryan Eichhorn, Professor, Dept. of Chemistry and Biochemistry, UMD

Research Description
Oil spills pose a serious threat to marine life, the environment, and human health. Current methods to remove oil from waterways and mitigate damage include burning, skimming, and synthetic sorbents; however, none of these are effective at removing enough oil to prevent environmental damage and all have substantial limitations. Recent literature has shown that cattail (Typha spp.) fibers have potential as natural oil sorbents due to their hydrophobic and lipophilic properties. Additionally, unlike currently used natural sorbents like cotton, cattail is a sustainable alternative. It is easily harvested, can be grown in a wide range of climates, and is a much more efficient use of water than cotton. The purpose of this study was to conduct a materials comparison between cattail fiber and other products such as cotton for application as a sorbent during oil spill cleanup and remediation. Oil sorption of cattail and cotton was measured and expressed as a gram-to-gram ratio of oil-to-fiber under a range of environmental conditions including temperature and water salinity. Both materials demonstrated excellent oil sorption but cattail showed much greater hydrophobicity than cotton. Sorption was not dramatically altered in either product by temperature or salinity. These results demonstrate that cattail would be a better solution than cotton since it is much more selective for oil compared to water sorption, and they supply information necessary for future developments in sorbent technology using cattails.

Acknowledgements
We would like to thank the Department of Plant Science and Landscape Architecture and the Research Greenhouse Complex for laboratory space and plant growth facilities. In particular we'd like to thank Sydney Wallace, Greenhouse Manager, and Meghan Fisher-Holbert, Agricultural Technician Supervisor, for their advice and support in the cultivation of our cattail plants. We also want to acknowledge and thank the Gemstone Program, the University of Maryland Library System, the Maryland Environmental Trust and Maryland State Highway Administration, and the Maryland Sea Grant for providing financial support for this study. We could not have completed this research without your support. We also want to especially thank the discussants for their time, attention, and valuable suggestions to improve this Thesis.

DIRE: Dark Internet: An Exploration of Culture and User Experience

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Librarian
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Discussants
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Dr. Paul Rodrigues, Assistant Research Scientist, VPR – Center for Advanced Study of Language
Dr. Peter Mallios, Associate Professor, Maryland Institute for Technology in the Humanities, UMD
Dr. Paul Syverson, Mathematician, U.S. Naval Research Laboratory

Research Description
Our research sought to investigate the culture of the Dark Internet through a combination of cultural analysis and experiential learning. We split our research into three major portions: analysis of culture of the Dark Internet through the way it is viewed by various media outlets and on the Dark Internet itself; how the culture of the Dark Internet reacts in times of crises; and a comparison of the experience of the users of Dark Internet marketplaces versus users of traditional Internet marketplaces. Our cultural analysis was accomplished through the use of textual coding; by coding the articles, forums, and pages that we were gathering; we were able to find and observe key commonalities in behavior and communication among the sources. We also went through the process of purchasing goods from both Dark Internet marketplaces and traditional Internet marketplaces allowing us to compare the experiences in a variety of ways including: ease of access, ease of purchase, delivery time, etc. This research aims to provide further insight into the nature of the Dark Internet and open the way for future research into this ever-changing culture.

Acknowledgements
Team DIRE would like to acknowledge many people for their help and support through our time in Gemstone. We would not have achieved our goals without the love and support of our families and we would like to thank them for their constant support of our project. We would like to acknowledge our librarian, Eric Cartier, for his early guidance in our search for literature. We would also like to acknowledge our mentor, Jon Hoffman, for his support and guidance through the many trials and roadblocks that we encountered. Finally, we would like to acknowledge the Gemstone staff for their support throughout our time in Gemstone and their flexibility in dealing with our unconventional project.

DREAM: Characterizing rTg4510 Mice Model on Neurogenesis and Cognitive Function

Research Team

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Melinda M. Matos, Biological Sciences and Psychology; Business minor
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Faculty Mentor

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Discussants

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Research Description

Alzheimer's Disease (AD) is a debilitating illness that affects millions of Americans each year. Many hypotheses of AD exist, including the cholinergic model, amyloid beta hypothesis, and tau pathology model. The rTg4510 mouse model over-expresses inducible human mutant tau (P301L), a pathological hallmark of AD. This study characterizes the rTg4510 mouse model through analysis of neurogenesis in the olfactory bulb, which is one of the first parts of the brain to be affected by AD, and behavioral changes in different age groups, specifically two months and seven months. Several behavioral paradigms, such as habituation/dishabituation, odor detection threshold, and novel object recognition, were executed to assess cognitive function of these mice, especially in relation to markers of olfactory behavior. Observed data suggests that there potentially is age-dependent cognitive impairment and associated age-dependent decline in neurogenesis. Further study is required to identify the effects of inducing the mutant tau on neurogenesis in the olfactory bulb and whether the overexpression of tau directly impacts cognitive decline.

Acknowledgements

We would like to thank Dr. Ricardo Araneda, our mentor, for providing us with continuous guidance, insight, and expertise as well as lab space, necessary equipment, and materials. We would also like to give special thanks to Krista Krahe, the lab's research assistant, for her support and guidance in the lab as well as one semester as our mentor. Thank you to all the LaunchUMD donors, especially Shaun McDuffee of the Stop Alzheimer's Now Foundation who has gifted us with an incredibly generous donation. We would like to thank all the lab members who have given us assistance in times of need throughout our project. Thank you to Dr. Kristan Skendall, Dr. Frank Coale, and the Gemstone staff for their support on team building. Lastly, thank you to Dr. Kara Duffy, Dr. Quentin Gaudry, Dr. Erica Glasper Andrews, Dr. Hadiya Woodham, and Dr. David Yager for agreeing to be our discussants during our Thesis Conference.

INJECT: Characterization and Evaluation of Curcumin-loaded Nanoliposomes for the Prevention and Treatment of Age-related Macular Degeneration

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Faculty Mentor

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Librarian

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Discussants

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Research Description

Age-related macular degeneration (AMD), the leading cause of vision loss for people age 50 and over, is a disease characterized by the buildup of oxidative stress in the back of the eye. Current remedies are limited to intravitreal injections that only target the more severe 'wet' form; the common 'dry' form has no readily available pharmaceutical solution. Curcumin, a natural antioxidant found in the spice turmeric, has shown potential in combating inflammatory diseases like AMD. However, its use is limited due to its hydrophobicity and poor bioavailability. We have created a curcumin-loaded nanoliposome that can be delivered noninvasively to potentially treat and prevent the onset of AMD. The nanoliposome was synthesized via rotary evaporation by using phosphatidylcholine, cholesterol, and curcumin, then characterized through dynamic light scattering and UV-visible spectroscopy. The curcumin-loaded nanoliposome was assessed using an *in vitro* oxidative stress model with ARPE-19 cells. Peroxide (H_2O_2) was pulse delivered to ARPE-19 cells for 24 hours. *Ex vivo* modeling was used to test the permeability of the nanoliposomes to the posterior hemisphere of a porcine eye. Results showed that curcumin-loaded nanoliposomes were successfully synthesized with a mean diameter less than 300 nm. *In vitro* studies demonstrated that the administration of curcumin-loaded nanoliposomes increased cell viability while the testing of oxidative biomarkers confirmed the protective properties of the nanoliposomes. Qualitative fluorescence analysis following *ex vivo* experimentation showed that the nanoliposomes were able to permeate through the different layers of the eye and reach the retina, our main target.

Acknowledgements

First and foremost, Team INJECT would like to thank Dr. Helim Aranda-Espinoza for his invaluable guidance, time, and resources along every step of our research. We would like to thank Dr. Katrina Adlerz, the Cell Biophysics, the Biotherapeutic Development and Drug Delivery, and the Tissue Engineering and Biomaterials lab groups for their guidance. To the Gemstone staff, thank you for your support, encouragement, and this truly unique opportunity and experience. To Dr. Justin Kerr, thank you for your expertise and helping hand. To Ms. Yan Guo, thank you for your laboratory training. To Dr. Giuliano Scarcelli and his lab group, thank you for your help with our *ex vivo* studies. Thank you to our LaunchUMD donors and the UMD Libraries for making our research possible. Without any of these people or our friends and family, we would not be where we are today!

MagNET: Magnetic Field Manipulation as a Means of Stabilization

Research Team

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Discussants

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Dr. Daniel Lathrop, Professor, Department of Physics and Geology, UMD
Dr. Robert Sanner, Associate Professor and Director of Undergraduate Studies, Department of Aerospace Engineering, UMD
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Research Description

Magnetic levitation technology is rapidly evolving, yet its applications to magnetic stabilization have not been fully explored. The goal of our research was to modify current magnetic levitation technology and create a proof-of-concept that paves the way for future research that more specifically explores the real-world applications of magnetic stabilization. As such, our research was primarily focused on developing a system that could stabilize a levitating magnet using solenoids. To accomplish this, we used the data we gathered on several permanent magnets to ensure proper solenoid calibration. We then developed code for a microcontroller with a real-time operating system to interface with the system's circuit components. We formulated the microcontroller's code by adapting a general control algorithm to effectively make micro-adjustments to the current provided to our inductors. Our code used the real-time data gathered by a custom hall-effect sensor array to make the necessary adjustments to achieve stabilization and levitation. Our findings and methods for code development show encouraging results, and suggest that further improvements to the design and calibration of our system should be explored in order to refine our proof-of-concept for specific applications.

Acknowledgements

We would like to acknowledge all those that have helped us in our research: our former teammate Emma Holms; our Mentor Dr. Frank Coale; our previous Mentor Dr. R. D. Gomez; and the Gemstone staff-Dr. Kristan Skendall, Dr. Vickie Hill, Leah Tobin, and Jessica Lee. We would also like to thank our Librarian Ms. Jesse Sigman; our former librarians Robin Dassler and Nevenka Zdravskovska; and expert advisors Dr. Jungho Kim, Dr. Bruce Jacob, and Mr. Martin Nelson. Finally, we would like to extend the most gracious of thanks to our Launch UMD donors, without whose contributions we would have been unable to support our research endeavors.

MORALS: More Disagreement, Less Polarization: Let's Chat

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Paul Monteiro, Board of Governors, Wesley Theological Seminary

Research Description

A prevailing belief is that Americans hold a shared set of values that is informed by our nation's founding documents. It is puzzling, then, to have to acknowledge that the United States is at its most polarized since Reconstruction. We examined possible explanations for the tension between Americans holding a shared set of values and their being highly polarized, especially concerning abortion, capital punishment, gun control, and same-sex marriage. We uncovered four main results: (1) there is more consensus about which values are most pertinent for capital punishment and gun control than for abortion and same-sex marriage; (2) the value that an individual ranked as most pertinent is predictive of how an individual judges an issue in both moral and policy terms; (3) the differential impact of how a value is defined is evident only when there is consensus about most pertinent value; and (4) demographic factors are more influential in predicting how an individual judges an issue in both moral and policy terms when there is no consensus on most pertinent value for an issue.

Acknowledgements

We would like to thank our mentor Dr. Susan Dwyer, the Gemstone staff, and all of our Launch UMD donors for their generous support. We would also like to thank Dr. John McCauley and Dr. Alan Lehman for their guidance on statistical analysis, as well as our thesis discussants for their expertise and feedback. Finally, we would like to thank our family and friends for supporting us throughout the entire research process.

MTB: Inhibition of Protein-protein Interactions in *Mycobacterium tuberculosis*

Research Team

Paige A. Chan, Bioengineering
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Elizabeth M. Corley, Biochemistry; Philosophy minor
Isaac H. Jeong, Physiology & Neurobiology
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Faculty Mentor

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Discussants

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Dr. Patricia Shields, Senior Lecturer, Department of Cell Biology and Molecular Genetics, UMD
Dr. Daniel Stein, Professor, Department of Cell Biology and Molecular Genetics, UMD

Research Description

Tuberculosis is a highly contagious, infectious disease that kills about 1.8 million people annually. Currently, the disease has suboptimal treatment due to the rise of multidrug resistant strains of *Mycobacterium tuberculosis* (Mtb), the causative bacterial agent of tuberculosis. Therefore, we worked to identify novel drugs that interfere with Mtb virulence mechanisms. We used the mycobacterial protein fragment complementation (M-PFC) assay to screen a 725 compound drug panel to find candidate drugs that interfered with type VII secretion systems or the two-component regulatory signal transduction systems of Mtb. As a result of this assay, we discovered novel drug candidates for the treatment of tuberculosis as well as drugs compounds that are not suitable for this type of inhibition. We hope that in the future our novel drug candidates can be transitioned into animal and hopefully clinical trials.

Acknowledgements

We would like to thank the Gemstone Program, our mentor Dr. Volker Briken, Dr. Jeffrey Quigley and the rest of the Briken lab for their guidance and support throughout our project. We would like to thank our librarians, Jeremy Garritano and Dr. Svetla Baykoucheva. We would like to thank Launch UMD, and all of our Launch UMD donors, especially Michael Chan, Elizabeth Nenortas, Dennis Kim, Wenbin Tuo, Charu Murthy, and Ming Zhang, and Xiufen Sui. Finally, we would like to thank our Thesis Conference discussants, Dr. McIver, Dr. Frauwirth, Dr. Shields, and Dr. Stein.

NATURE: Cellulose Nanopaper: A study of composition and surface modifications to develop sustainably-sourced alternatives to plastics

Research Team

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Faculty Mentor

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Discussants

Dr. Jeffrey Gilman, Project Leader of Functional Polymers Group, National Institute of Standards and Technology (NIST)
Dr. Tian Li, Postdoctoral Researcher, Department of Materials Science and Engineering, UMD
Alex Pearse, PhD Student, Rubloff Research Group, Department of Materials Science and Engineering, UMD
Dr. Ian White, Associate Professor, Fischell Department of Bioengineering, UMD

Research Description

Pollution from the fossil fuel-powered production of plastics presents a serious threat to the planet's environmental health. To address this issue, Team NATURE found cellulose nanopaper (CNP) to be an abundant, sustainably-sourced potential alternative. Initially derived from wood pulp, CNP is a type of paper comprised of a network of nanosized cellulose fibers. Although CNP has exhibited remarkable optical transparency, porosity, and stiffness, we identified the need for improvement in its chemical and electrical properties. Optimizing these properties would allow CNP to function in flexible electronic systems. We identified the most effective treatments to increase CNP's functionality by altering the paper through several surface processing experiments. These treatments included altering the source of cellulose, performing atomic layer deposition (ALD), conducting surface esterification reactions, and applying transparent, conductive coatings. Along with conventional pine fibers, we have made CNP with longer cellulose fibers from the jute plant. Sequential, uniform deposition of Al_2O_3 films via ALD was also implemented for added stability. The surface of the CNP was treated with organic acids to yield nonpolar ester groups, with the goal of increasing water resistance. Finally, carbon nanotube ink coatings demonstrated an increase in sheet resistance. After the treatments, Team NATURE characterized material properties including strength, flexibility, water resistance, conductivity, surface smoothness, and transparency. Improvements in hydrophobicity, conductivity, and surface smoothness were observed. These findings are promising as ways to improve the functionality of CNP without dramatically altering its high transparency and flexibility.

Acknowledgements

We thank our mentor, Dr. Liangbing Hu, for all of his educational support, countless hours of time, and dedication to our research project. We also thank the BingNano Group, Dr. David Stewart, Jianwei Song, and our wonderful teaching assistants, Yonggang Yao and Nathaniel Jang for their assistance and guidance. Thank you also to Dr. Frank Coale, Dr. Kristen Skendall, and the rest of the Gemstone staff for their constant support. We thank our thesis proposal and defense panel members: Dr. Raymond Phaneuf, Dr. Jeremy Munday, Dr. Tian Li, Dr. Jeffrey Gilman, Dr. Ian White, and Alex Pearse. We thank our librarians, Robin Dasler and Nevenka Zdravkovska, for research advice. We thank the donors and staff that contributed to the success of our LaunchUMD campaign, and the Sustainability Grant for helping us fund our research. Finally, we thank our friends and families for supporting us throughout the duration of this project.

PIEZO: Piezoelectric Sensing and Energy Harvesting in Touchscreens

Research Team
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Research Description
Team Piezo investigated the increasing demands on smartphone batteries by developing a touchscreen prototype that integrates piezoelectric materials to sense touch location and generate energy for the battery. The touchscreen prototype uses a piezoelectric element with patterned electrodes that extract a current when touched. A circuit with an Arduino microcontroller successfully senses the location of the activated piezoelectric sections. The team designed several prototypes and conducted testing to evaluate performance and electrical response. Methods of extracting and storing energy were investigated, however storage was not successful enough to integrate into the prototype. Phone usage data was collected with surveys and was compared to power output of the touchscreen system to determine the theoretical amount of retrievable energy for future development.

Acknowledgements
Team PIEZO would like to acknowledge the Gemstone staff: Dr. Coale, Dr. Skendall, Leah Kreimer Tobin, Jessica Lee, and Vickie Hill for all their support throughout this process. We would also like to extend a huge thank you to our mentor, Dr. Bao Yang, for his guidance and assistance with our research. We would like to recognize our librarians, Alex Carroll and Jim Miller for their help with our literature review and patent search. We also could not have completed our prototype fabrication without the help of Thomas Loughran and the Maryland NanoCenter FabLab staff. In addition, Andrea Dragan and the Institutional Review Board staff were essential to the success of our surveys. Finally, the team would like to acknowledge the University of Maryland Sustainability Fund and the Office of Technology and Commercialization for their support. Thank you!

SCOPE: Integration of object recognition and natural language interaction for assistive robotics with medical applications

Research Team

John M. Bachkosky VI, Aerospace Engineering
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Faculty Mentor

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Librarian

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Discussants

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John Purtilo, Project Manager, FedCentric Technologies
Dr. Beth St. Jean, Assistant Professor, School of Public Health, UMD

Research Description

Team SCOPE has created an assistive robot for healthcare delivery. The robot is mobile, responds to spoken English commands, and possesses artificial intelligence (AI) so it “understands” conversations with patients about their ailments. It extracts meanings relevant to the patient’s health from these conversations, from its visual interaction with the patient, and from its surroundings. It then summarizes and merges these observations into reports that are merged with the patient’s online electronic health records. The robot achieves these functions to aid healthcare professionals in performing routine tasks and documentation by using cloud-based AI services such as IBM Watson, which are integrated with onboard processing. A Microsoft Kinect implements image segmentation and cloud services provide the backend for natural language interaction (NLI), object recognition, and healthcare intelligence. Dialogs for medical applications were constructed based on medical literature, and on hypothetical conversations with patients with potential ailments (e.g. chest pain). A summary form for the healthcare professional is then generated from the results of the conversation. Using Vex Robotics parts and sensors controlled by an Arduino microcontroller, SCOPE has created a mobile platform for the assistive robot. The robotic platform implements basic motions and obstacle avoidance algorithms using the Kinect and distance sensors. Technically the AI implementation connects NLI, vocal processing, image recognition, mobility, and location awareness systems, integrated using a Java driver program, Node Red, and remote IBM Watson cloud services. The resulting AI can be expanded for different applications within healthcare delivery.

Acknowledgements

We would like to thank our mentor Dr. Anil Deane for his guidance over the past 3 years, our discussants Dr. Gilmer Blankenship, Dr. Beth St. Jeane, and Mr. John Purtilo for their review and consultation of our research, our librarian Ms. Elizabeth Soergel, and the Gemstone staff for their continuous support.

STRIDE: Dopaminergic Signaling and Oxytocin Administration in a Rat Model of Empathy

Research Team
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Research Description

The rat model is commonly used to study prosocial and empathetic behavior. However, the neural underpinnings of such behavior is unknown. We investigated the potential roles dopamine (DA) and oxytocin (OT) in empathetic and prosocial behavior of rats. Our first experiment used a Pavlovian association task with two rats to investigate how DA release was modulated by social context. This experiment used fast-scan cyclic voltammetry (FSCV) to measure subsecond DA release. Consistent with previous work, cues that predicted reward were associated with increased DA release, and cues that predicted shock inhibited DA release non-discriminately across trial types. However, during shock trials, DA release was modulated by social context in two ways. First, reductions in DA release during shock trials were weaker in the presence of the conspecific, suggesting a consoling effect which was supported by approach behavior. Second, DA release during shock trials increased when shock was administered to the conspecific, suggesting that recording rats were using the emotional reactions of the conspecific to verify personal safety. We concluded that DA release is modulated by social context in that rats use social cues to optimize predictions about their own well-being. In our second experiment, we investigated the influence of oxytocin on prosocial behaviors. OT was administered intranasally prior to a distress task in which a lever press resulted in reward delivery and one of three additional outcomes: no-shock (reward only), shock to engaged rat, or shock to the conspecific. Results demonstrated that oxytocin did not significantly increase prosocial behaviors.

Acknowledgements
We would like to acknowledge Brian Lee, John Mallon, Nick Woytowitz, for all of their help in the lab with surgeries, data collection, data analysis, and video scoring; Dr. Frank Coale, Dr. Kristan Skendall, Dr. Vickie Hill, Leah Kreimer Tobin, and Jessica Lee as members of the Gemstone staff for supporting our research endeavors; our Launch UMD donors for funding our oxytocin experiment and travel to a professional conference; our team librarians Nedelina Tchangalova and Jeremy Garritano; and our discussants for their expertise and feedback at today's thesis defense.

VESSEL: Electrospun small-diameter silk fibroin vascular grafts with tuned mechanical and biocompatibility properties as tissue engineered scaffolds

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Faculty Mentor
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Discussants
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Dr. Sira Duson, Assistant Professor of Surgery, University of Maryland Medical Center, University of Maryland School of Medicine
Dr. Steven Jay, Assistant Professor, Fischell Department of Bioengineering, UMD
Dr. Justicia Opoku-Edusei, Senior Lecturer, Department of Biology, UMD

Research Description
Almost 9 million people in the U.S. have peripheral arterial disease (PAD). In severe cases of PAD, arterial bypass surgery is a common treatment option to redirect flow around the problem area. However, for many elderly patients, this surgery is not feasible because of the limited availability of tissue to use for grafting, so there is a clinical need for engineered vascular grafts. As a replacement, engineered grafts attempt to mimic the properties of the native vessel using biomaterials. Despite success in large diameter vessel applications, small diameter grafts are still prone to a number of issues such as occlusion, hyperplasia, and thrombosis. Silk fibroin is a promising biomaterial for creating vascular grafts because of its demonstrated mechanical strength and biocompatibility. Our research established a method for electrospinning the silk fibroin onto a rotating mandrel for seamless grafts. Mechanical testing, including burst pressure and tensile strength tests, compared the strength of our grafts to that of the autologous vessel. Finally, biochemical modifications, aimed at both recruiting and proliferating HUVECs on the grafts, increased cell adhesion on the grafts *in vitro*.

Acknowledgements
We would like to thank everyone who supported us throughout this project. First, our mentor, Dr. Adam Hsieh, and other members of the OML lab — Dr. Hyunchul Kim, Poonam Sharma, and Lauren Resutek — for their guidance, resources, and assistance in our project. Our librarian, Eileen Harrington, and the Gemstone staff have continuously provided support. The Hu, Jay, Scarcelli, Kofinas, Fisher, White, and Kaplan (Tufts University) labs contributed resources, training, and advice. Finally, many thanks to our families and friends for believing in us throughout these past four years. Funding was provided by Gemstone, the UMD Libraries, and our Launch UMD donors.

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ARM IT: VR Operated UAV

Team Members: Ryan Collins, Joshua Gaus, Kathryn Jahn, Michael Jurrens, Saimouli Katragadda, Kaitlin Krejcik, Arun Kulkarni, Xincheng Li, Eileen Liu, Colin McNulty, Benedict Mondal, Matthew Weston-Dawkes, Tiffany Yen
Faculty Mentor: Dr. Anil Deane, Research Associate Professor, Institute for Physical Science and Technology; Director, Laboratory for Computation and Visualization, UMD
Librarian: Celina McDonald, University Libraries, UMD

Research Description
Search and rescue operations are challenging due to the limited time in which to locate the subject, the hazards imposed on the rescuer and the difficulties of the non-local distribution of the full rescue team. Team ARM IT has been developing a virtual and augmented reality interface that controls a mounted camera payload on an unmanned aerial vehicle through a head mounted display. This allows rescuers to manipulate an unmanned aerial vehicle to assist search and rescue missions safely and effectively through telepresence and enhanced situational awareness. We planned to test our hypotheses by prototyping, testing, and refining individual components of the system through the use of flight simulation software and on-site testing. By providing a realistic sense of the UAV environment enhanced with relevant information, our project will reduce the danger to the rescuers and provide cognitively natural situational awareness.

BACTERIA: Using Enzymatic Combinations to Treat Asphaltene Aggregation

Team Members: Julia Abolafia, Jack Cowan, Anna Harrison, Jackson Hensley, Danme Kim, Wing-Mei Ko, Megan Le, Hema Manivannan, Lorena Rivera Rubio, Prateeti Sarker, Radhika Tyagi
Faculty Mentor: Dr. Siddhartha Das, Assistant Professor, Department of Mechanical Engineering
Librarian: Eileen Harrington, University Libraries, UMD

Research Description
We conducted research with the goal of determining an optimal mixture of enzymes produced that would effectively and significantly reduce asphaltene aggregates in heavy crude oil, or bitumen. Asphaltenes tend to flocculate to form nanoaggregates on the walls of pipelines, creating both safety and environmental hazards as well as decreasing the efficiency of oil transportation. Conventional methods of asphaltene reduction utilize chemicals that are both energy-intensive and expensive; thus, a biological method of deflocculation would improve the sustainability of oil transportation. We hypothesized that a mixture of enzymes would most effectively degrade asphaltenes due to the decrease in the energy barrier for oxidation. Furthermore, we predicted that the enzymes would work synergistically to reduce asphaltene flocculation. The three enzymes we selected for experimentation act as the driving force for the reduction of asphaltenes in microbial-enhanced oil recovery (MEOR), a method of oil refinement: chloroperoxidase, dioxygenase, and laccase. Thus far, we have determined a flocculation curve for the precipitation of asphaltene in n-heptane to serve as a basis for comparison with the flocculation of enzyme-treated asphaltene samples. The curve demonstrates saturation, exhibiting a maximum value of asphaltene precipitation of approximately 50%. Our future research entails conducting experiments to determine whether the enzymes laccase, chloroperoxidase, and dioxygenase reduce the flocculation of asphaltene and ultimately determine an optimal mixture of enzymes for the reduction of asphaltene aggregation.

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Biases: Bilingual Internet Approaches to Systematically Examine Sources

Team Members Brianna Caljean, Katherine Calvert, Ashley Chang, Elliot Frank, Rosana Garay, Cassidy Laidlaw, John McAninley, Geoffrey Palo, Ryan Rinker, Gareth Weakly, Nicolette Wolfrey, William Zhang
Faculty Mentor: Dr. David Zajic, Assistant Research Scientist at the University of Maryland Center for Advanced Study of Language, UMD
Librarian: Eric Lindquist, University Libraries, UMD

Research Description
We proposed a method to automatically detect bias across large multilingual corpora by comparing topic distributions across languages. Using Wikipedia articles on the Cold War in English, Russian, and Spanish as a case study, we automatically placed Spanish articles on a spectrum between the English and Russian language viewpoints through a regression model based on topic distribution from Latent Dirichlet Allocation. In addition, we showed that this topic-coverage bias score did not correlate well with what human annotators perceived as bias. If humans and topic models looked for different cues in detecting bias, then topic modeling would be useful in helping humans detect bias that they otherwise would have missed.

BioCHIPS: Optimization of Microfluidic Devices via 3D-printing and Sensor Technology

Team Members: Joanne Chan, Chandni Dhamsania, Monil Ghodasra, Elana Laster, Kimberly Lo, Julie Mehta, Sarah Onimus, Mayuri Patel, Veda Ravishankar, Samuel Rombro, Yasasvhinie Santharam, Joy Wang, Jessica Yau
Faculty Mentor: Dr. William Bentley, Robert E. Fischell Distinguished Professor, Fischell Department of Bioengineering, UMD
Librarian: Nedelina Tchangalova, University Libraries, UMD

Research Description
Current research and modern discoveries have revolutionized drug delivery techniques, but there still remains ethical concerns and unreliable models that need to be addressed to improve overall efficiency and efficacy. In vivo and in vitro testing provide preliminary testing of drugs within specific cells and animal models but fail to provide an elaborate model to test complex interactions between the drugs on the organs and organ systems. This research strives to improve alternative methods of testing drugs and modeling diseases, focusing specifically on the gastrointestinal tract to create a superior gut-on-a-chip model through the integration of various types of sensors. The sensors serve to better replicate the conditions of the human gut and have measurable quantitative effect to analyze the effects of a potential treatment on a disease. The disease (Clostridium difficile infection) and treatment (vancomycin) has been chosen for testing the efficacy of the improved gut-on-a-chip model.

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BLOOD: Battling Leukemia by Optimizing Stem Cell Differentiation

Team Members: Michael Amedeo, Prableen Chowdhary, Aria Jalalian, Eric Lai, Amil Sahai, George Thomas, Akhil Uppalapati, Farah Vejzagic
Faculty Mentors: Dr. Nam Sun Wang, Associate Professor, Department of Chemical & Biomolecular Engineering, UMD
Librarian: Nedelina Tchangalova, University Libraries, UMD

Research Description
The aim of our research is to optimize Induced Pluripotent Stem Cell (iPSC) to Hematopoietic Stem Cell (HSC) differentiation by investigating the effects of OP9 cells in induction of differentiation. We are currently able to derive HSCs from iPSCs by co culturing the iPSCs with OP9 stromal cells. While this is an effective method of generating HSCs, our aim is to determine whether the OP9 cells are necessary to induce differentiation or if simply the proteins that OP9 cells secrete are sufficient. Furthermore, we look to isolate and identify the proteins that are responsible for the differentiation of the secreted proteins are found to be the cause for differentiation. The focus of the experiment is on the OP9 co-culturing methodology and the isolation of molecular components that are responsible for induced hematopoiesis. The results of this research will be critical in further understanding hematopoiesis and the engraftment potential of iPSCs in leukemia patients.

BREATHE: Biowalls Reducing Atmospheric Toxins in Indoor Environments

Team Members: Erica Brown, Gabrielle Enguillado, Robert McDermott, Nicole Palumbo, Jill Smith, Michelle Stanley, Morgan Sulzbach, Jaclyn Taylor
Faculty Mentors:
Dr. Andrew Ristvey, Clinical Professor, Department of Plant Science & Landscape Architecture, UMD
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Librarian: Dr. Svetla Baykoucheva, University Libraries, UMD

Research Description
Harmful volatile organic compounds (VOCs) are present in indoor air at concentrations that are on average ten times higher than outdoor air due to common industrial and household materials. These VOCs contribute to health problems including headaches, dizziness, nausea, and, in extreme scenarios, cancer. Indoor biowalls present a solution to poor indoor air quality because of their ability to filter out these harmful compounds with microbial communities that are present on the plant roots, specifically the Hyphomicrobium genus. We identified four plant species commonly used in biowalls with a variety of root structures to test for differences in Hyphomicrobium spp. concentrations. Additionally, we selected four VOCs to use in our experiments. These plants and VOCs were chosen for their relevance, feasibility, and availability. We designed an aeroponics experiment to test for the ability of our plant species to host Hyphomicrobium spp. This setup includes an aeroponics chamber for each plant species with the selected VOCs added, as well as a mirrored control chamber for each plant. Further, we designed a hybrid biowall system to improve the efficiency of passive biowalls. This newly-designed system forces air into the irrigation system of the biowall, so that VOCs are dissolved into the water reservoir and brought directly to the roots of the plants. Future work includes completing the aeroponics testing for VOC levels and Hyphomicrobium spp. concentrations, and building prototype biowalls with and without our innovative passive biowall addition to assess the effectiveness of our system compared to a traditional biowall design.

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DRIVE: Expanding the Scope of Hybrid Technology

Team Members: Brendan Bradley, Clifton Buxbaum, Dain Golsen, Sean Haliyur, Nikhil Hosamane, Alan Kaplan, Avery Layne, Trisha Patel, Alexander Pique, Zachary Rodriguez, Zachary Spawn, Bryan Zeug
Faculty Mentor: Bryan Quinn, Director of Technical Operations, Department of Electrical Engineering, UMD
Librarian: Elizabeth Soergel and Nevenka Zdravkovska, University Libraries, UMD

Research Description
In order to increase the limited scope of hybrid technology, we researched the possibility of implementing a regenerative braking system in the form of an alternator onto the drive shaft of rear wheel (RWD) and all-wheel drive (AWD) cars. After researching sources of lost energy on the drivetrains of vehicles, CAD models of salient rotor prototypes were evaluated using ANSYS Maxwell in order to optimize pole geometry. Afterwards, we conducted an experiment in which the optimal salient rotor shapes were compared to a Lundell alternator in an experimental test rig that simulated the drive shaft of a vehicle.

GOLD: Evaluating the Properties of a Gallium-Conjugated Siderophore Complex as an Antibacterial Treatment

Team Members: Demetri Cendo, Parmida Enkeshafi, Paul Han, Cameron Harner, Rachel Herman, Margo Huffman, Faith Lee, Taylor Liu, Connie Nguyen
Faculty Mentor: Ben Woodard, Director, Biotechnology Research and Education program; Director, Bioprocess Scale-Up Facility (BSF), UMD
Librarian: Dr. Svetla Baykoucheva, University Libraries, UMD

Research Description
In 2013, the Centers for Disease Control and Prevention estimated that approximately two million individuals in the United States acquired antibiotic-resistant infections. Increasing rates of bacterial antibiotic resistance necessitates development of alternative treatments. Gallium-desferrioxamine (Ga-DFO), a gallium-chelated bacterial siderophore, offers a promising alternative. This treatment exploits bacteria's natural iron-uptake pathway to introduce toxic gallium ions into the cytoplasm. Previous research demonstrates that Ga-DFO is effective against several bacterial strains in ideal treatment conditions. This study expands knowledge about the complex by testing its effectiveness against additional strains of bacteria in different growth conditions and mammalian cell culture. If the treatment significantly decreases bacterial cell count without harming mammalian cells, Ga-DFO will have proven to be a viable alternative to traditional antibiotics.

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MATRIX: Developing an Extracellular Vesicle Based Treatment for Osteoarthritis

Team Members: Sumon Bhattacharya, Allison Chen, Stephanie Chill, Madelyn Golding, Danielle Lee, Thomas Mumford, Alex Pu, Mary Robichaux, Kayla Sukri, Jay Swayambunathan, Kellen Weigand
Faculty Mentor: Dr. Steve Jay, Assistant Professor, Fischell Department of Bioengineering, UMD
Librarian: Jim Miller and Elizabeth Soergel, University Libraries, UMD

Research Description
Osteoarthritis (OA), a disease characterized by the degradation of articular cartilage, affects millions of individuals worldwide. Existing treatments are invasive and are only able to alleviate symptoms of OA without addressing the root causes. Manipulating extracellular vesicle (EV) bioactivity may provide a solution to cartilage degradation. EVs are cargo-filled bodies that are involved in intercellular communication and OA pathogenesis. In this study, EV-based communication was studied and manipulated as a means of combatting OA. EVs derived from various cell types were delivered to OA chondrocytes, and any changes in OA pathology were quantified. Further experimentation will seek to identify EV contents able to promote positive change in OA chondrocytes to develop an effective treatment for reversing OA pathology.

PHAGE: Bacteriophage Disinfectant as a Solution to Listeria monocytogenes Biofilms

Team Members: Sarah Frail, Gina Liu, Grace MacAtee, Tejas Mavanur, Kerina Ochieng, William Peabody, Cara Purdy, Patrick Shan, Thomas Tran, Sarah Wain
Faculty Mentor: Dr. Debabrata Biswas, Associate Professor, Department of Animal and Avian Sciences, UMD
Librarian: Nedelina Tchangalova, University Libraries, UMD

Research Description
The infectious bacteria Listeria monocytogenes is a threat to public safety due to its prevalence in the food processing industry and immunity to traditional antibiotics, resulting in frequent recalls of common food items. Bacteriophage viruses have potential to penetrate the protective biofilm created by the bacteria and lyse them. Detergents of phage are currently employed in food processing environments, but are still relatively rare. L. monocytogenes growth was characterized, and L. monocytogenes specific phage A511 was grown. Treatments of phage were applied to L. monocytogenes cultures and titer was measured. Future research will focus on characterizing phage effect on biofilm, and further tests in mock industry environments.

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PRINT: Computer Aided Design Retention Based on Interface Designs

Team Members: David Alcantara, Ji Chang, Brian Choi, Mark Hubbert, Caroline Massey, Timothy Morrill, Patrick Musselman, Alexander Vecchioni, Andrew Wang
Faculty Mentor: Dr. Mark Fuge, Assistant Professor, Department of Mechanical Engineering, UMD
Librarian: Nevenka Zdravkovska, University Libraries, UMD

Research Description
Two problems integrated in traditional Computer Aided Design (CAD) software directly inhibit new CAD users from optimally learning CAD concepts. First, the symbols with which CAD operations are presented have never been vetted to ensure that they minimize the time new users take to associate CAD operations with their respective visual actions. Second, these symbols are not known to optimize the retention of CAD operations among new users. As a result, we are performing two studies: one to determine which symbols new users find most intuitively describe the actions performed by CAD operations, and one to determine which input method results in optimal retention and recall time of CAD concepts by new users. We have hypothesized that there exists a set of symbols that both decreases recall time and increases retention of CAD operations when utilized by students unfamiliar with CAD.

VIRUS: Viral Investigation of Regulatory Human Astrocytes to Understand the Glymphatic System

Team Members: Paul Butz, Lucas Cheng, Riddhi Gopal, Anna Lin, Folarin Onifade, Robin Sultan
Faculty Mentor: Dr. Yanjin Zhang, Associate Professor, Department of Veterinary Medicine, UMD
Librarian: Kelsey Corlett-Rivera, University Libraries, UMD

Research Description
Alzheimer's Disease (AD) is a major neurodegenerative disease that affects one in six people over the age of sixty-five. Alzheimer's Disease results from an accumulation of β-amyloid plaques caused by the failure of Aquaporin-4 (AQP4) to regulate cerebrospinal fluid (CSF) flow through the glymphatic system. The AQP4 experiences a downregulation in the presence of neuropathogenic Herpes Simplex Virus-1 (HSV-1). Using neurovirology and molecular biology methods, we plan to understand the impact of HSV-1 infection on the production and structural changes of the M23 tetraform isomer found in AQP4. Completion of this study will reveal insight into the role of HSV-1 infection in the downregulation of AQP4 and will contribute to the understanding of molecular regulation of the glymphatic system.

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