Welcome to the 2022 Works in Progress Symposium

The Helen Hardin Honors College is proud to sponsor the 2022 Works in Progress Symposium. This annual event provides a means for undergraduate students throughout the University to share their research with the general University community and recognizes the significant contribution to research by University of Memphis undergraduates.

Providing undergraduates with the opportunity to engage in scholarly research is important to our students' educational experience and professional development. To the faculty mentors who have guided their students along the way, we thank you for ensuring UofM students have every opportunity to pursue undergraduate research.

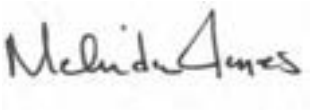
Thanks also to the faculty evaluators, who kindly provide feedback to the student presenters to better prepare their research projects for submission to professional conferences. We also thank our moderators for their assistance and support.

A special thanks is due to the incredible, hard-working Honors College team, without whom the planning of such an event would be impossible: Jonathan Holland, Assistant Director; Chetana Wilson, Coordinator of Recruitment and Engagement; Roselle Revelle, administrative secretary, the Honors College Student Ambassadors; and Amir Rouhollahi, doctoral student in English who designed the Works in Progress program book.

Finally, to the student presenters, congratulations for the quality research you have accomplished and for your participation in the Works in Progress Symposium. I hope you will consider submitting your research to QuaesitUM, the University of Memphis undergraduate research journal.

Welcome to the 2022 Works in Progress Symposium. We hope you will enjoy the conference and the students' presentations. Best wishes to all faculty, staff, and students who make this event possible.

Sincerely,



Melinda Jones, Ph.D.
Director

Acknowledgements

Faculty Evaluators

The Helen Hardin Honors College thanks the following faculty mentors for providing feedback to the student presenters:

Aaryani Sajja, Biomedical Engineering Amy Abell, Biological Sciences
Ali Sadeghianmaryan, Biomedical Engineering
Ben McCarty, Mathematical Sciences
Carl Herickhoff, Biomedical Engineering
Chris Hartless, Psychology
Daniel Baker, Chemistry
Daniel Foti, Mechanical Engineering
Douglas Powell, Health Sciences
Gary Bowlin, Biomedical Engineering
James Murphy, Psychology.
Joel Bumgardner, Biomedical Engineering
Josh Bush, Biomedical Engineering
Ladrica Menson-Furr, English
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Mohamed Laradji, Physics and Materials Science
Rajesh Balasubramanian, Engineering Technology
Roger Kreuz, Psychology
Sage Graham, English
Tammy Jones, English
Yuan Gao, Mechanical Engineering
Yue Guan, Mechanical Engineering

Faculty Mentors

The Helen Hardin Honors College gratefully acknowledges the following faculty sponsors whose mentoring has contributed to the research produced by our presenters:

Aaryani Sajja, Biomedical Engineering
Daniel Foti, Mechanical Engineering
Deranda Lester, Psychology
Douglas Powell, Health Sciences
Firouzeh Sabri, Physics and Material Science
Tomoko Fujiwara, Chemistry
Gary Bowlin, Biomedical Engineering
Jaime Sable, Biological Sciences
James McGinnis, Engineering Technology
Jeremy Tubbs, Music
Joel Bumgardner, Biomedical Engineering
Joel Roberts, Music
Jessica Jennings, Biomedical Engineering
Leigh Boardman, Biological Sciences
Lorinda Cohoon, English
Marcin Arendt, Music
Mark LeDoux, Psychology
Máté Wierdl, Mathematical Sciences
Maxime Paquette, Health Sciences
Reza Molaei, Mechanical Engineering
Stephanie Huette, Psychology
Stephen Turner, English
Thomas Hagen, Mathematical Sciences

Session Moderators

Thank you to the following individuals for serving as session moderators:

Angela Kuykendoll, UM Global
Bethany Prudente, International Student Services
Betsy Loe, Engineering
Brian Deal, Recruitment and Orientation
Brian Meredith, Graduate School
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Mandy Gaw, Honors Student Organization.
Peggy Callahan, Graduate School
Mar Newell, Graduate School
Taylor Duncan, Recruitment and Orientation

Design and Publication
Amir Rouhollahi, Honors College

Presentations (12:00-1:00)

Iris (338)

12:00 **Alix Kirkendol**

Engagement in Metacognition Among Undergraduate Biology Students

Mentor: Jaime Sabel, Biological Sciences

12:30 **Riley Morris**

Introduction to Ciphers in Cryptography

Mentor: James McGinnis, Engineering Technology

1:00 **Kimberly Baldwin**

Who's who in the Zoo Poo: Dung Insect Assemblages in Memphis

Mentor: Leigh Boardman, Biological Sciences

Bluff (304)

Lara van Heerden, Cesar Gutierrez Mendoza, and Victoria Sena

Evaluation and Analysis of Biomaterials Used in the Treatment for Periodontal Disease

Mentor: Joel Bumgardner, Biomedical Engineering

Samantha Hall

In-vitro Evaluation of Macrophage Inflammatory Profile in Response to Raspberry Ketone

Mentor: Joel Bumgardner, Biomedical Engineering

Haley Pruitt

Electrospun Chitosan Membranes Dually Loaded with Raspberry Ketone and Simvastatin to Determine Drug Delivery Rates for Guided Bone Regeneration

Mentor: Joel Bumgardner, Biomedical Engineering

Presentations (12:00-1:00)

Ballroom A (320A)

12:00 **Krista Dyer**

Fatigue of Additively Manufactured Ti-6Al-4V Cellular Structures under Uniaxial, Torsional, and Multiaxial Stresses

Mentor: Reza Molaei, Mechanical Engineering

12:30 **Noah Molder and Tyler Owens**

Gambling Paradoxes: Always Be the Winner

Mentors: Thomas Hagen and Mate Wierdl, Mathematical Sciences

1:00 **Elizabeth Betrous**

A Forgotten Violin Sonata

Mentor: Marcin Arendt, Music

Poplar (308)

Steven Go, Lauren Carter, and Thomas Yates

Development of Glaucoma Biomaterial Devices for Improved Treatment

Mentor: Joel Bumgardner, Biomedical Engineering

Brandon Fuentes

Varying Negation Particle Location and its Effect on Language Learning

Mentor: Stephanie Huette, Psychology

Presentations (1:30-2:00)

Iris (338)

1:30 **Sedra Sous**

Investigating Undergraduate Students' Engagement in Systems Thinking Using Causal Maps

Mentor: Jaime Sabel, Biological Sciences

2:00

Bluff (304)

Jada Sandridge

Touch-spinning Polydioxanone and Polycaprolactone to Develop Small Diameter Vascular Grafts

Mentor: Gary Bowlin, Biomedical Engineering

Ethan Wales

Evaluation of Glutaraldehyde Crosslinked Chitosan-Elastin Electrospun Membranes for Skin Wounds

Mentor: Joel Bumgardner, Biomedical Engineering

Presentations (1:30-2:00)

Ballroom A (320A)

1:30 **Catherine Monroe**

Where Words Fail, Music Speaks

Mentor: Jeremy Tubbs, Music

2:00 **Sophie Wood**

Sub-grid Scale Characteristics of Godunov-based Schemes for Cavitating Two-Phase Flows

Mentor: Daniel Foti, Mechanical Engineering

Poplar (308)

Richard David Howe III

Comparative Depictions of Romance in Children's Literature: How LGBTQIA+ Representations Emphasize Their Age-Appropriate Subject Material by Mirroring Similar Stories in Heterosexual Examples

Mentor: Lorinda Cohoon, English

Presentations (2:30-3:30)

Iris (338)

2:30 **Grayson Nelms**

Synthesis of Magnetic Fe3O4 Thin Films on PDMS and Aerogel Substrates to Repel Mars Regolith

Mentor: Firouzeh Sabri, Physics and Materials Science

3:00 **Farraday Johnson, Tamanna Ferdous, Tomoko Fujiwara**

Development of Micelle-Hydrogels for Controlled Dual Drug Delivery

Mentor: Tomoko Fujiwara

3:30

Bluff (304)

Dylan Thompson, Elizabeth Scheiderer, and Artis Hardaway

Deafness - a review of current and potential hearing devices

Mentor: Joel Bumgardner, Biomedical Engineering

Tibirni Yusuf

Cytocompatibility of Electrospun Chitosan Membranes Treated with Decanoic Anhydride and loaded with biofilm inhibitors and bupivacaine

Mentor: Jessica Jennings, Biomedical Engineering

Thomas Yates

Examining the Renal Lipidomic Effects of High-fat Diet and Sex in Nile Grass Rats using NMR Spectroscopy

Mentor: Aaryani Sajja, Biomedical Engineering

Presentations (2:30-4:00)

	Ballroom A (320A)	Poplar (308)
2:30	**Morgan Edwards**	**Olivia Tutor and Nada Herzallah**
	Examining the Effects of Chronic Unpredictable Stress on Mesolimbic Dopamine Release in Mice	Biomaterials Used for Breast Reconstruction
	Mentor: Deranda Lester, Psychology	Mentor: Joel Bumgardner
3:00	**Josie Steen**	**Jessica Fall**
	Measuring Preference for Social Stimuli in Mice	Effects of Breast Support on Trunk and Knee Joint Biomechanics in Female Collegiate Athletes During a Change of Direction Task
	Mentor: Deranda Lester, Psychology	Mentor: Douglas Powell, Health Sciences
3:30	**Kyla Anderson**	**Katherine Batista**
	Oxytocin's Influence on Dopamine Transmission in Relation to Estrous Cycle Changes	What Biomechanical Variables Are Predictors of Running Economy and Metabolic Power in Well-Trained Male Distance Runners?
	Mentor: Deranda Lester, Psychology	Mentor: Maxime Paquette, Health Science

Presentations (4:00)

	Iris (338)	Bluff (304)
4:00	**Katherine Luttrell**	**Jalyssa Smith, James Huang, and Georgia Hill**
	CNS Localization of Major and Long Gnal isoforms with Cell-Type Specificity	Infertility: A Biomedical Approach to the Inconceivable Dilemma
	Mentor: Mark LeDoux, Psychology	Mentor: Joel Bumgardner, Biomedical Engineering

Presentations (4:00)

	Ballroom A (320A)	Poplar (308)
4:00	**Reynara Amaryllis**	**Jalyssa Smith, James Huang, and Georgia Hill**
	Challenging the Acceptance of Opioid Stigma Through Education	Infertility: A Biomedical Approach to the Inconceivable Dilemma
	Mentor: Deranda Lester, Psychology	Mentor: Joel Bumgardner, Biomedical Engineering

Abstracts

ENGINEERING

Fatigue of Additively Manufactured Ti-6Al-4V Cellular Structures under Uniaxial, Torsional, and Multiaxial Stresses

Krista Dyer
Mentor: Reza Molaei, Mechanical Engineering

Additive manufacturing (AM) is a rising, largely applicable manufacturing procedure. The ability to build complex geometry components is one of the many advantages of AM. Included in these complex geometries are metallic cellular structures. These structures have a variety of applications in fields such as biomedical, automotive, and aerospace engineering. To ensure the full range of applications can be utilized, it is vital to understand the fatigue behaviors of the porous structures. Fatigue is the result of cyclic loading and may cause components to fail at much lower stresses than their ultimate or yield strengths. There is a major gap in the information with regards to loadings outside of compression-compression. The purpose of this study is to model and predict the fatigue properties and behavior of Ti-6Al-4V cellular structures, under uniaxial, torsional, and multiaxial loadings. This research is divided into three stages: manufacturing, testing, and modeling. For this project, all components are built using the Laser Powder Bed Fusion AM technique. Analysis of the test results will lead to a single numerical model to predict the fatigue behavior for different porosities under any combination of loading.

Development of Glaucoma Biomaterial Devices for Improved Treatment

Steven Go, Lauren Carter, and Thomas Yates
Mentor: Joel Bumgardner

Glaucoma is the degradation of the optic nerve fibers due to increased intraocular pressure (IOP). The elevated IOP is caused by substantial buildup of aqueous humor fluid within the eyeball which compresses the optic nerve and the surrounding blood vessels. Axonal damage not only causes death of the retinal ganglion cells but results in blurred eyesight and eventual complete loss of vision. Presently, there is no cure for the disease, but there are means of treatment. Today's technologies attempt to reduce this IOP by either draining the fluid of the eye or minimizing fluid flow obstruction. This research has holistically reviewed the clinical problem and currently applied biomaterial devices for effective development of an improved implant design concept that addresses the issue.

In-vitro Evaluation of Macrophage Inflammatory Profile in Response to Raspberry Ketone

Samantha Hall
Mentor: Joel Bumgardner, Biomedical Engineering

Guided bone regeneration (GBR) is a process used to enhance bone growth and treat alveolar bone loss when insufficient bone volume is present. GBR uses membranes to prevent soft tissue infiltration into areas of new bone growth. Previous studies have used GBR membranes for local drug delivery to promote wound healing. Macrophages, a type of white

blood cell, are key indicators of the wound healing process. As wound healing occurs, macrophages polarize from a pro-inflammatory phenotype (M1) to an anti-inflammatory and pro-healing phenotype (M2). Therefore, a strategy that can be implemented to facilitate wound healing is the promotion of macrophage polarization. Raspberry ketone (RK) is a natural phenolic compound that possesses antioxidant and anti-inflammatory properties. In previous studies, RK has shown promise in accelerating macrophage polarization. This study will use Raw 264.7 cells, a line of macrophage-like mouse cells, to assess the anti-inflammatory and pro-healing properties of RK in cell culture media. Lipopolysaccharide (LPS) will be used to activate the macrophages by initiating the production of pro-inflammatory mediators. After the addition of RK, the inflammatory response will be characterized through microarray analyses. Twenty cytokines will be measured, providing information on the inflammatory response and cell phenotype. For future work, the inflammatory properties of RK will be assessed in combination with Simvastatin, a known osteogenic promoter.

Evaluation and Analysis of Biomaterials Used in the Treatment for Periodontal Disease

Lara van Heerden, Cesar Gutierrez Mendoza, and Victoria Sena
Mentor: Joel Bumgardner, Biomedical Engineering

An estimated 14% of the global adult population suffers from severe periodontal disease according to WHO. Periodontal disease is the inflammation and infection of the gums and bone structures that surround the teeth. The disease causes tooth decay, attachment loss, and corrosion of the alveolar bone. The bacteria can also cause numerous health issues, such as cardiovascular disease and issues with diabetes. Periodontitis is more prevalent with an increase in age, with 70.1% of U.S. adults over 65 having periodontitis. It also affects the homeless and low-income populations more. There are several treatment options that are surgical and non-surgical. With less severe cases, scaling and antibiotics are recommended to control the bacterial infection. With advanced periodontitis, dental surgery is recommended, including soft tissue or bone grafts, tissue regeneration, tissue-stimulating proteins, or pocket reduction surgery. Different biomaterials have been used for the treatment and regeneration of periodontitis, such as Platelet-rich fibrin (PRF), natural and synthetic hydrogels, ceramics such as bioactive glass, and polymers like chitosan. The advantage of using biomaterials is that it aids in bone regeneration, whereas surgical treatment does not. To address issues due to the use of biomaterials, research should focus on how to improve the outcome of the biomaterial delivery systems. Using a combination of different therapies could improve future approaches.

Electrospun Chitosan Membranes Dually Loaded with Raspberry Ketone and Simvastatin to Determine Drug Delivery Rates for Guided Bone Regeneration

Haley Pruitt
Mentor: Joel Bumgardner, Biomedical Engineering

Guided bone regeneration (GBR) membranes have been used as a barrier between bone grafting sites and soft tissue. Electrospun chitosan membranes have shown potential in being used as a GBR membrane due to their nanofibrous structure which allows local drug delivery. Dual delivery of raspberry ketone, a natural phenolic compound that has immunomodulating properties and simvastatin, an anti-cholesterol drug that has secondary osteogenic effects, may lead to improved bone regeneration.

Electrospun chitosan membranes were modified with one of three different fatty acid (FA) anhydrides: hexanoic, butanoic, or acetic. Combinations of RK (0, 100 μg) and SMV (0, 50, 100, 250, 500 μg) were loaded onto the membranes. The membranes were suspended in phosphate buffer solution (PBS) which was collected at different intervals to examine the release profile of RK and SMV. Scanning electron microscopy (SEM) was used before and after the release study to determine if the nanofibrous structure of the membranes changed from being suspended in PBS. High performance liquid chromatography (HPLC) was used to determine the release rates of RK and SMV.

SEM images showed that the nanofibrous structure of the chitosan membranes remained intact after the 28-day release study was performed. HPLC showed a large burst release of RK from the membranes on day 1 for all three membrane treatments. HPLC will be used to determine release rates for the rest of the 28-day study for RK and SMV.

Touch-spinning Polydioxanone and Polycaprolactone to Develop Small Diameter Vascular Grafts

Jada Sandridge
Mentor: Gary Bowlin, Biomedical Engineering

Cardiovascular diseases are common conditions that affect the heart or blood vessels. These diseases can affect blood flow due to blood clots or narrowing of the blood vessels in a process known as atherosclerosis. Due to its prevalence, it is important to develop a vascular graft that can be used to replace or bypass a damaged vessel when there is a limited supply of autologous vessels. A current treatment is a synthetic vascular graft made from either e-PTFE® or Dacron®. While these grafts have had high success in diameters larger than 6 mm, there has been low success in diameters smaller than 6 mm due to rapid occlusion and thrombosis. To develop resorbable vascular grafts, spinning techniques, such as touch spinning, can be used. Touch spinning is a process that mechanically draws out fibers. Using this technique, the aim of this study will be to develop resorbable, small diameter vascular grafts that can be used as an alternative to autologous vessels in surgical procedures. Both polydioxanone (PDO) and polycaprolactone (PCL) will be dissolved in HFP separately. PDO will be used due to its high flexibility, mechanical strength, and degradation rate. PCL will be used due to high flexibility, elasticity, and degradation rate. The two types of grafts will be examined under a scanning electron microscope to further examine and validate the pattern of the fibers. Mechanical characterization will also be performed to determine their potential use as a vascular graft.

Infertility: A Biomedical Approach to the Inconceivable Dilemma

Jalyssa Smith, James Huang, and Georgia Hill
Mentor: Joel Bumgardner, Biomedical Engineering

The ability to reproduce is a trait intrinsically possessed by all living things. Due to various factors, however, some individuals are incapable of doing so successfully. For humans, this process requires the gametes of two heterosexual members of the same species to fuse together and become a fertilized egg. Once fertilized, the embryo must survive and develop for the duration of the gestational period before parturition. From a clinical standpoint, infertility occurs when a couple is unable to conceive after one year or unable to carry their child to live birth. In the United States alone, 15% of couples struggle with infertility. Moreover, infertility is multifaceted; several factors affect the fertility of an individual, including dysfunctional gametes, hormone

imbalances, environmental factors, age, and overall health. In our research, we investigated the pathology, diagnosis, demographics, and societal impacts behind infertility. In Vitro Fertilization (IVF) was then explored as one of the methods to combat infertility. The process of IVF includes retrieving mature eggs from a female's ovaries and fertilizing them with sperm in an environment outside of the human body, then implanted into the uterus during the optimal time of a female's menstrual cycle. From this study we aim to provide methods to optimize the in vitro fertilization process and potential global result if implemented.

Deafness - a review of current and potential hearing devices

Dylan Thompson, Elizabeth Scheiderer, and Artis Hardaway
Mentor: Joel Bumgardner, Biomedical Engineering

A comprehensive literature review of the effects, pathology, demographics, and societal impacts of severe to profound hearing loss was performed. Additionally, the current state of biomedical devices available was described and assessed. The project aims to develop an implant with consideration to the shortcomings of the current set of devices available.

Biomaterials Used for Breast Reconstruction

Olivia Tutorand Nada Herzallah
Mentor: Joel Bumgardner

Breast Cancer is a malignant disease that affects millions of women and men from all different races each year. It is defined as the rapid growth of cells within the breast region. Women are more likely to receive a breast cancer diagnosis than men due to a more complex breast tissue structure. After receiving a breast cancer diagnosis, some people opt to have a mastectomy, a procedure to remove the infected breast tissue. In cases where the breast cancer has metastasized to other body regions, a mastectomy is crucial to a positive prognosis outcome. After a mastectomy is performed, many patients follow the procedure with breast reconstruction. There are two main biomaterial devices currently used to replace lost tissue: breast implants and natural tissue flaps. Breast implants are typically made up of a saline filled solution or a silicone gel. Natural tissue flaps replace the lost breast tissue with skin and fat located from other regions of the body. Problems that can arise from breast implants due to biocompatibility issues are infection, autoimmune disorders, and ruptured implants. Natural tissue flaps face problems like abdominal weakness, necrosis, and blood clots. Most implants are only recommended for approximately 10-20 years in the body. To combat the issues that arise from current biomaterials used to reconstruct breast tissue, longevity and biocompatibility properties are being improved through bio-printing technology to create living tissue.

Evaluation of Glutaraldehyde Crosslinked Chitosan-Elastin Electrospun Membranes for Skin Wounds

Ethan Wales
Mentor: Joel Bumgardner, Biomedical Engineering

Electrospun, chitosan membranes (ESCM) have seen success for guided bone regeneration applications. Chitosan is a biodegradable, naturally occurring polysaccharide derived from crustacean exoskeleton that has many pro-healing properties applicable to other tissue. This biomaterial can also be mixed with other polymers, like elastin, to improve mechanical properties and bioactivity, increasing its healing capabilities. Specifically, the elastin-

polysaccharide nanofiber structure may serve as a template in skin tissue engineering applications. However, when untreated, the chitosan-elastin membrane's nanofiber structure is lost in aqueous environments leading to poor cytocompatibility. This has led researchers to develop post treatments to retain fibrous morphology including amine group neutralization, hydrophobic treatments, and crosslinking. This study explores the usage of glutaraldehyde as a crosslinker to prevent the loss of fibrous morphology of chitosan-elastin membranes in aqueous environments.

Electrospun samples were treated using glutaraldehyde vapor for 24 hrs. Sample characterization included SEM imaging for fiber diameter and morphology, degree of crosslinking, and cytocompatibility with normal human dermal fibroblasts (NHDF) cells. Cytocompatibility was evaluated using a resazurin fluorescence assay.

Ongoing work is being done with an animal model to evaluate the in-vivo compatibility, and characterization including mechanical properties and degradation behavior.

Examining the Renal Lipidomic Effects of High-fat Diet and Sex in Nile Grass Rats using NMR Spectroscopy

Thomas Yates
Mentor: Aaryani Sajja, Biomedical Engineering

A major issue in our society today is metabolic syndrome, a disease encompassing diabetes, obesity, insulin resistance, hypertension, and more. High fat diets have become increasingly common and tend to lead to complications associated with metabolic syndrome. NMR can be used to measure metabolite levels to distinguish the effects of different diets, drugs, and even genetics. Metabolite levels are also used to identify an organism or tissues phenotype. Most animal studies in dietary metabolomics research tend to only focus on one sex, however it is important to note that there is a difference between male and female metabolism. The purpose of this study is to examine the effects of a high-fat diet on renal metabolome of Nile Grass Rats and also observe if there are any sex differences between male and female metabolic profiles. Rats were placed on a regular chow diet and a high-fat diet. A modified Mayatosh extraction was used on kidney tissue and samples were scanned using an NMR spectrometer. Deconvolution was selected for lipids due to several important lipid resonances being of too low signal-to-noise ratio to be detected by CRAFT. To determine statistically significant difference between the diets and the sexes, two-way ANOVA was used. Statistical analysis of the quantified concentrations of the lipids showed no significant differences between the two diets. As for the aqueous metabolites there were little differences noted between diet and sex.

Cytocompatibility of Electrospun Chitosan Membranes Treated with Decanoic Anhydride and loaded with biofilm inhibitors and bupivacaine

Tibirni Yusuf
Mentor: Jessica Jennings, Biomedical Engineering

Cellular responses to loaded electrospun membranes have previously been shown to promote healing in wound applications such as burns by reducing pain, preventing infection, and modifying inflammatory responses through the release of local anesthetics. In this study, we will use RAW264.7 mouse cells, a transformed macrophage-like cell line, to observe expression of inflammatory and anti-inflammatory cytokines and cell response to decanoic anhydride (DA) treated chitosan membranes loaded with therapeutics, both with and without stimulation with

Lipopolysaccharide (LPS). RAW cells are generally loosely adherent and simple to detach from a plate, detaching after scraping the remaining adherent cells gently with a cell scraper. LPS is a bacterial polysaccharide that activates this macrophage cell type and drives them into inflammatory phenotypes present in wounded tissue. Macrophages are extremely sensitive to LPS endotoxin from Gram-negative bacteria. We will observe the effect of LPS on the cellular inflammatory response of RAW cells to DA treated chitosan membranes. Electrospun chitosan membranes treated with fatty acid decanoic anhydride were placed in a 24 well plate and loaded with either 0.15mg of anti-biofilm cis-2-decenoic aid (C2DA), 0.5 mg of local anesthetic Bupivacaine, or a combination of the two in ethanol. Each membrane was loaded with a total of 30 µL of solution, except for the unloaded membranes, which served as a control. Membranes will be exposed to RAW cells, both in the presence of LPS and not, to simulate acute response and inflammatory phases of wound healing. We hypothesize that these RAW cells will express inflammatory or anti-inflammatory proteins in the presence of different concentrations of therapeutics. RAW264.7 cells showed increased IL-10 production after 72 hours in all groups that had high concentrations of C2DA, with minimal production at 24 hours. The RAW264.7 cells also showed increases in TNF-alpha after 72 hours in simultaneous delivery groups delivering low to medium concentrations of the therapeutic molecules.

PHYSICAL AND APPLIED SCIENCES

Synthesis of Magnetic Fe3O4 Thin Films on PDMS and Aerogel Substrates to Repel Mars Regolith

Grayson Nelms
Mentor: Firouzeh Sabri, Physics and Materials Science

With the increased amount of space exploration trips to Mars, we have heavily encountered the problem of dust accumulation on surfaces. Even slight levels of dust can be troublesome for some aerospace equipment such as fine-tuned measuring machines, mechanically moving parts and gears, and especially with blocking light for solar panels. The accumulation of this Mar's regolith has proved to be extremely problematic and can dramatically shorten expensive missions to mars. In this work, we explore a solution to this, by creating magnetic Fe304 thin films with the goal of using the magnetic fields to repel the magnetic oxides largely compromising the Mars regolith. The Fe304 thin films are made using a PMMA resist on highly applicable aerospace surfaces of PDMS and aerogel. Both PMMA and PDMS are cheap, lightweight polymers that are easy to make and widely used in space travel. Aerogels are highly porous solids made from removing all liquid in a gel, which gives it its characteristic traits of being the lightest material and greatest insulator in the world. By using a spin coater, we can use centrifugal force to spread the liquid resists on these materials, making thin films, that can only be observed under electron microscopes. Along with the PMMA, other resists were used in attempts to optimize the thin film such as olive oil and magnetic ink. Each strategy had the goal to make a homogenous film with even coverage in order to create an orderly magnetic field.

Sub-grid Scale Characteristics of Godunov-based Schemes for Cavitating Two-Phase Flows

Sophie Wood
Mentor: Daniel Foti, Mechanical Engineering

Numerical accuracy of large-eddy simulations for cavitating flows decreases near discontinuities such as shock waves generated by vapor-bubble collapse, vapor-liquid phase boundaries, and complexities of solid boundaries. The errors can often be attributed to explicit sub-grid scale models. An alternative methodology, implicit large-eddy simulation, leverages the numerical discretization error of monotone, sharp-interface capturing schemes to mimic the physical dissipation rate. The characteristics of the
numerical dissipation rate and implicit sub-grid scale are detailed for a class of Godunov-based schemes for cavitating flows discretized in generalized curvilinear coordinates. Because the variable reconstruction is performed locally, the scheme can capture both discontinuities and low Mach number features. Leading terms of modified equation analysis confirm the dissipation behaviors. A series of cases are undertaken including two-phase shock tube, homogeneous isotropic turbulence, and cavitating flow over a cylinder, which employs a sharp-interface immersed boundary method for compressible flow. The turbulence spectra, statistics and void fraction profiles show good agreement with direct numerical simulation.

MATH AND COMPUTER SCIENCES

Introduction to Ciphers in Cryptography

Riley Morris
Mentor: James McGinnis, Engineering Technology

Security is a major deal in today's culture due to the accessibility of information over the internet. The internet provides a vast space to exchange private information such as social security numbers, credit cards, and health care information. This information is typically protected using encryption. Cryptography was created out of the need to conceal information and is simply the means by which one is able to encrypt information through codes or ciphers and then decrypt these encrypted messages utilizing keys. Cryptography takes unencrypted data also known as plaintext and applies an encryption method that transforms the data into ciphertext. One can then apply a key to this ciphertext in order to decrypt the data. A huge aspect of this process is authentication. One needs to ensure that they are receiving the message from the right person and that the right person is able to interpret the message. One huge way cryptography can authenticate is utilizing a key system. Just like how one needs to have a key to enter a locked house, one must have a key to decrypt a "locked" message. In cryptography, there are public and private key algorithms both helping decrypt and encrypt secret messages.

Gambling Paradoxes: Always Be the Winner

Noah Molder and Tyler Owens
Mentors: Thomas Hagen and Mate Wierdl, Mathematical Sciences

Given three dice, can we put the numbers 1 through 6 on the dice, allowing repetitions, so that after a first player chooses one die of the three, the second player can always choose a "better" one among the remaining two. Here we understand that a die is "better" than another one if it has a higher probability of rolling a greater number. If so, is it possible to optimize the chances of winning, both by theoretical and computational means?

This research project draws on techniques from probability theory, combinatorics, complexity theory, game theory and scientific computing. The topic falls in the category of non-transitive games, a research area in mathematics and economics, and combines theoretical and practical methods. The strategies developed in this project may be applicable to politics, trade negotiations and the stock market.

SOCIAL AND BEHAVIORAL SCIENCES

Challenging the Acceptance of Opioid Stigma Through Education

Reynara Amaryllis
Mentor: Deranda Lester, Psychology

Stigma around drug use and addiction can contribute to reduced treatment-seeking and elongation of the recovery process. Four key opioid-related stereotypes have been previously identified: 1) “cannot be trusted”, 2) “to blame for their problems”, 3) “are lazy”, and 4) “are dangerous”. The purpose of this study is to assess whether college students at the University of Memphis are aware of such opioid stigma and whether education of the topic can reduce acceptance of these stigmas. The current study will utilize data gathered from the Memphis Opioid Workforce Paraprofessional Expansion Program (MOW-PEP), which was funded in 2019 through the Health and Resources Services Administration (HRSA). MOW-PEP is focused on training a diverse group of students to work in community-based settings that meet the various needs of those impacted by substance use disorders. As part of the program, students are also required to take 2 courses in substance use and attend the Memphis Opioid Summit. Before and after this 2-semester training, students are given the Brief Opioid Stigma Scale (BOSS)to assess their awareness and agreement with opioid stigmas. We hypothesize that students will enter the program aware of opioid stigmas and that their acceptance of these stigmas will decrease following completion of the MOW-PEP training program.

Oxytocin's Influence on Dopamine Transmission in Relation to Estrous Cycle Changes

Kyla Anderson
Mentor: Deranda Lester, Psychology

Oxytocin is being researched as a treatment for psychostimulant use disorder. We have previously found that oxytocin administration reduces the dopaminergic response to cocaine in isolated female mice. Oxytocin release and receptor levels have been shown to fluctuate within the stages of the female estrous cycle; however, it is not clear how these fluctuations affect oxytocin and dopamine interactions. Using vaginal cytology samples collected prior to dopamine measurements, the current study aimed to determine whether the effects of oxytocin on dopamine functioning were moderated by the estrous cycle stage. The data for this study is currently under analysis and will be ready to present at the symposium. We predict that mice in the proestrus stage, which occurs right before ovulation, will be more responsive to oxytocin (otherwise seen as an increased effect of oxytocin administration on dopamine functioning) in comparison to mice in the later stages.

Examining the Effects of Chronic Unpredictable Stress on Mesolimbic Dopamine Release in Mice

Morgan Edwards
Mentor: Deranda Lester, Psychology

Chronic unpredictable stress is a well-known rodent paradigm used to elicit behaviors similar to those of depression and anxiety. The mesolimbic dopamine pathway, often referred to as the reward pathway, consists of cell bodies in the ventral tegmental area (VTA) that project to limbic regions, particularly the nucleus accumbens (NAc). Drugs of abuse increase activity in this pathway. The current study was developed to determine the effects of chronic unpredictable stress on reward-related dopamine functioning. Half of the mice will be exposed to the chronic unpredictable stress paradigm, in which mice will spend portions of each day for a 4-week period in a stress-inducing condition. The stressors will consist of physical constraint, social isolation, cage dampening, cage tilt, or light cycle reversal. Control mice will remain in their home cages during these stress-conditioning periods. Once the 4-week stress paradigm is complete, in vivo fixed amperometry will be used to measure VTA stimulation-evoked dopamine release and reuptake in the NAc of anesthetized mice before and after an in-test injection of the psychostimulant nomifensine. We hypothesize that the mice exposed to chronic unpredictable stress will have a greater dopaminergic response to nomifensine compared to control mice, and we hypothesize that these stress-induced changes will be greater in females than males. The results of this study may be useful for treatment and prevention of stress-related drug misuse.

Varying Negation Particle Location and its Effect on Language Learning

Brandon Fuentes
Mentor: Stephanie Huette, Psychology

Language learning and comprehension rely on various levels of language itself including semantic, syntactic, morphological, and pragmatic information. Negation interacts with these levels in especially a semantic and syntactic sense. Interestingly, conversational word negation has even been observed to evolve over time, as is the case in Jespersen's Cycle. But what correlation does negation have in the semantic representation of words when negation particle location is also brought into question such as in Jespersen's Cycle? Therefore, the purpose of this project is to

explore the effects of negation particle location on the results of language learning, and ergo, the "learnability" of those words. This study will utilize made-up nouns with pre-noun and post-noun negation particles following a pattern inspired by Jespersen's Cycle. We will employ auditory and visual stimuli that will contain the novel words with the negation particles in different locations (post, pre, both, or none) and images of what the word could mean. We will also use eye-calibration technology to track the participants' eyes and see what they become fixated on throughout the procedure. This will take place over a practice phase and then finally a testing phase where we will test the effect that the differently located negation particle(s) has on the word learning of the participant.

Measuring Preference for Social Stimuli in Mice

Josie Steen
Mentor: Deranda Lester, Psychology

Deficits in social behavior, such as reduced social motivation and impairments in social cognition, are key symptoms of many psychiatric disorders. Social reward processing involves directing attention and assigning value to social stimuli. Animal models can provide insight into the complexities of social interactions, their relations to other behaviors, and their neural underpinnings. The current study used social conditioned place preference (CPP) to examine the degree to which mice prefer social interaction over solitude in a novel environment and the effect of sex on social reward. On Day 1, mice freely roamed the two CPP chambers for 15 minutes. The next 8 days were training days in which the mice were placed in either the social-paired chamber or the control chamber. On the last experimental day (Day 10) mice were again allowed to freely roam the two chambers, and the time spent in the social-paired chamber was assessed and compared pre-conditioning tests (Day 1). Our analysis revealed that 75% of the mice exhibited a preference for the social-paired chamber and that males and females displayed similar preferences for the social-paired chamber. Such studies are important for establishing animal models for research and ultimately improving therapies for social symptoms.

LIFE AND HEALTH SCIENCES

Who's who in the Zoo Poo: Dung Insect Assemblages in Memphis

Kimberly Baldwin
Mentor: Leigh Boardman, Biological Sciences

Insect assemblages play major roles in community ecology, serving as biomarkers of the environment. Differing environments, yield different biomarkers of community health indicative of their evolution as a result of human interaction and change. Here, we aimed to determine the insect assemblages present in dung from large animal species at both the Memphis Zoo and Shelby Farms. Dung from Ceratotherium simum and Loxodonta africana were placed at sites in the Memphis Zoo, and Bison bison dung was gathered from Shelby Farms. These sample sites were monitored for up to 3 days. The temperature under the dung was recorded to account for the microclimates present. Insects were collected and identified to species level (where possible). Assemblages from sampling sites were compared across the summer months in both the Memphis Zoo and Shelby Farms. The most abundant species found at Shelby Farms was the Calamosternus granarius, and at the Memphis Zoo, it was Hister abbreviates. In total 408 insects were found, with 69% at Shelby Farms. The results of the study demonstrated a biologically diverse ecosystem present in both the Memphis Zoo and Shelby Farms, as well as providing the

groundwork for further studies examining a variety of external factors such as thermal tolerance, impacts of urbanization, and antiparasitic treatment impacts. This study suggests that in the selected regions of Memphis wherein biodiversity is prioritized there are complex and abundant insect communities.

What Biomechanical Variables Are Predictors of Running Economy and Metabolic Power in Well-Trained Male Distance Runners?

Katherine Batista
Mentor: Maxime Paquette, Health Science

BACKGROUND: Running economy (RE) and metabolic power are two laboratory-based measures of running performance. Running performance is influenced by complex interactions of biomechanical and physiological processes. PURPOSE: This study aimed to identify lab-based and practical biomechanical variables correlated to metabolic power and RE. METHODS: Eighteen well-trained male distance runners ran under three different speed conditions: 16, 18, and 20 km/h. An instrumented force treadmill (1200 Hz, Bertec) and a 3D motion capture system (240Hz, Qualysis AB) were used to collect GRF and kinematic data during running trials. A metabolic system (TrueOne 2400; ParvoMedics, Murray, Utah) was used to collect expired gases (to calculate RE and metabolic power) while running. Pearson correlation coefficients among biomechanical variables and running performance measures were calculated. RESULTS: We expect to see that some factors will be better lab-based predictors running performance while other factors will be stronger practical predictors of running performance. DISCUSSION: Results from this study will help identify biomechanical factors related to running performance that can be used by coaches in training and in scientific studies focused on running performance.

Effects of Breast Support on Trunk and Knee Joint Biomechanics in Female Collegiate Athletes During a Change of Direction Task

Jessica Fall
Mentor: Douglas Powell, Health Sciences

Background: Cutting tasks observed in multidirectional sports are connected to a variety of lower extremity injuries. The presence of breast mass influences trunk and lower extremity biomechanics which make women more likely to experience a lower extremity injury. Purpose: To examine the effects of breast support on trunk and knee joint biomechanics in female collegiate athletes during a change of direction task. Methods: Five single-limb cutting tasks were performed on each limb by fourteen female collegiate athletes in three different sports bra conditions: no support, low support, and high support. Three-dimensional kinematics (250 Hz) and ground reaction forces (1250 Hz) were recorded simultaneously. Visual 3D was used to calculate trunk segment and knee joint angles and moments. Custom software (MATLAB 2021a) was used to determine discrete values for trunk segment and knee joint variables. A repeated measures analysis of covariance will be used to determine the effect of breast support on knee joint and trunk biomechanics. Results: We expect to see that lower levels of breast support are associated with knee joint, and trunk biomechanical profiles suggested to increase lower extremity injury risk.

Development of Micelle-Hydrogels for Controlled Dual Drug Delivery

Farraday Johnson, Tamanna Ferdous, Tomoko Fujiwara
Mentor: Tomoko Fujiwara

Controlled drug delivery systems have undergone remarkable progress to minimize side effects and maximize drug efficacy over an extended time. Implantable and injectable polymeric carriers hold promise as a method of administration that targets specific areas of disease or injury. Our group is developing novel hydrogels for musculoskeletal therapy and regeneration using biocompatible and biodegradable polymers, chitosan, polyethylene glycol (PEG), and polylactic acid (PLA). Our goal is to facilitate a localized drug delivery system by creating a hydrogel loaded with selected drugs. Curcumin and simvastatin are naturally occurring hydrophobic drugs. Curcumin is an extract of turmeric powder and shows an anti-inflammatory effect. Simvastatin, known to have cholesterol lowering effects, has also been reported to activate osteoblasts and promote bone regeneration. In this study, the amphiphilic triblock copolymers, PLA-PEG-PLA, with precise molecular weights were first synthesized. Next, Simvastatin was encapsulated in the copolymer micelles by nanoprecipitation. Lastly, the micelle-drug loaded networked hydrogels were prepared by photo-crosslinking using light at 405nm. Drug release studies of these hydrogels showed sustained release of simvastatin for 14 weeks in vitro. The effects of the drug-loaded hydrogel on tissue repair and cell growth will be further evaluated.

CNS Localization of Major and Long Gnal isoforms with Cell-Type Specificity

Katherine Luttrell
Mentor: Mark LeDoux, Psychology

GNAL in humans encodes a protein known as Guanine nucleotide-binding protein subunit alpha, also known as Gα(olf). G proteins as involved as modulators or transducers in various transmembrane signaling systems. Gα(olf) mediates signal transduction within the olfactory neuroepithelium and the basal ganglia. It may be involved in some aspect of visual transduction and in mediating the effect of one or more hormones or neurotransmitters. Mutations in this gene are associated with dystonia 25 and cervical dystonia, and this gene is in a susceptibility region for bipolar disorder and schizophrenia. This research project would isolate where this gene is expressed and lead to an increased understanding of where to target pharmacological intervention. Alternative splicing of this gene results in multiple transcript variants.

We will determine the localization of the major [Gα(olf)] and long [XLGα(olf)] Gnal isoforms with cell-type specificity. In situ hybridization (RNAscope®), QRT-PCR, immunohistochemistry, and quantitative Western blotting will be used to define the temporal (P14, 1 mo., 3 mo., 6 mo., 12 mo., 15 mo., and 18 mo.) and spatial (frontal cerebral cortex, striatum, olfactory bulb, thalamus, and cerebellum) profiles of Gnal expression in mouse brain. Moreover, Western blotting will employ fractionation to determine relative amounts of Gα(olf)/XLGα(olf) in the nuclear and cytoplasmic compartments. Preliminary results show an increased concentration of Gnal isoforms in PCs.

EDUCATION

Engagement in Metacognition Among Undergraduate Biology Students

Alix Kirkendol
Mentor: Jaime Sabel, Biological Sciences

How a student utilizes a study method, comprehends material, and prioritizes learning can all be used to differentiate how students engage in metacognition. Student awareness of metacognition, which is the process of thinking about one's own thinking and understanding, can aid in fostering improved changes to study plans and learning methods. These changes can result in students reaching greater comprehension, understanding the material and achieving higher grades on exams and in courses. Students in each of the 5 core biology courses participated in surveys and interviews, answering questions related to principles of metacognition. Responses from individual students were classified into four metacognitive levels as proposed by Stanton et al. (2015): Not Engaging, Struggling, Emerging, and Developing. We found that there are three overarching concepts that vary between all four levels: 1) the ability to identify poor study habits and capability to make changes, 2) the emphasis placed on grading and how it affected study effort, and 3) the focus on comprehension rather than rote memorization. Furthermore, we then explored the presence of the three dimensions of metacognition: Intelligibility, Plausibility, and Wide-Applicability. In both of these instances, results were found demonstrating the dimensions that each level should be integrating to enhance their metacognition development. Next steps include developing an instrument to measure students' metacognition engagement.

Investigating Undergraduate Students' Engagement in Systems Thinking Using Causal Maps

Sedra Sous
Mentor: Jaime Sabel, Biological Sciences

To study how undergraduate students engage in systems thinking, we conducted a pre-post study with students in an undergraduate botany course. All students in the study were asked to complete a causal map at the beginning and end of the course and were also asked to answer two questions about their causal map:1. Explain how your causal map demonstrates the relationships of plants and the environment? and 2. If someone, a non-scientist, asked you to explain how plants connect to everyday life or situations, how would you answer using your causal map? We used open coding and the framework for systems thinking developed by Mehren et al (2018) as utilized by Mambrey et al(2019) to determine common topics among the answers to evaluate the questions students answered after drawing their causal maps. This framework is defined by three stages toward developing skills of system thinking. At Stage 1, students provided a vague level of understanding. In Stage 2, students made moderate connections between plants and the environment. At Stage 3, students identified multiple connections relating to plants and the environment and were complex. Results showed that most students did not draw upon specific connections when answering the questions but expressed vague connections. This work highlights students' difficulties with systems thinking but provides insight into areas in which students engage in more complex thinking and areas we can target with instruction and intervention.

LIBERAL AND FINE ARTS

A Forgotten Violin Sonata

Elizabeth Betrous
Mentor: Marcin Arendt, Music

In this project I would like to propose an in-depth analysis of the composer, the context, and the structure and style, as well as a conceptual and technical analysis of the Karen Khachaturian Violin Sonata op. 1 in g minor. This presentation will be divided into three sections: the first section addressing historical context; the history of the sonata including its instrumental role in establishing K. Khachaturian's career and Jascha Heifetz's role in recording and performing this piece; and finally a practical and conceptual analysis of this piece addressing violin techniques and interpretive concerns.

I would like to embark on this writing process for several reasons; namely, I believe that it is part of the performer's responsibility to learn, understand, and conceptualize the pieces that one plays so that we may present an educated interpretation to the audience. In addition, there remains widespread misconceptions about the lives and works of Soviet Era composers that cloud our perceptions in the West that I would like to address: namely, about the role of the composers as an artist and representative of the Soviet Regime and why it was necessary to adapt one's careers to stay afloat in an uncertain political, cultural, and historical environment. These reasons, I believe, contribute to why performers and audiences remain unaware of exceptional works like this sonata.

Comparative Depictions of Romance in Children's Literature: How LGBTQIA+ Representations Emphasize Their Age-Appropriate Subject Material By Mirroring Similar Stories in Heterosexual Examples

Richard David Howe III
Faculty Mentor: Lorinda Cohoon, English

In my research, I have found that depictions of love in children's literature do not engage in sexual or explicit material, and that holds true in both heterosexual and LGBTQIA+ inclusive examples. Simply put, my argument is that LGBTQIA+ representation in children's literature is age-appropriate when such works mirror heterosexual examples in regards to depiction of family, romance, or intimacy.

My presentation involves a close comparative analysis of the illustrations and texts of Sleeping Beauty and Prince & Knight, with a focus on how the picturebooks use composition and language to tell a child-friendly fairy tale romance. Scanned pages side by side reveal very convincing similarities. This would be bookended by discussion of the current controversies around LGBTQIA+ representations in children's literature, and the outlining of further avenues for research.

Debates around the age-appropriateness of LGBTQIA+ representation in Children's Literature are made extremely consequential by state provisions such as Tennessee's PC 744, which enters into law a compulsory materials review for public schools that must include "A procedure for the development of a library collection at each school that is appropriate for the age and maturity levels of the students who may access the materials." It also requires the removal of materials deemed not age or maturity appropriate.

Where Words Fail, Music Speaks

Catherine Monroe
Mentor: Jeremy Tubbs, Music

Music can be heard all around us. We strain our ears to hear the familiar tune being drowned out by the sounds of patrons while at a restaurant. Songs are powerful tools reverberating over the speakers or coming through our headphones. But have music accompany a TV or movie scene with power and emotion, the result is an unbelievable combination of heart, soul, and passion. There are many elements that structure a scene. Dialogue, setting, costume design, and many other minute details lends itself to the storyline. Music adds an extra layer of suspense, emotion, and rounds out the scene. There are all different compositions and placements of music within the medium, but they all have different and some similar effects on the listener. Music is able to capture the feelings of an audience and transcend them into the scene in which the melody plays. Music can take many forms to draw in a watcher. Musical numbers can be a scene themselves or it can take over the whole scene to create an enthralling moment. Scores create an experience and often become iconic to a character or a particular moment. Determining which song to add can make a scene go from dull to unforgettable. Dialogue is not the only tool for drumming up an emotional response from an audience. Music speaks where words fail.

The Standards of Womanhood and the Paradox of Feminine Identity

Meg Wiles
Mentor: Stephen Turner

In the years between 1837 and 1901 (named the Victorian Era for the reigning queen of the time), society ascribed to an ideology called The Cult of True Womanhood. This value system asserted that a “true woman” would possess four main cardinal virtues: piety, purity, submissiveness, and domesticity. It outlined the roles women were meant to play in society and became a sort of yardstick with which to measure women’s femininity. The term “Madonna-Whore Dichotomy” describes a system in which a woman falls into one of two opposite categories: the pure, feminine, and submissive Madonna, or the promiscuous, immoral, and malicious Whore. Evidence of these two ideologies, and their consequences, can be found in many literary works of the time. Because womanhood was defined in such rigid and often unattainable standards, the average woman found herself in the position of teetering on the edge between Madonna and Whore. And whether she persevered in the effort to remain wholly pious and pure, or freed herself from these stringent expectations and pioneered her own identity, she could never entirely win. The Madonna is ignorant, boring, and dull, but the Whore is immoral, disgusting, and poisonous to society. This project will examine that dichotomy and the impossibility for a woman to ever truly meet the standards set by society.