AUGUSTA UNIVERSITY

# 2024 UNDERGRADUATE RESEARCH AND FINE ARTS CONFERENCE

APRIL 3RD, 2024

SUMMERVILLE CAMPUS

JAGUAR STUDENT ACTIVITIES CENTER

## About *The Arsenal*

*The Arsenal: The Undergraduate Research Journal of Augusta University* (ISSN 2380-5064) is a peer-reviewed, open-access, interdisciplinary journal for undergraduate research conducted at Augusta University. This journal is a collaboration between the Center for Undergraduate Research and Scholarship (CURS), University Libraries, and the CURS student Ambassadors.

*The Arsenal* was initiated by the undergraduate research student organization named On the Shoulder of Giants in Fall 2016. The journal represents and highlights undergraduate research of academic and scholarly value from various disciplines at Augusta University. Each article undergoes a peer-review process facilitated by the journal's Editorial Review Board and must be approved by an appointed faculty reviewer in the article's respective discipline. More information can be found at augusta.edu/arsenal-home.php.

## Editorial Board

# Preface

The Center for Undergraduate Research and Scholarship (CURS) proudly presents the proceedings for the 24th annual Undergraduate Research and Fine Arts (URFA) Conference on April 3, 2024. This annual conference is supported by the CURS, the AU Chapter of Phi Kappa Phi, and the Office of Interdisciplinary Research. The proceedings consist of the program for the 24th annual conference, along with the abstract of each undergraduate's original work across multiple disciplines.

This year we host 90 undergraduate student presenters majoring in Accounting, Graphic Design, Biology, Business Administration Cell and Molecular Biology, Chemistry, Communications, Computer Science, Cybersecurity, Digital Storytelling, Education, English Literature, Health Services, Kinesiology, Physics, Nursing, and Psychology. We are pleased to have 41 Faculty Mentors from the departments of Allied Health, Art and Design, Biochemistry and Molecular Biology, Biological Sciences, Chemistry, Community and Behavioral Health Physics, Computer & Cyber Sciences, English and World Languages, Georgia Cancer Center, History, Anthropology & Philosophy, Internal Medicine, Rheumatology, Kinesiology, Music, Neuroscience and Regenerative Medicine, Nursing & Nursing Science, Oral Biology and Diagnostics, Physics & Biophysics, Physiology, Psychiatry and Health Behavior, Teaching and Leading, and Vascular Biology are represented at this year's conference.

We would like to express our gratitude to all the speakers, presenters, participants, and volunteers for their contributions. In particular, we would like to thank our generous sponsors for their financial support to the 24th URFA Conference. Without the support of the Provost's Office, the Vice Provost for Instruction, the Senior Vice President for Research, and the Phi Kapp Phi Honor Society, we would not be able to provide such an impactful event for our students. We hope that the proceedings and conference grant the most beneficial and fruitful experience to all those involved.

Dr. Quentin Davis, Co-Chair URFA Conference
Dr. Alex St. Louis, Co-Chair URFA Conference

# Table of Contents

**Volume 7, Issue 1 (2024)**
**Special Edition**

# President's Welcome


It is with great pleasure that I welcome you to Augusta University's 24th annual Undergraduate Research and Fine Arts Conference; a showcase of discovery, ingenuity, and scholarship. The URFA conference is hosted by the Center for Undergraduate Research and Scholarship with support from the AU Chapter of Phi Kappa Phi and the Office of Interdisciplinary Research.

CURS, established in 2008, has a mission of supporting undergraduates in the pursuit of discovering new information, investigating factors of influence, and innovating original work under the collaborative guidance of a faculty mentor. Since 1897, Phi Kappa Phi – the nation's oldest, largest, and most selective all-discipline honor society—has displayed a perfect blend of academic and personal excellence. As the original host of this event, PKP continues to offer students the opportunity to showcase their scholarly and artistic endeavors. The Interdisciplinary Research Office also reaches across all colleges and campuses to connect collaborative research groups assist researchers in pursuing internal and external support.

Our focus at Augusta University is to be like no other through a commitment to effective teaching and engaged learning. Academic research is both a teaching tool and a pathway to discovery. Scholarly engagement brings education to life, impacts students long-term, and develops competencies and networks that prepare them to become life-long learners and contributors to an ethical and innovative society. I encourage you to immerse yourself in the comprehensive and stimulating presentations highlighting the research and creative concepts developed by our students.

I appreciate the volunteers and faculty whose hard work made this conference possible. Enjoy today's experience and congratulations to all of our student presenters and performers.

Go Jags!
Dr. Brooks Keel, President of Augusta University

# Conference Agenda

| | |
|---|---|
| **Poster Session A** | 10:30 am – 11:45 am |
| **Opening Ceremony** | 12:00 pm -12:50 pm |
| *Welcome* | Dr. Quentin Davis, Center for Undergraduate Research and Scholarship |
| *Opening remarks* | Dr. Zach Kelehear, Vice Provost for Instruction |
| *Artistic Performance* | Shiloh Reimche, Digital and Visual Storytelling major<br>*Alice in Wonderland Scene Eleven: Who Stole the Tarts* |
| *Navigating the Conference* | Dr. Alex St. Louis, Center for Undergraduate Research and Scholarship |
| **Oral & Poster Sessions** | 1:00 pm – 5:00 pm<br>See detailed schedule (1:00 – 4:00 pm) |
| *4x4 Showdown* | Research Pitch Competition (4:00 pm) |
| *Artistic Performance* | Brody McLaughlin, Music Education major<br>*"La Rosa" and "Wrath & Whimsy"* (4:30 pm) |
| **Awards Ceremony & Reception** | 5:00 pm – 6:00 pm |
| *Conference Awards* | Dr. Josefa Guerrero-Milan, Department of Physics and Biophysics |
| *Distinctions in Research* | Dr. Alex St. Louis, Center for Undergraduate Research and Scholarship |
| *Closing Remarks* | Dr. Neil MacKinnon, Executive Vice President and Provost |
| *Acknowledgments* | Dr. Quentin Davis, Center for Undergraduate Research and Scholarship |

# Schedule of Events

**Welcome & Artistic Performance**
12:00 – 12:50

**Poster Sessions**
Session A 10:30 – 11:45 Session B 1:00 – 2:15

**Interdisciplinary Science Oral Sessions**
Session A 1:00 – 2:30 Session B 2:45 – 3:45

**Smart City Environmental Monitoring Applications**
Session 1:00 – 2:30

**Modern Drug Discovery**
Session 2:45 – 3:45

**Humanities**
Session 1:00 – 2:30

**Society & Science**
Session 2:45 – 3:45

**4x4 Showdown Research Pitch Competition**
Session 4:00 – 4:30

**Musical Performance**
Session 4:30 – 5:00

**Awards Ceremony & Reception**
*light refreshments served*
5:00 – 6:00

# Navigation

| TIME | BUTLER Rm 227 | COFFEEHOUSE Rm 235 | BALLROOM Rm 155 | HARDY Rm 232 |
|---|---|---|---|---|
| 10:30 – 11:45 am | | | Poster Session A | |
| 11:45-Noon | | | Break | |
| Noon – 12:50 pm | | | Welcome & Keynote; Theatrical Performance | |
| 12:50-1:00 pm | Break | Break | Break | Break |
| 1:00 – 2:30 pm | Interdisciplinary Science A | Smart City Environmental Monitoring Applications | Poster Session B | Humanities |
| 2:30 – 2:45 pm | Break | Break | Break | Break |
| 2:45 – 3:45 pm | Interdisciplinary Science B | Modern Drug Discovery | | Society & Science |
| 3:45-4:00 pm | Break | Break | Break | Break |
| 4:00 – 5:00 pm | | | 4x4 Showdown<br>Musical Performance | |
| 5:00 – 6:00 pm | | | Awards, Closing | |

# Artistic Performance Showcases

## Shiloh Reimche

(they/them) is a senior Digital and Visual Storytelling undergraduate at Augusta University. They have found a passion in both filmmaking and performance during their time at AU and they plan on pursuing video editing as a career while also engaging in local theatre. In the spring semester of 2023, they produced a music video for "Scream Queen" by Vexagon in the Music Video Production course and they grew to enjoy video editing during this experience as well as gaining more of a handle on directing and cinematography. They are a Davidson Fine Arts Magnet School alumnus with a concentration in theatre performance and costume design. At Augusta University, they performed in Theatre AUG's productions of *Metaphysique D'Ephemera*, *Is She Mad or Does She Joke*, *Charlotte's Web*, and *Alice's Adventures in Wonderland*. They have received the Katherine R. Pamplin Talent Award three times (2022-2024), the Freeman Schoolcraft Award (2024), and the GCA Film Festival Award of Excellence for Micro-Work (2024). Shiloh studies performance with Dr. Melanie Kitchens O'Meara, theatre with Doug Joiner, and film with Matthew Buzzell.

## Brody McLaughlin

is a Music Education Major at Augusta University, President of the University's CNAfME Chapter (Collegiate National Association for Music Education), and aspiring composer and conductor. He has lived in Augusta, Georgia for most of his life and graduated from Lakeside High School. Although Mr. McLaughlin's main instrument is the trumpet, which he has been playing since middle school (10 years' playing experience), his main passion is for composing and conducting ensembles. He has been composing and arranging since his junior year of high school and loves every

moment he spends at the pen. He has won the state level for both the MTNA (Music Teachers National Association) and the GMEA (Georgia Music Educators Association) composition competitions at the state collegiate level. His compositions and arrangements have been played by various ensembles at the university, such as the Augusta University Orchestra, the Augusta University Wind Ensemble, and the Augusta University Brass Studio. He has taken composition lessons under Dr. Martin David Jones while pursuing his degree in Music Education. With countless works in development, Mr. McLaughlin is always eager to hear his work performed.

**Musicians**

Abigail Burdette, Piccolo /Flute

Becan Flynn. Clarinet

Owen Radke, Soprano Saxophone

Hayden Seymour, Tenor Saxophone

Parker Lewis, Horn

Noah Uini, Trumpet

Eric Radulovich, Bass Trombone

Jacob Lyda, Tuba

Indian Barkley, Timpani

Rico Lambert, Aux Percussion

Arendil Plummer, Violin I

Tyquan Watts, Violin II

Sydney, Viola

Tallulah Schaumann, Cello

1:00 – 2:30 Butler Room 227

# Interdisciplinary Science A

Moderator: Dr. Robert Saunders

**Cameron Cunningham, Cybersecurity Engineering** **1:00 – 1:15**
MODELING THE EFFECTS OF IMMUNE RESPONSE AND ANTIVIRIAL THERAPY ON SARS-COV-2 INFECTION
Mentor: Dr. Eric Numfor

**Haley Gilbert, Kinesiology** **1:15 – 1:30**
DO COMPRESSION GARMENTS INFLUENCE OXYGEN CONSUMPTION AND HEART RATE DURING A SUBMAXIMAL ENDURANCE RUN
Mentor: Dr. Craig-Jones

**Dawson Jones, Computer Science** **1:30 – 1:45**
PREDICTING VAULT APPS USING MACHINE LEARNING
Mentor: Dr. Ming Ming Tan

**Tajman Randhawa, Cell and Molecular Biology** **1:45 – 2:00**
ADULTHOOD TRAUMATIC BRAIN INJURY LEADS TO CHRONIC CEREBRAL ATROPHY
Mentor: Dr. Kumar Vaibhav

2:45 – 3:45 Butler Room 227

# Interdisciplinary Science B

Moderator: Thomas Weeks

**Joshua Hale, Physics** **2:45 – 3:00**
ISOLATING DEUTERIUM ISOTOPES VIA QUANTUM FILTERING
Mentor: Dr. Theja DeSilva

**Evan Pate, Physics** **3:00 – 3:15**
QUANTIFYING SHAPES OF 3D TUMOR CELL COLLECTIVES
Mentor: Dr. Abdul Malmi Kakkada

**Jenny Zhang, Cell and Molecular Biology** **3:15 – 3:30**
PERIVASCULAR ADIPOSE TISSUE IN THE PATHOGENESIS OF LUPUS VASCULOPATHY
Mentor: Dr. Hong Shi

**Bryson Hall, Kinesiology** **3:30 – 3:45**
THE INFLUENCE OF ACUTE EXERCISE ON COGNITION IN YOUNG ADULTS
Mentor: Dr. Debra Jehu

1:00 – 2:30 Coffeehouse Room 235

# Smart City Environmental Monitoring Applications

Mentor: Dr. Joseph Hauger

Moderator: Emily Harris

**Brycen Havens, Computer Science** **1:00 – 1:12**
DESIGNING AN AUTONOMOUS SURFACE VEHICLE FOR WATER QUALITY MONITORING

**Wesley Cooke, Physics and Computer Science** **1:12 – 1:24**
AN AUTONOMOUS SURFACE VEHICLE FOR WATER QUALITY MONITORING

**Keiichi Iguchi, Physics** **1:24 – 1:36**
A LOW-COST IN-LINE PIPE INSPECTION ROBOT

**Patrick Rimbey, Cybersecurity Engineering &** **1:36 – 1:48**
**Maggie Karraker, Biology**
INVESTIGATING THE IMPACT OF LOW FREQUENCY SOUND ON CRUSTACEANS

**Kaylee O'Steen, Cybersecurity** **1:48 – 2:00**
A LOW-COST LOW-POWER FLOW VELOCITY SENSOR FOR STREAM FLOW MEASUREMENT

**Dean Meyer, Physics** **2:00 – 2:12**
LONG RANGE TRANSMISSION OF ENVIRONMENTAL DATA

**Cameron Cunningham, Cybersecurity Engineering** **2:12 – 2:24**
MAKING TRASH SMARTER

2:45 - 3:45 Coffeehouse Room 235

# Modern Drug Discovery

Mentor: Dr. Siva Panda

Moderator: Jennifer Davis

**Holden Dinkins, Chemistry,** **2:45 – 2:57**
**Julio Chavez, Chemistry**
NEW HYBRIDS BASED ON CURCUMIN AS POTENTIAL THERAPEUTICS FOR CANCER

**Iris Truong, Chemistry,** **2:57 – 3:09**
**Jade Moore, Chemistry**
DESGINING AND SYNTHESIZING POTENTIAL DRUG CANDIDATES USING MOLECULAR HYBRIDIZATION

**Brianna Lynn, Chemistry,** **3:09 – 3:21**
**Ashley Pham, Chemistry**
MOLECULAR HYBRIDIZATION OF FLUOROQUINOLONES TO TARGET CANCER CELLS

**Nihal Amineni, Cell and Molecular Biology** **3:21 – 3:33**
**Ashley Pham, Chemistry**
URSOLIC ACID DERIVED POTENTIAL HYBRID CONJUGATES FOR CANCER THERAPY

**Rishi Krishnamurthy, Cell and Molecular Biology** **3:33 – 3:45**
**Manya Sharma, Biology**
AMINOACYL BENZOTRIAZOLIDES: VERSATILE REAGENTS FOR THE PREPARATION OF DRUG CANDIDATES

1:00 – 2:30 Hardy Room 232

# Humanities

Moderator: Elizabeth Lightfoot

**Gustavo Gonzalez Hernandez, Cell and Molecular Biology** **1:00 - 1:15**
SHERLOCK HOLMES AS A LITERARY ANALYSIS ESSAY: AN EXPLORATION
Mentor: Dr. Amelia Hall

**Danielle Denton, English** **1:15 - 1:30**
AILING: AN ABJECT HORROR STORY
Mentor: Dr. Spencer Wise

**Colin Owen, English** **1:30 – 1:45**
DISSECTING THE FUNCTION OF FEMALE SEXUALITY IN SIR GAWAIN AND THE GREEN KNIGHT
Mentor: Dr. Blaire Zeiders

**Sonia Jose, Cell and Molecular Biology** **1:45 - 2:00**
EVALUATION AND REVITALIZATION PLAN OF THE MULTICULTURAL MENTORSHIP PROGRAM RETREAT
Mentor: Dr. Shareen Clement

2:45 – 3:45 Hardy Room 232

# Society and Science

Moderator: Aspasia Luster

**David Timmerman, Physics and Biophysics** **2:45 – 3:00**
VISUAL AND INFORMATION THEORETIC ANALYSIS OF MUSICAL NOTES AND COMPOSITION

Mentor: Dr. Trinanjan Datta

**Sakshi Shah, Cell and Molecular Biology** **3:00 – 3:15**
A ROLE FOR INTESTINAL CGMP SIGNALING IN INTESTINAL AGING

Mentor: Dr. Darren Browning

**Emily Radulescu, Graphic Design** **3:15 – 3:30**
ART MEET SCIENCE: CREATING AN INFORMATIONAL VIDEO FOR OLDER ADULTS

Mentors: Dr. Deborah Jehu, Prof. A.B. Osborne

**Ro Outlaw, Biology** **3:30 – 3:45**
RACIAL UPLIFT OR SELF UPLIFT: CHALLENGING THE BLACK ELITE'S HOLD ON PROGRESS

Mentor: Dr. Walter Quiller

4:00 – 4:30 Ballroom Room 155

# 4x4 Showdown

Moderator: Ladan Kian

**Vanessa Browning, Psychology**
UNDERGRADUATE MENTOR AND K-12 STUDENT VIEWS: QUESTIONING IN SCIENCE CLASSROOMS

Mentor: Dr. Alexandra St. Louis

**Charmi Patel, Cell and Molecular Biology**
FEASIBILITY OF THE ADAPTED OTAGO EXERCISE PROGRAM IN DEMENTIA

Mentor: Dr. Deborah Jehu

**Grace Oh, Cell and Molecular Biology**
THE UTILITY OF NON-SYSTEMIC PDE5 INHIBITORS FOR COLON CANCER PREVENTION

Mentor: Dr. Darren Browning

**Diana Fowler, Kinesiology**
GLUTEUS MEDIUS, HAMSTRING, QUADRICEPS ACTIVATION DURING VARIATIONS OF COMMON LUNGES

Mentor: Dr. Lori Bolgla

10:30 – 11:45 Ballroom, Room 155

# Poster Session A

1. **Stephanie Felonta, Nursing**
   SOCIAL DETERMINANTS OF HEALTH (SDOH) COMPARISON BETWEEN SCOTLAND AND GEORGIA
   Mentor: Dr. Elizabeth Nesmith, Thomas Joshua

2. **Komalpreet Bhullar, Cybersecurity**
   GENERATION AND CHARACTERIZATION OF UFM1 CONDITIONAL KNOCKOUT MICE
   Mentor: Dr. Jie Li

3. **Isaac Bloom, Neuroscience**
   THE ROLE OF JMJD1C ON OLIGODENDROCYTE LINEAGE CELLS AFTER WHITE MATTER INJURY.
   Mentor: Dr. Evan Goldstein

4. **Elizabeth Bowman, Cell and Molecular Biology**
   BIS BENZOTHIAZOLE COMPOUNDS REDUCE PROLIFERATION OF PANCREATIC CANCER CELLS
   Mentor: Dr. Maria Sabbatini

5. **Tate Allen, Cell and Molecular Biology**
   KYNURENINE'S AFFECT ON THE DIFFERENT STAGES OF OSTEOBLASTIC DIFFERENTIATION
   Mentor: Dr. Meghan McGee-Lawrence

6. **Manuela Guzman Zabala, Kinesiology**
   TRAUMATIC BRAIN INJURY SUPPRESSES RBC-MEDIATED BRAIN OXYGENATION AND CEREBRAL CIRCULATION
   Mentor: Dr. Kumar Vaibhav

7. **Retta Holmes, English**
   **Odessa Hinton, English Education**
   **Annabelle Whitten, English Education**
   POETRY INTEGRATION IN ELA INSTRUCTION
   Mentor: Dr. Anna Harris-Parker

8. **Ford Berger, Biology**
   POSSIBLE ROLE OF MICROBIOTA-DERIVED TRYPTOPHAN METABOLITES IN LONGEVITY
   Mentor: Dr. Sadanand Fulzele

9. **Taylor Kate Guerrero, Elementary Education**
   FROM SCIENCE CONCEPTS TO PRACTICAL INQUIRY: ENHANCING QUESTIONING SKILLS THROUGH SCIENCE AND ENGINEERING PRACTICES
   Mentor: Dr. Alex St. Louis

10. **Kritika Pokharel, Biology**
    INVESTIGATING EXPRESSION OF HCN CHANNELS THROUGH IMMUNOHISTOCHEMISTRY IN OVARY & TESTIS
    Mentor: Dr. Chung Sub Kim

11. **Nithya Rajanala, Cell and Molecular Biology**
    THE EFFECT OF CHRONIC UNPREDICTABLE STRESS ON PARVALBUMIN NEURONS AND PERINEURAL NETS
    Mentor: Dr. Xin-Yun Lu

12. **Ezequiel (Zeke) Balbino, Kinesiology**
    SEX DIFFERENCES IN RENAL POLYAMINE HANDLING
    Mentor: Dr. Daria Ilatovskaya

13. **Sonia Jose, Cell and Molecular Biology, Jesse Sang, Biology**
    INVOLVEMENT OF THE NF-KAPPAB AND CXCL10/CXCR3 SIGNALING PATHWAYS IN TRIPLE NEGATIVE BREAST CANCER INVASION
    Mentor: Dr. Jennifer Bradford

14. **Saja Sanadiki, Business Administration & Nursing**
    MORALLY GREY CHARACTERS
    Mentor: Dr. Blaire Zeiders

15. **Anvi Peddi, Cell and Molecular Biology**
    MULTI-PURPOSING COMMON MEDICINES: A BETTER CURE FOR CANCER?
    Mentor: Dr. Bal Lokeshwar

16. **Grace Neiswender, Cell and Molecular Biology**
    IDENTIFYING THE MOLECULAR BASIS OF BICD2 ASSOCIATED SMALED2 MUTATIONS
    Mentor: Dr. Graydon Gonsalvez

17. **Brionna Law, Communications**
    HOW MUSIC AND FOOD RELATE IN LOCALLY OWNED CULTURAL RESTAURANTS
    Mentor: Dr. Angela Bratton

18. **Makayla Xiong, Biology**
    CLIMATE STRESS AND OVARIAN IMMUNITY
    Mentor: Dr. Babak Baban

19. **Jasmine Patel, Cell and Molecular Biology,**
    **Julie Bishara, Cell and Molecular Biology**
    ESSENTIAL OILS AND OAIN PRESSURE THRESHOLD FEASIBILITY STUDY: METHODOLOGY
    Mentor: Dr. Dawn Langley Brady

1:00 – 2:30 Ballroom, Room 155

# Poster Session B

1. **Shawn Macon, Physics**
   CELL SIZE AFFECTS SYNTHETIC CELL-CELL SIGNAL OUTPUT IN VIVO
   Mentor: Dr. Abdul Malmi-Kakkada

2. **Kaamya Mehra, Cell and Molecular Biology**
   CARING ABOUT HEALTHCARE PROFESSIONALS: A SURVEY OF GEORGIA AHEC PRECEPTORS' MENTAL HEALTH AND WELLBEING
   Mentor: Dr. Neil MacKinnon

3. **Arion Brooks, Psychology**
   RELIGIOUS ORIENTATION AND RELIGIOUS COPING ON JUSTICE-ORIENTATED BELIEFS
   Mentor: Dr. Melanie Wilcox

4. **Alisha Hussain, Cell and Molecular Biology**
   CHARACTERIZATION OF AD05 AS A NOVEL INHIBITOR OF HSP90
   Mentor: Dr. Dr. Ahmed Chadli

5. **Noah Wiese, Chemistry**
   EXPLOITING HRAS-MUTATED HEAD AND NECK SQUAMOUS CELL CARCINOMA WITH TIPIFARNIB, A FARNESYLTRANSFERASE INHIBITOR
   Mentor: Dr. Vivian Lui

6. **Maksim Diakov, Cell and Molecular Biology**
   ROLE OF HISTAMINE IN THE REGULATION OF CALCIUM AND ACTIN DYNAMICS IN COLLECTING DUCT CELLS
   Mentor: Dr. Daria Ilatovskaya

7. **Laili Afzali, Biology**
   THE ROLE OF ERDAFITINIB IN HEAD AND NECK CANCER
   Mentor: Dr. Vivian Wai Yan Lui

8. **Vibha Amble, Cell and Molecular Biology**
   MODERATE TO SEVERE TRAUMATIC BRAIN INJURY LEADS TO CHRONIC NEUROLOGICAL DEFICITS AND ALZHEIMER'S DISEASE-LIKE PATHOLOGY
   Mentor: Dr. Kumar Vaibhav

9. **Elise Frails, Accounting**
   FRAMING THE PATHWAYS FROM POLICE SPENDING TO COMMUNITY OUTCOMES
   Mentor: Dr. Simon Medcalfe

10. **Vivie Vo, Cell and Molecular Biology**
    THE SENSITIVITY OF MUTANT VERSUS WILDTYPE IN HNCC TOWARD DRUG AMG 232 AND ALRIZOMADLIN
    Mentor: Dr. Vivian Lui

11. **Kaitlyn Le, Biology**
    VIRT DIRT: VIRTUAL REALITY CERAMICS
    Mentor: Dr. Raoul Pacheco

12. **Kyara Vences, Chemistry,**
    **Deborah Yang, Chemistry**
    **Emil Ayala-Cosme, Chemistry**
    PEPTIDES AS PROTEIN-PROTEIN INTERACTION INHIBITORS: SYNTHESIS OF NOVEL NRF2 BLOCKERS
    Mentor: Dr. Matteo Borgini

13. **Katherine Fleming, Chemistry**
    SYNTHESIS AND SCREENING OF A-METHYLENE LACTAMS AS COVALENT INHIBITORS
    Mentor: Dr. Matteo Borgini

14. **Sruthi Medicherla, Biology**
    TESTING OF NORTHEASTERN GEORGIA AMPHIBIANS FOR CHYTRID FUNGUS IN AUGUSTA, GA
    Mentor: Dr. Robert Cromer

15. **Natasha Gavara, Cell and Molecular Biology**
    ABILITY OF TWIST TO INDUCE MMP-9 EXPRESSION AT TRANSCRIPTIONAL LEVEL IN HPAC'S
    Mentor: Dr. Maria Eugenia Sabbatini

16. **Reeya Patel, Biology**
    UNRAVELING FXR GENE'S IMPACT ON MOUSE EYE BLOOD VESSEL FORMATION
    Mentor: Dr. Menaka Thounaojam

17. **Shelle Outlaw, Biology**
    EXPRESSION PROFILES OF COPPER TRANSPORT PROTEINS IN THE HIPPOCAMPUS AND CORTEX OF MODELS FOR ALZHEIMER'S DISEASE AND TYPE 2 DIABETES
    Mentors: Dr. Tohru Fukai & Dr. Masuko Ushio-Fukai

18. **Simran Bhikot, Biology**
    MECHANOSENSITIVE RECEPTOR ACTIVATION IN TISSUES OF THE FRUIT FLY DROSOPHILA MELANOGASTER
    Mentor: Dr. Paul Langridge

19. **Emma Gomez Lopez, Cell and Molecular Biology**
    ACUTE KIDNEY INJURY (AKI) IMPAIRS NITRIC OXIDE SYNTHASE (NOS)
    Mentor: Dr. Jennifer Sullivan

20. **Jessica Alvarez, Biology**
    TRYPTOPHAN MODULATION EFFECTS ON LONGEVITY AND HEALTH IN DROSOPHILA MELANOGASTER
    Mentor: Dr. Jessica Hoffman

21. **Jasmine Afzali, Biology**
    EFFECTS OF INFIGRATINIB IN PATIENT DERIVED CULTURES OF HEAD AND NECK SQUAMOUS CELL CARCINOMA
    Mentor: Dr. Vivian Lui

# Special Thanks

**Conference Committee and Planning Team**

Ms. Jennifer Davis, *Library Services*
Dr. Quentin Davis, *Center for Undergraduate Research and Scholarship*
Ms. Janice DeLoach, *IT Customer Experience*
Dr. Josefa Guerrero-Milan, *Department of Chemistry and Physics*
Mr. Jordan Moratin, *CURS Office*
Ms. Jen Lask, *Brand Communications*
Mr. Michael Holahan, *University Communications Photographer*
Mr. Sam Klein, *JSAC Coordinator of Student Involvement*
Mr. A.B. Osborne, *Department of Art & Design*
Ms. Skyler Owens, *CURS Ambassador*
Ms. Arijana Reese, *IT Customer Experience*
Dr. Alex St. Louis, *Center for Undergraduate Research and Scholarship*
Ms. Dora Walden, *Classroom and Event Scheduling*

**Recognition of Financial Contributions and Support**

Phi Kappa Phi Chapter 324
Dr. Michael Diamond, *Senior Vice President for Research*
Prof. Scott Thorp, Associate *Vice President for Interdisciplinary Research*
Dr. Zach Kelehear, *Vice Provost for Instruction*

**CURS Ambassadors**

Tanish Kumar, *President*
Daniel Francois, *Vice President and Treasurer*
Kaitlyn Le, *Secretary*
Taylor Kate Guerrero, *Historian*

Vanessa Browning, *Arsenal Undergraduate Journal Committee, Co-Chair*
Trinity Johnson, *Arsenal Undergraduate Journal Committee, Co-Chair*
Riya Patel, *Arsenal Undergraduate Journal Committee*

Skyler Owens, *Undergraduate Conference Committee, Chair*
Sai Nasanally, *Undergraduate Conference Committee*
Grace Neiswender, *Undergraduate Conference Committee*
Charmi Patel, *Undergraduate Conference Committee*

# Special Thanks

### Oral Session Moderators

Ms. Jennifer Davis, University Libraries
Ms. Emily Harris, University Libraries
Ms. Ladan Kian, Department of Computer & Cyber Sciences
Ms. Elizabeth Lightfoot, University Libraries
Ms. Aspasia Luster, University Libraries
Dr. Robert Saunders, Music
Mr. Thomas Weeks, University Libraries

### Session Judges

**Oral**

Dr. Matteo Borgini, Chemistry & Biochemistry
Ms. Ashley Christman, Undergraduate Health Professions
Dr. Kim Davies, Pamplin College
Dr. Cassandra Groth, Psychiatry & Health Behavior
Dr. Pam Hayward, Communications
Dr. Jessica Hoffmann, Biological Sciences
Dr. Tianxiang Hu, Georgia Cancer Center
Dr. Ravirajsinj Jadeja, Biochem & Mol. Bio.
Dr. Deborah Jehu, Community & Behavioral Health Sciences
Dr. Chung Sub Kim, Neuroscience & Regenerative Medicine
Mr. Jim Majors, JD, Community Member
Dr. Daphne Maysonet, English & World Languages
Dr. Nick Musisca, Emergency Medicine
Dr. Siva Panda, Chemistry & Biochemistry
Dr. Rucha Samudra, Social Sciences
Dr. Alireza Taheritajar, Computer Science
Dr. Maneka Thounaojam, Cellular Biology & Anatomy
Dr. Kumar Vaibhav, Neurosurgery
Dr. Seretha Williams, English & World Languages

**Poster**

Dr. Kelly Allen, Research, Counseling and Curriculum
Dr. Liana Babayan, English & World Languages
Dr. Tiana Curry-McCoy, Undergraduate Health Professions
Dr. Binnur Eroglu, Neuroscience & Regenerative Medicine
Dr. Sadanand Fulzele, Medicine
Dr. Josefa Guerrero-Millan, Department of Physics and Biophysics
Dr. Amelia Hall, English & World Languages
Dr. Anna Harris-Parker, English & World Languages
Dr. Dawn Langley-Brady, Nursing Science
Dr. Ellen LeMosy, Cellular Biology & Anatomy
Dr. Duygu Minton, English & World Languages
Mr. Brad Warren, University Libraries

***Special Thanks to All our Volunteers***!

# The Role of Erdafitinib in Head and Neck Cancer

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## ABSTRACT

Eradafitinib is an FDA approved class of medications known as kinase inhibitors which work by blocking the action of abnormal proteins that signal cancer cells to multiply. The drug has been FDA-approved for the treatment of bladder cancer. This proposed project will study the family of proteins known as Fibroblast Growth Factor Receptors (FGFR) and the relation of the drug on patients with specific FGFR gene alterations. We evaluate the potential anticancer activity of this FGFR targeting drug in head and neck squamous cell carcinoma (HNSCC) using a panel of HNSCC patient-derived cultures (PDCs). The research was performed by treating HNSCC PDCs with erdafitinib and then using an MTT assay to check on the growth inhibitory activity of the drug on the treated cells. MTT assay is a colorimetric assay that will measure the cellular metabolic activity of cells signaling of cell viability. Western blotting was performed to inspect the expression of FGFR proteins or downstream signaling proteins that were potentially altered by the drug. The overall goal of the project is to provide a better treatment for HNSCC based on the effectiveness of erdafitinib in inhibiting FGFR. Based on the Dose Response Curves, it was evident that the T77 PDC compared to the other PDCs had a greater sensitivity to erdafitinib. The Western Blot gel imaging of the T77 PDC only had visible bands for P-MAPK, FGFR1, MAPK, and β-actin, but T77 PDC was not distinctive with that feature because other PDCs that were tested also

had those following bands. This could mean that although erdafitinib is an FGFR pathway inhibitor, this would not be the reason T77 PDC was sensitive.

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# Kynurenine's Effect on the Different Stages of Osteoblastic Differentiation

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## ABSTRACT

This study focuses on the dynamics of age-related changes in osteoblasts' matrix production, with a specific focus on the involvement of the aryl hydrocarbon receptor (AhR). The AhR is activated by kynurenine, a metabolite of the amino acid tryptophan that tends to increase with age. The study utilizes a 21-day differentiation process of mesenchymal stem cells, employing "window experiments" that vary the intervals of kynurenine treatment to explore its impact at different stages of osteoblast development. The experimental setup involves four distinct conditions: a control group with a vehicle, a group treated with kynurenine, a group with an AhR antagonist (BAY), and a group treated with both kynurenine and BAY. The AhR antagonist, specifically BAY2416964, serves to investigate whether any observed effects of kynurenine are mediated through AhR signaling. Results, analyzed through alizarin red staining, demonstrate a notable negative impact of kynurenine on matrix production, particularly in the middle stages of osteoblast differentiation. The study further employs crystal violet staining to confirm the presence of cells in the experimental wells, providing assurance of the reliability of the alizarin staining procedure. Importantly, this staining procedure also suggests that the effects of kynurenine on mineralized matrix production are largely independent of any potential impacts on cell viability.

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# Tryptophan Modulation Effects on Longevity and Health in Drosophila Melanogaster

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**ABSTRACT**

Previous studies have suggested that the tryptophan metabolic pathway has a significant effect on health and longevity across species. This pathway involves metabolic reactions that degrade tryptophan into multiple metabolites including kynurenine and serotonin. Here, we investigated which genes and metabolites in this pathway affect longevity and health, using the fruit fly, Drosophila melanogaster. Previous research suggests that, as a fruit fly ages, they have an increase in the concentration of kynurenine and its downstream metabolites that may have negative effects on longevity, so we looked at flies knocked down and knocked out genes in this pathway, specifically vermillion and cinnabar. Vermillion converts tryptophan to kynurenine, and cinnabar following after converts kynurenine to 3-hydroxykynurenine. We looked at longevity and age-related health in these flies both with and without extra supplemented dietary tryptophan. From these experiments, we hypothesize that a decrease in the vermillion and cinnabar expression will increase the lifespan of the fruit fly. From the data collected with the Cinnabar experiment, the knocked down flies did live longer, and the female knockdown flies performed better under environmental stress. However, the increase of tryptophan in the flies' diet did not boost performance and longevity in files when compared as the flies with and without supplemental tryptophan died off at a similar rate. However, if given too much tryptophan, the flies will be short-lived as the experiment shown that by the 40-day mark that they were all dead. Along with that, majority of the vermillion experiments has been conducted, and based on what has been seen so far from the vermillion flies it can be said that the knockdown of vermillion doesn't not extend the fly's longevity, nor does it a positive impact on the fly's age-related health. This was seen when certain health assays were conducted, the vermillion knockdown flies performed poorly compared to their cinnabar counterparts. Along with that, the cinnabar flies were also longer lived than vermillion flies which can suggest that the gene that should be regulated more was a fly ages should be cinnabar and not vermillion.

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# Moderate to Severe Traumatic Brain Injury Leads to Chronic Neurological Deficits and Alzheimer's Disease-like Pathology

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## ABSTRACT

Traumatic brain injury (TBI) is a foremost cause of disability and mortality globally. While scientific and medical emphasis is to save lives and avoid disability during acute period of injury, it is clear that severe health problems can manifest years after injury. For instance, TBI increases the risk of cognitive impairment in the elderly. Remote TBI history was reported to accelerate clinical trajectory of Alzheimer's disease-related dementia (ADRD) resulting in earlier onset of cognitive impairment and increased AD pathological markers like greater amyloid deposition and cortical thinning. It is not well understood whether a single TBI event may increase the risk. Moreover, the cellular signaling pathways remain elusive for chronic effects of TBI on cognition. We have hypothesized that a single TBI induces sustained neuroinflammation and disrupts cellular communication in a way that results later in ADRD pathology. To test this, we induced TBI in young adult CD1 mice and assessed the behavioral outcomes after 11 months followed by pathological and histological assessments. We found these brains showed progressive atrophy, markers of ADRD, loss of neuronal cells and growth factors even after 1-year post-TBI. Because of progressive neurodegeneration, these mice had motor deficits, showed cognitive impairments, and spent longer time in the central region. We, therefore, conclude that progressive pathology after adulthood TBI leads to neurodegenerative conditions such as ADRD and impairs neuronal functions.

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# Ursolic Acid Derived Potential Hybrid Conjugates for Cancer Therapy

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## ABSTRACT

Cancer is a serious health issue worldwide, including in the United States. One of the most common types of cancer that affects the bladder is known to recur even after treatment. The primary treatment for this cancer is surgery, but doctors also use other methods such as chemotherapy, radiation therapy, and immunotherapy. However, these treatments have side effects that can be harmful. Researchers are seeking new treatments that are safer and more effective. One such treatment that shows great promise is Ursolic Acid (UA), a natural substance in various plants. UA has many beneficial properties, including protecting organs, reducing inflammation, and fighting cancer. However, UA is not easy to use as a medicine because it is not very soluble in water and does not last long in the body. Researchers have developed new compounds that are conjugates of UA and work better against bladder cancer cells. These compounds could be a potential new treatment for cancer in the future.

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# Sex Differences in Renal Polyamine Handling

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## ABSTRACT

Polyamines (PA) are polycationic molecules with multiple amino groups that are found within nearly all living organisms and are involved in various biochemical functions such as cell proliferation, regulation of apoptosis, and interactions with nucleic acids. PA levels must be tightly maintained because their dysregulation could lead to pathophysiology, f.i., kidney disease. There is a gap in knowledge regarding sex differences in PA levels, although we know that kidneys exhibit sex differences in function and structure. We hypothesized here that differences in PA biosynthesis and catabolism pathways lead to higher PAs in male renal cortex and medulla compared to females, which could be implicated in different susceptibility to renal disease in males and females. Male and female healthy Sprague Dawley rats had *ad libitum* access to food and water. At 11 weeks of age, the rats were euthanized, and their kidneys were harvested and separated into the cortex and medulla. To assess the abundance of proteins involved in PA metabolism, Western blotting technique was utilized. Densitometry of protein bands were measured and normalized to the total protein. 2-way ANOVA with Holm Sidak post-hoc test was used for statistical analysis. We revealed that ornithine aminotransferase (OAT) exhibits a difference within the renal cortex ($p<0.001$) and medulla ($p=0.04$) with a higher abundance in females in both renal tissues. We also report differences in agmatinase (AGMAT) between both cortex ($p=0.002$) and medulla ($p<0.001$) (higher levels in females). Interestingly, spermidine synthase (SRM) showed a greater expression in males in the medulla ($p=0.01$) and in the cortex (0.04). The result of OAT reveals that females favor the TCA cycle; however, the higher expression of AGMAT suggests that females supplement PA levels by bypassing ornithine through agmatine, and higher levels of SRM in males indicate that there are higher PA levels in males. Our data supports our initial hypothesis that there are sex differences in PA biosynthesis and catabolism pathway leading to higher PA levels in male renal tissues.

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# Possible Role of Microbiota-derived Tryptophan Metabolites in Longevity

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## ABSTRACT

Aging is the primary risk factor for diverse health issues and mortality on a global scale. Therefore, it is imperative to develop interventions that reduce morbidity and elevate overall well-being during the aging process, ultimately extending a healthy lifespan. Our group previously reported the critical role of endogenous tryptophan metabolites in musculoskeletal health with age. Our preliminary studies on Microbiota-derived tryptophan metabolites (Indole propionic acid, (IPA)) demonstrated positive benefits to protect cells from oxidative stress. Our initial results encourage us to study the effects of Microbiota derived tryptophan metabolites (IPA, indole butyric acid (IBA), and tryptamine (TRY) on longevity and health in a *Drosophila melanogaster*. Using three different genotypes and both sexes, we supplemented the above-mentioned metabolites into the food of *D. melanogaster* flies and evaluated both lifespan and health effects. We observed that certain metabolites positively affected life span in a sex-specific manner. IPA showed the most positive impact on increased life spans across multiple genotypes compared to other metabolites. Further studies are needed to understand the molecular mechanism behind the positive benefit of these metabolites on longevity.

*Keywords*: Aging; metabolites; microbiota; Indole Propionic Acid (IPA); Indole Butyric Acid (IBA); Tryptamine (TRY); Tryptophan (TRP)

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# Mechanosensitive Receptor Activation in Tissues of the Fruit Fly Drosophila Melanogaster

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## ABSTRACT

Notch receptors, found in all animals, play a crucial role in development and are associated with various diseases, including cancer. They work by responding to mechanical cues. When a neighboring cell releases a ligand called Delta, it binds to the Notch receptor, causing mechanical stress on the ligand-receptor complex. This stress triggers a change in the receptor's structure, leading to its cleavage by protease enzymes. The cleavage releases a fragment that acts as a transcription factor, traveling to the nucleus to activate genes involved in Notch signaling. Recent progress has allowed the creation of synthetic Notch (synNotch), which can be customized to produce specific responses. SynNotch uses modified ligand-receptor interactions and incorporates foreign transcription factors to induce desired outcomes, such as gene expression or therapeutic effects. However, understanding how synNotch behaves in tissue contexts where it's used therapeutically remains a challenge, as it depends on various factors like tissue structure and response strength. The goals of this study include characterizing existing mechanosensitive receptors in Drosophila, designing and constructing novel receptor combinations, and testing their effects in both the fly wing and nervous system. By using molecular and imaging techniques, the goal is to identify the cellular processes and signaling pathways triggered by these engineered receptors.

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# Generation and Characterization of UFM1 Conditional Knockout Mice

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## ABSTRACT

In recent studies impairments in protein homeostasis are shown to be contributing factors of cardiac diseases. Additionally, studies have shown that ufmylation plays an important role to sustain cell development and tissue homeostasis. The protein UFM1 (ubiquitin-fold-modifier 1) is mostly found in multicellular organisms such as mice. Mutations in ufmylation proteins have been linked to various human diseases, and has also been reported in heart failure. To study the role of the ufmylation component UFM1 specific to the heart, we use the cre lox system to generate UFM1 specific conditional knockout mice targeting the heart tissue. The cre lox system is used to carry out deletions, translocations, and insertions at specific flox sites. In this case the $aMHC^{cre}$ is targeting the UFM1 gene present in the heart tissue. In order to target the heart we must breed a mouse that carries a UFM1 flox-flox gene with a mouse that carries an $aMHC^{cre}$ (a-myosin heavy chain promoter- driven cre transgenic) gene. Furthermore, when offspring are produced their toe is clipped as a DNA sample, and is digested. Then specific primers are made to target the UFM1 gene. The samples are then put into the PCR (polymerase chain reaction) machine, which is set at 68 degrees in order to amplify the gene. After the machine has completed its run, the samples are then transferred to a sybr safe nucleic acid gel for imaging. The gel allows us to see the UMF1 flox-flox gene (homozygous) and the UFM1 flox-positive gene (heterozygous) present in the offspring. This then allows us to determine if a UFM1 knockout is present. By confirming heart specific UFM1 knockout we will be able to determine the importance and role UFM1 plays in heart diseases.

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# The Role of JMJD1C on Oligodendrocyte Lineage Cells After White Matter Injury

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## ABSTRACT

Over ten percent of babies are born preterm. Often, the lungs of preterm infants are not fully developed, leading to challenges in getting oxygen to the brain. This can result in brain white matter injury characterized by decreased myelination of axons. Prior research using a chronic hypoxia mouse model of developmental white matter injury demonstrated that recovery is enhanced when mice live in an enriched environment. Oligodendrocytes, the myelinating cells in the brain, are generated in higher numbers, myelinate more axons, and locomotor recovery is improved, when mice recover in an enriched environment. To uncover the molecular mechanisms behind this enrichment-induced recovery, oligodendrocyte-specific RNA sequencing was performed. A significant number of histone-modifying enzymes were differentially expressed. One particularly interesting histone modifier, Jumanji Domain Containing 1C (JMJD1C), is a lysine demethylase that acts on histone 3-lysine 9, and promotes lipogenesis – a critical process in myelination. JMJD1C is downregulated after hypoxic injury but upregulated during enrichment-induced recovery. We hypothesize that JMJD1C directs enrichment-induced effects on oligodendrocytes following hypoxia. To determine the role of JMJD1C in oligodendrocytes after hypoxic injury, JMJD1C was conditionally knocked-out of oligodendrocyte precursors in PDGFRα-CreER$^{T2}$ x Rosa-YFP x jmjd1c$^{fl/fl}$ mice. These mice were housed in low oxygen (10.5% $O_2$) from postnatal day (P) 3 through P11. Cre recombinase was activated by intraperitoneal injections of tamoxifen at P13-P15. At P15, mice were either placed into a standard laboratory mouse cage, or an enriched environment, until P45. Mice were then processed for immunohistochemistry, and oligodendrocyte density was assessed in the subcortical white matter. Our data suggest that oligodendrocyte-specific knockout of JMJD1C diminishes the oligodendrogenic response present during enrichment-induced recovery from hypoxia. These preliminary findings appear to support our overarching hypothesis. Going forward, more work will elucidate the role of JMJD1C in myelination and functional recovery following hypoxia. This work has the potential to identify a therapeutic target for preterm infants with white matter injury.

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# Bis Benzothiazole Compounds Reduce Proliferation of Pancreatic Cancer Cells

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## ABSTRACT

Pancreatic cancer is a fatal rapidly progressive malignancy that is the number four cause of cancer related death in the United States. The pancreas is vital in the processes of digestion, hormone secretion, and blood glucose regulation. Unfortunately, pancreatic cancer is rarely found in its initial stages because symptoms do not typically arise until it has metastasized. While the prognosis is variable based on each patient, the general five-year survival rate is extremely low (5-10%). Currently, there is no effective, readily available treatment for individuals suffering from pancreatic cancer; therefore, it is imperative that new avenues of treatment options are explored and researched. This research project aimed to analyze the effects of twelve newly synthesized bis benzothiazole compounds on pancreatic cancer cells. An optimized, eco-friendly protocol has been developed for the highly efficient synthesis of novel symmetrical head-to-head bis benzothiazoles via various linkers. The method involves a one-pot condensation reaction of 2-amino thiophenol and N-acylbisbenzotriazoles. The advantages of this methodology are short reaction time, easy and quick isolation of the product, and excellent yield, making it suitable for large-scale synthesis. The compounds were added to pancreatic adenocarcinoma cell lines HPAC and PANC1. The protocol for this portion of experimentation involved production of dilutions of each compound (BBT 1-12), addition of several different dilutions to the target cells, and then in-depth analysis of the rate of cell proliferation after 0, 24, 48, and 72 hours of exposure. The results of the experiment showed that BBT 4 was the most promising compound. BBT 4 proved to be the most effective at decreasing the rate of cell proliferation in a concentration-dependent matter in both HPAC and PANC1 cells. This study aims to further the understanding of how pancreatic cancer cells respond to various novel compounds, as well as to track the efficacy of each compound at different concentrations.

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# The Role of Religious Orientation and Religious Coping on Justice-Orientated Beliefs

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## ABSTRACT

This project examined individual attitudes related to the societal shifts in the United States throughout the current decade through the resurgence of the Black Lives Matter Movement, the Women's Rights Movement, civil unrest involving the 2021 Presidential Election, and the discourse on the COVID-19 vaccine. However, our discussion extends beyond civil rights to gain a better understanding of the role of religion in politics. This study investigates the correlation between religiosity, political ideologies, adverse childhood experiences, and attitudes toward social justice, racism, and vaccines through the frames of Social Dominance Theory (SDT) and Right-Wing Authoritarianism (RWA). SDT emphasizes that all societies organize around group-based hierarchies that ultimately serve to establish and maintain oppression. RWA describes two forms of authoritarian behaviors, aggression, and submission, which represent the willingness to cause harm for and submit to perceived authority figures. This study sought to understand how individuals' religious and spiritual health influences political ideology and socially impactful attitudes. Participants in this study included people from a diverse range of religious backgrounds, education levels, political affiliations, genders, and ages, contributing to a comprehensive understanding of the subject matter. The findings can enhance understanding of the connection between religion, political beliefs, and their influence on behavior within American society.

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# Undergraduate Mentor and K-12 Student Views: Questioning in Science Classrooms

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## ABSTRACT

Students learning science in the classroom need additional pedagogical support (Akinoglu 2008; Firman et al. 2019). A form of support includes inquiry-based learning, which can deepen students' conceptual understanding of science more than traditional learning (Aktamis et al., 2016). The purpose of this qualitative exploratory study is to investigate how K-12 students and undergraduate mentors view questioning in scientific inquiry through participation in the iBEARS (Inclusive Biologist Exploring Active Research with Students) program. iBEARS is a novel program that allows undergraduate students to mentor K-12 students through a semester-long project-based learning experience in science, intended to promote the development of 21st century skills in undergraduate students, along with content knowledge in K-12 students (St. Louis et al., 2021). The participants of this study are undergraduate mentors and K-12 students. Using a qualitative methods design, we used the *Views About Scientific Inquiry* (Lederman et al., 2014) instrument to investigate how participants consider questioning in the scientific inquiry process. Preliminary results of this study show that undergraduate mentors' views about questioning decreased, becoming more naïve (rather than informed) after serving as mentors, while K-12 students' views about questioning were mostly stagnant. Additional research is needed to understand further why views about questioning changed after serving as a mentor, and how direct mentorship and participation in this classroom intervention specifically affected K-12 student views. The preliminary results of this study give insight to how inquiry-based learning curricula affect mentor and student views.

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# An Autonomous Surface Vehicle for Water Quality Monitoring

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**ABSTRACT**

We have designed and tested an autonomous surface vehicle (ASV) which will be deployed to monitor water quality in the Augusta Canal and other nearby bodies of water. It uses a dual-band Global Navigation Satellite System (GNSS) and the BNO055 nine-axis absolute orientation sensor to determine its location and current heading and autonomously navigate along a predetermined path. Experimental results have been collected using the control algorithm for both a land, and water-based versions of the ASV. Our algorithm development was based on results of the land-based ASV, but we found that this control algorithm transferred to the water-based ASV with minimal modification. Details of the algorithm, and testing results will be presented. We will also outline future research aims to integrate water quality sensors onto the ASV.

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# Making Trash Smarter

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## ABSTRACT

Traditionally, municipalities and other large organizations collect garbage from trash bins at specified time intervals. This is an inefficient use of resources because trash bins in higher traffic locations may need more frequent attention, whereas those in lower use locations need less frequent service. This can lead to overflowing trash bins and the resulting hygiene and environmental contamination risks. In addition, too frequent servicing of low use trash bins wastes valuable resources that could be applied to higher demand locations. We have developed a low-cost electronic solution which allows for remote monitoring of trash buildup levels. A waterproof sonic ranger measures the volume of trash in a trash can and uses low-power radio signals to transmit this information to a website via our on-campus long range radio wide area network (LoRaWAN). This allows waste management employees to know when a trash can needs service while providing data about trash volume at each monitored location. Both an indoor and outdoor model have been created and deployed on campus for testing purposes. Future plans include the deployment of ruggedized versions across the city of Augusta.

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# Modeling the Effects of Immune Response and Antiviral Therapy on SARS-CoV-2 Infection

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## ABSTRACT

The severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) emerged in December 2019, and as of December 2023, this virus was responsible for about 6.9 million confirmed deaths and about 773 million confirmed cases of COVID-19 globally. In this project, we used a within-host model to investigate the impact of antiviral therapy and CTL immune response on viral load and the number of productively infected cells. The infection-free equilibrium of our model is derived, and the basic reproduction number is computed, using the next-generation matrix approach. We studied the elasticity indices of the reproduction number with respect to each parameter and identified parameters that are most sensitive in increasing the reproduction number and those that are most sensitive in decreasing the reproduction number. Numerical simulations suggest that protease inhibitors are more effective in reducing viral load than fusion inhibitors. Moreover, a combination of fusion and protease inhibitors results in lower viral loads than individual inhibitors. Different combinations of antiviral therapy and CTL immune response were investigated. Our numerical simulations suggest that in the presence of fusion and protease inhibitors, the activation of the immune response (CTL immune response) results in low viral loads, a reduced number of productively infected cells, and a delay in the viral relapse phase. Thus, a combination of antiviral therapy and CTL immune response is optimal in reducing the viral load and the number of productively infected cells.

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# Ailing: An Abject Horror Story

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## ABSTRACT

For my thesis, I plan to create a creative piece called Ailing that is influenced by Julia Kristeva's theory of the abject. My goal is to create a story that uses the horror and confusion of the abject to create something truly horrifying. This piece will be a short story that is completely original and dripping with my own style and voice. The purpose of this project is to create something that is horrifying in nature and to expand my writing skills. I aim to study Kristeva's horror theory and use it to shape the plot, characters, and themes of my piece. Specifically, the abject seems to be the things that are inside of us that we refuse to accept are part of us. For example, any discharge from the human body. For a more specific example, vomit. We, as humans, find that vomit is disgusting, but we create it from our body. Thus, it can become difficult for one to separate the object, the vomit, from themselves. It is almost impossible to separate the object from the subject. There is a sense of discomfort and confusion regarding our identity, and that's horrifying. Another horrifying aspect of the abject is the fact that seeing corpses reminds us of our own mortality. It is easy for us to distract ourselves from the fact that we are on a constant hurl towards the unknowing, inevitable force of death. The abject, however, forces us to look death in the face, through things like corpses. With this in my mind, I have decided that my story will explore the themes of bullying and trauma through the lens of sickness and body horror while applying the theory of the abject through corpses, vomiting, and identity breaking. I plan to have both a creative piece and a reflection on the way that the abject is reflected in the piece.

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# Role of Histamine in the Regulation of Calcium and Actin Dynamics in Collecting Duct Cells

**Presenter(s)**: Maksim Diakov

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## ABSTRACT

Histamine, a nitrogen-based molecule pivotal in allergic reactions and immune responses, elevates in renal pathologies like nephrotic syndrome and diabetic nephropathy. Previous research revealed abundant histamine receptors (HR1 to HR4) in the kidney, impacting intracellular Ca2+ in collecting ducts. Despite the critical role of calcium signaling in actin-cytoskeleton dynamics, a knowledge gap exists on histamine's specific contribution. This study hypothesizes that histamine exposure induces Ca2+ release, prompting F-actin cytoskeleton reorganization in cortical collecting duct cells, illuminating the intricate interplay between histamine, calcium signaling, and cellular integrity. Immunofluorescent staining and Western blotting characterized renal histamine receptor (HR) expression and histaminergic system (HiS) enzymes. Testing histamine effects in mouse cortical collecting duct cells utilized live confocal imaging for intracellular Ca2+ changes (Fluo 8, 490/525 nm). F-actin cytoskeleton rearrangements were assessed through rhodamine-phalloidin staining, with image analysis in FIJI (NIH). Acute histamine application (100 uM) primarily increased intracellular Ca2+ through extracellular influx, with minor intracellular store release. Blocking HR1-4 with loratadine (5uM), ranitidine (10 uM), iodophenpropit (500 nM), and A943931 (100 nM) showed HR1, HR3, and HR4 involvement in Ca2+ influx, excluding HR2. Incubation of mpkCCD cells with 100 uM histamine for 4 hours induced F-actin stress-fiber formation in the submembrane space, providing insights into histamine's impact on cellular dynamics. Our data revealed that histamine exposure leads to an influx of Ca2+ in these cells, which is mediated via H1R, H3R, and H4R. Additionally, histamine induced actin cytoskeleton rearrangements, suggesting its role in maintenance of renal epithelial cell structure. Our findings highlight the relationship between histamine, calcium regulation, and actin cytoskeleton dynamics in the renal epithelial cells, offering insights into future therapeutic strategies.

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# New Hybrids Based on Curcumin as Potential Therapeutics for Cancer

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## ABSTRACT

Breast cancer is a significant concern for women, and the current treatments available can cause serious side effects. However, scientists have discovered a natural molecule called curcumin, derived from turmeric, that has shown potential in fighting cancer. The only problem is that the body does not absorb curcumin easily, making it challenging to use effectively. Scientists have developed a new approach to modify curcumin to overcome this challenge by attaching it to another scaffold with anticancer properties. They have synthesized several hybrid conjugates and screened them against various breast cancer cell lines. The new approach has been tested, and the results are promising. The aim is to develop new, effective treatments for breast cancer that are safe and free of harmful side effects. All the synthesized hybrid conjugates have been well characterized using spectroscopic techniques, and several of the molecules have shown effective anticancer properties against various breast cancer cell lines and in animal models. This is an exciting development in the field of cancer research, and it holds the promise of providing a safer and more effective treatment option for breast cancer patients in the future.

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# Social Determinants of Health (SDoH) Comparison Between Scotland and Georgia

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## ABSTRACT

Social determinants of health (SDoH) describe non-medical factors, such as environment, access to healthcare, economic stability, education, that significantly impact health outcomes within populations. These factors are intrinsically associated with the undeniable reality of unequal healthcare opportunities within populations, commonly known as health disparities. Disparities are evident on factors such as disease prevalence, life expectancy, and overall well-being; often disproportionately affecting marginalized and vulnerable communities. Research conducted by the Center of Disease Control (CDC) has shown that rural Americans face greater health disparities in comparison to those who reside in urban areas, with the rural population being more prone to exhibit higher mortality rates related to hearth disease, chronic respiratory disease, cancer, stroke, and alcohol and drug abuse. Unfortunately, these poor health outcomes are related to the higher rates on unemployment, lower education attainment, and less access to health care services within the rural communities. Addressing these issues is essential to improve our nation's current healthcare system, and to progress toward advocating for more policies and education that promote health equity, fair and just opportunity to attain optimal health regardless of race, ethnicity, disability, socioeconomic status, geography. This project focuses on comprehending the impact of Social Determinants of Health (SDoH) and assessing the depth of health disparities within Georgia's rural population. The research utilizes secondary data analysis that aims to assess parallels and disparities in social determinants of health (SDoH) between rural populations in Scotland, the state of Georgia, and the United States. Secondary objectives encompass the examination of health equity and disparities among these two countries. Our methodology involves retrospective data analysis of public health data from Scotland, Georgia, and the United States. Ultimately, our study's goal is to gain deeper insight on the impact of SDoH within these populations, enabling possible mitigating solutions to be devised.

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# Gluteus Medius, Hamstring, and Quadriceps Activation During Variations of Common Lunges

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## ABSTRACT

Hip and knee muscle weakness is associated with many conditions such as patellofemoral pain (PFP), anterior cruciate ligament (ACL) injury, and iliotibial band stress syndrome (ITBS). Physical therapists commonly prescribe lunges as a functional way to improve hip and knee strength. Typically, patients perform a lunge by moving the involved lower extremity away from the midline of the body. The lunge may be modified by standing on the affected lower extremity and moving the uninvolved extremity away from the midline of the body. To date, it is unknown if differences exist in hip and knee muscle activation when performing a lunge in either manner. The purpose of this study is to determine the relative activation of hip and knee muscles during various lunges performed in a non-weight bearing (lunge performed with the limb moving away from the body midline) and weight bearing (lunge performed with the opposite limb moving away from the body midline) manner. We hypothesized that subjects would generate similar muscle activity across the lunge variations. Surface electromyographic (EMG) activity of the gluteus medius (GM), vastus lateralis (VL), and biceps femoris (BF) was collected for thirteen subjects during a series of lunges and conditions. Subjects performed 5 repetitions of a front, side, and curtsy lunge in a non-weight bearing and weight bearing manner. Data were expressed as a percent maximal voluntary isometric contraction (MVIC). Separate 2 (condition) X 3 (lunge type) analyses of variance with repeated measures were used to determine differences in muscle amplitudes for each exercise. The level of significance was established at the 0.05 level. EMG activity for the GM during all lunge variations ranged from low to moderate (17.8-23.0% MVIC). The EMG activity for the VM ranged from low to moderate (7.9-26.9% MVIC) while EMG activity for the BF was low (4.2-12.0% MVIC). Lunges may be used for strengthening and endurance training. For most of the lunges and conditions, muscle activation generally was higher than during the weightbearing condition. The muscle activation produced for all muscles ranged from low to moderate. Our findings show that lunges that generate moderate EMG activity are best for endurance training. Lunges that only require low levels of EMG activity will need to be performed with an external load to increase the exercise intensity. Findings from this study provide an evidence-based approach for the clinician when prescribing lunges for individuals with hip and knee weakness.

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# Framing the Pathways from Police Spending to Community Outcomes

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## ABSTRACT

Law enforcement funding gained increased visibility and focus after 2020's tragic killing of George Floyd. For years, activists advocated cutting law enforcement budgets and the George Floyd murder increased calls by activists to "defund the police". However, others advocated for a reallocation of funds while others wanted to protect police spending. This thesis will analyze the effect of changing police spending on a variety of community outcomes using county level data from Georgia and South Carolina. Specifically, we examine the relationship between police spending and violent crime, self-reported mental health, and high school graduation. We find that police spending has no effect on crime, improves mental health, and decreases education attainment. Policy changes based on these results are suggested for local governments.

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# Exploring the Ability of Twist1 to Induce MMP-9 Expression at the Transcriptional Level in Human Pancreatic Stellate Cells

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**Affiliation(s):** Department of Biological Sciences, Augusta University

## ABSTRACT

This thesis investigates the ability of transcription factor Twist1 to induce the synthesis of Matrix Metalloproteinase-9 (MMP-9) in human pancreatic stellate cells (hPaSCs). MMP-9, a collagenase, plays a critical role in extracellular matrix degradation, influencing cell migration, tissue remodeling, and wound healing, with significant implications in cancer metastasis. Twist1, a basic helix-loop-helix transcription factor, is known for its involvement in cellular processes, including cell migration and differentiation.

The study employed luciferase reporter assays to demonstrate that Twist1 significantly enhances MMP-9 synthesis in HEK293 cells and hPaSCs. This induction was less pronounced in hPaSCs compared to HEK293 cells. The involvement of NF-κB1 (p50), another transcription factor, in this regulation was also investigated, revealing that NF-κB1 assists Twist1 in synthesis of MMP-9. The application of the NF-κB inhibitor Bay 11-7082 confirmed this interaction, as it reduced the Twist1-induced MMP-9 synthesis.

Western blot analysis was integral in confirming the presence of Twist1 and NF-κB1 p50 in both HEK293 cells and hPaSCs. In HEK293 cells, the presence of Twist1 led to a significant increase in MMP-9 synthesis. Similarly, hPaSCs transduced with lentiviral particles carrying Twist1 showed increased MMP-9 synthesis, although to a lesser extent compared to HEK293 cells.

These results illustrate the molecular interplay between Twist1, NF-κB, and MMP-9 in pancreatic stellate cells, and suggest the potential of targeting this pathway in therapeutic strategies against pancreatic cancer. The study provides insights into the regulatory mechanisms of MMP-9 in pancreatic stellate cells, emphasizing the translational relevance in developing treatments for pancreatic cancer progression and metastasis.

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# Do Compression Garments Influence Oxygen Consumption and Heart Rate During a Submaximal Endurance Run?

**Presenter(s):** Haley Gilbert

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## ABSTRACT

PURPOSE: To examine the effect of compression garments on oxygen consumption (VO2) and heart rate (HR) during a 40-minute submaximal run.

METHODS: 7 injury-free runners (33.43±9.98 yrs;69.60±10.22kg;1.72±0.06m; 4M, 3F) participated in the study. Participants ran in full-leg compression garments (COMP) and loose-fitting control garments (CON). The participants ran each condition for 40-minutes on a treadmill at their preferred speed which was determined by taking the average speed from 3 blinded trials. Each participant was instructed to increase pace until they were comfortable for a 60-minute training run. Oxygen consumption was recorded continuously via a metabolic cart. HR was measured continuously using a telemetric heart rate monitor placed below the sternum and averaged across each condition. Average V02 was calculated beginning at the onset of steady state until the end of each 40-minute condition. Average VO2 drift was calculated subtracting the average VO2 of the last 3 minutes of each run from the first 3 minutes of steady state. Dependent variables (avg VO2, VO2 drift, and HR) were analyzed using paired sample t-tests ($\alpha$=0.05).

RESULTS: Average VO2 was not different ($p>0.05$) between conditions (CON:31.39±9.37 ml/kg/min, COMP: 32.33±7.86ml/kg/min). VO2 drift was not different ($p>0.05$) between conditions with COMP increasing 1.91+ 3.02ml/kg/min and CON increasing 2.07+4.25 ml/kg/min over the 40-minute run. Additionally, HR was not different ($p>0.05$) between conditions (CON: 142.57±17.36 bpm, COMP 143.77±19.32 bpm).

CONCLUSION**:** Based on our findings compression garments had no effect on oxygen consumption or heart rate.

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# Acute Kidney Injury (AKI) Impairs Nitric Oxide Synthase (NOS)

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## ABSTRACT

Acute kidney injury (AKI) is caused by a sudden stop of blood supply to the kidney. AKI occurs in ~1 in 5 hospitalizations and patients who recover from AKI are at risk for developing chronic kidney disease and cardiovascular events and have increased all-cause mortality. There is growing evidence that the renal nitric oxide (NO)/NO synthase (NOS) system is impaired following AKI in males contributing to poor outcomes. Importantly, males have greater incidence and severity of AKI compared to females and males have been reported in numerous studies to have less NO than females. Little is known about the long-term impact of AKI on the female kidney. The goal of this study is to test the hypothesis that AKI results in chronic impairment of the renal nitric oxide synthase system in females. To test this hypothesis, we will measure NOS enzymatic activity, total NOS protein expression and NOS phosphorylation in kidney samples from female Sprague-Dawley (SD) rats following a surgical sham procedure or 30 minutes bilateral renal ischemia following by reperfusion (IR) as an experimental model of AKI. Subsets of rats were euthanized 1, 3, 7, 14, or 30-days post IR and kidneys were harvested for biochemical analyses. To analyze the NOS system, we performed citrulline assays to measure NOS enzymatic activity and Western Blots to measure protein expression. Pilot studies in the lab used wire myography to measure vascular function in 3rd order mesenteric arteries. Data confirmed a decrease in NOS-mediated vasodilation by day 3-post IR, which remained impaired at day 30. To date, we have performed sham and IR surgeries and isolated the kidneys from all rats. I have been trained in Western blot analysis, tissue homogenization, and how to perform Citrulline assays. We anticipate a decrease in NOS activity and expression within 3 days of IR compared to sham controls.

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# Science Content to Science Practice: Developing Student Questioning through Scientific Inquiry

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## ABSTRACT

This qualitative study aims to investigate scientific inquiry, specifically the relationship between students' understanding of science content with the implementation of science and engineering practices (SEPs). The Next Generation Science Standards (NGSS) (NGSS Lead States, 2013) emphasizes the process of scientific inquiry as a set of "practices" students engage with to investigate the natural world around them. K-12 students engaging in the iBEARS (Inclusive Biologist Exploring Active Research with Students) program learn science content and practice SEPs through inquiry-based learning by participating in an authentic research experience, culminating in the creation of a research poster (St. Louis et al., 2021). Using a qualitative approach, we used student views about questioning from the Views About Scientific Inquiry (Lederman et al., 2014) instrument and their completed research posters to investigate how students understand and implement questioning skills whilst "doing science." Preliminary results of this study show that initially, K-12 students held Naïve and Mixed Views in science, and after participating in the iBEARS program, met the expectation of being able to ask questions and define problems in science. Future research investigating how K-12 students view scientific inquiry aspects and develop SEPs is necessary to understand better how inquiry-based learning curricula can support student science content and practice skill development.

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# Isolating Deuterium Isotopes via Quantum Filtering

**Author(s)**: Joshua Hale and Theja DeSilva

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## ABSTRACT

Heavy hydrogen isotopes such as deuterium have critical applications in modern technology like optimizing nuclear reactions or calibrating magnetic resonances (MR) instruments. Given its shared chemical properties to protium, the isotope can only be separated via high-energy techniques. The motivation of this research is to employ a separation system that is more energy-effective than current methods. We propose the use of a graphene monolayer to sieve the hydrogen isotopes. We study the dynamic behaviors such as equilibrium positions, migration trajectories, and quantum tunneling of the particles on the graphene surface. This is done by analyzing the interaction potential energy of the hydrogen and deuterium atom located above the surface. The classical trajectories and equilibrium positions are determined numerically by solving Newton's laws. From this, we calculate the quantum transmission coefficient and atomic flow rates using the Wentzel-Kramers-Brillouin approximation.

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# The Influence of Acute Exercise on Cognition in Young Adults

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## ABSTRACT

Several studies have shown that an acute bout of aerobic exercise improves memory among various populations. During exercise there are many mechanisms that can help cognition such as an increased blood flow to the brain, increase in neurotrophies, and increased catecholamine levels. However, the effects acute exercise has on other domains of cognition like perception, executive function and processing speed in healthy young adults remains to be seen. We hypothesized that there would be an improvement in cognitive performance after an acute bout of exercise, and that performance would return to baseline 24 hours later. We included healthy young adults (n = 8; Age: 21 ± 2.1 years, 44.4% Female; BMI 21.84 ± 2.76; Pittsburgh Sleep Quality Index (PSQI): 6.14 ± 3.62 points). The participants completed several specific, valid, and reliable cognitive assessments 3 times during this study: once before exercise was performed, again immediately after the exercise was complete, and finally 24 hours later. The study used a treadmill to measure exercise heart rate and intensity. Descriptive statistics were calculated to summarize participant characteristics, and a repeated measures analysis of variance (ANOVA) was conducted to assess the effects of Time (pre-acute exercise, post-acute exercise, post-sleep) and Cognitive Task, encompassing all cognitive tasks. There was a Time by Cognitive Task interaction ($F(12,72)=3.62$, $p<0.001$, $\eta p2=0.38$). There was a trend for faster TMT B-A time to completion between pre-exercise and 24 hours later ($p=0.06$) and post-exercise and 24 hours later ($p=0.054$; pre-exercise: 30.44 s; post-exercise: 20.72 s; post-sleep: 12.42 s). There was a longer Stroop 3-2 time to completion between pre-exercise and 24 hours later ($p=0.04$; pre-exercise: 14.79 s; post-exercise: 12.29 s; post-sleep: 10.43 s). Lastly, there was a significantly higher number of symbols between pre-exercise and post-exercise ($p=0.04$), post-exercise and 24 hours later ($p=0.02$) and pre-exercise and 24 hours later ($p=0.02$; pre-exercise: 40.14 digits; post-exercise: 47.86 digits; post-sleep: 52.29 digits). All other comparisons were not significant ($p>0.05$). Despite our initial Hypothesis, engaging in a single session of exercise does not seem to lead to enhancements in cognitive performance. Interestingly, certain cognitive tests such as the Trail Making Test (TMT), Stroop test, and Digit Symbol Substitution Test (DSST) may be influenced by repeated administration. However, it is also important to approach these findings cautiously as data collection is still in progress.

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# Designing an Autonomous Surface Vehicle for Water Quality Monitoring

**Presenter**: Brycen Havens

**Authors**: Brycen Havens[1], Wesley Cooke[1], Wes Byne[2], Oscar Flite[2], and Joseph Hauger[1]

**Faculty Sponsor**: Joseph Hauger, PhD

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**ABSTRACT**

We have designed and tested an autonomous surface vehicle (ASV) that will be deployed to monitor water quality in the Augusta Canal and other nearby bodies of water. The ASV is constructed from supplies readily available at big-box retail stores and is powered by two brushless electric motors. The hull is made from a modified kayak and PVC outriggers, providing a cost-effective and stable platform. A maximum weight capacity of 100 lbs allows for the attachment of multiple sensors and a large battery capacity. To safeguard the brushless motors from debris, motor housings were developed using 3D CAD software and constructed by 3D printers. The PVC outriggers and brushless motors are removable from the main hull for easy transportation. The details of the current design results will be presented, along with outlines for future research in hull construction and efficiency.

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# Sherlock Holmes as a Literary Analysis Essay: An Exploration

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**Affiliation(s):** Department of English and World Languages, Augusta University

## ABSTRACT

My paper, titled “Sherlock Holmes as a Literary Analysis Essay: An Exploration”, argues that in the same way that an essay is a carefully crafted exploration of a topic, Sherlock Holmes can be understood as an academic paper. Like a well-structured essay, Holmes's methods are organized, methodical, and systematic. Specifically, I demonstrate that Sherlock Holmes's formula and mannerisms mimic those of an essay and its structure, and I do so through exploring Holmes’ ability to observe minuscule details, gather evidence—that is, do research—and his ability to perform cryptic close-reading, enhancing his analytical skills. Attending to these features reveals a new way to understand Holmes—as the living embodiment of the writing process. Moreover, this paper applies a similar methodology to Holmes's companion, Watson, which reveals that Watson can be understood using the writing process too: specifically, Watson is the reader of Holmes, the Essay. As the close friend and confidant of Holmes, Watson witnesses and critiques all of Holmes's actions; watching and interpreting everything, Watson is essentially "reading" Holmes's behavior. Watson's status as a reader is underscored by the fact that he literally reads Sherlock Holmes's accounts of prior brilliance. Ultimately my paper shows us that Sherlock Holmes mirrors the structured arguments and exploration of ideas found in well-crafted essays. As a result, this paper offers a new way of understanding Sherlock Holmes and Watson’s dynamic as one exemplifying contrasting perspectives of analytical brilliance and understanding. Beyond the role of a mere detective, Holmes emerges as more than just a character in a story; he embodies a literary innovation.

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# Poetry Integration in ELA Instruction

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## ABSTRACT

Poetry can be intimidating. Students often find it difficult to become engaged with something they have limited experience with, and poetry and creative writing have primarily been an afterthought in K-12 ELA instruction. Standards in these classrooms are typically aimed at teaching students how to create lab reports and research-based products. In this way, creativity and individual autonomy are often sacrificed, making it more difficult for those students to utilize their voice or find their argument in university classes. The presenters set out to bridge this gap between student and medium, developing two options for integrating poetry and other literary forms into the modern classroom. In this poster presentation, we will present an online module and a structured poetry journal to help students focus on the meaning and context, thereby mitigating the mystery and intimidation often associated with this genre. For the online module, we utilized Canvas, a free learning management system that allows students to work through scaffolded content and assessments. The structured poetry journal combines graphic organizers, poetry prompts, response questions, and response space for students to practice analyzing poetry in a controlled and low-stakes environment.

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# Characterization of AD05 as a Novel Inhibitor for Hsp90

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**Faculty Sponsor(s):** Ahmed Chadli, PhD[2]

**Affiliation(s):** [1]Augusta University Honors Program, [2]Georgia Cancer Center

## ABSTRACT

Heat Shock Protein 90 (Hsp90) is a very important protein to both normal cells and cancerous cells. In normal cells, Hsp90 functions as a molecular chaperone to aid proteins into their native conformation. If this structure isn't achieved the protein will be recycled. Overall, this process regulates the balance of proteins within the cell. During situations of heat shock, or high stress due to temperature, levels of HSP90 are upregulated because of its ability to maintain proteostasis, balance of proteins, and keep proteins from denaturation. This ability of Hsp90 is hijacked by cancerous cells to promote the longevity of mutated proteins. In cancer cells, Hsp90 also helps promote the hallmarks of cancer such as metastasis, sustained proliferative signaling, resisting cell death, evading growth suppressors, inducing angiogenesis, and enabling replicative immortality. The dependence of cancer cells on HSP90 to promote its hallmarks makes HPS90 a great target for the treatment of cancer. Even though Hsp90 is a good target for cancer treatment, many drugs have failed to get to or pass clinical trials because when they inhibit Hsp90 they induce the heat shock response. The heat shock response activates other molecular chaperones such as Hsp70, Hsp40, and Hsp27 that inhibit cancer cell apoptosis and keep the cancer cell functional. Using a high throughput assay, recent work in Dr. Ahmed Chadli's laboratory at the Medical College of Georgia has identified a new Hsp90 inhibitor, called AD05. This inhibitor is unique because it can inhibit Hsp90 without enacting the heat shock response. My research will identify the mechanism by which AD05 inhibition causes cancer cell death, specifically its effect on the mitochondria of the cancer cells. We will use several cell models such as human and murine breast and prostate cancers. The techniques that will be used in this experiment are western blots, cell culture, immunohistochemistry, and seahorse analysis.

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# A Low-Cost In-Line Pipe Inspection Robot

**Presenter**: Keiichi Iguchi

**Authors**: Keiichi Iguchi[1], Wes Byne[2], Oscar Flite[2], and Joseph Hauger[1]

**Faculty Sponsor**: Joseph Hauger, PhD

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**ABSTRACT**

We have designed and constructed a low-cost, in-pipe inspection robot that can be used to map and examine the integrity of municipal water supply and wastewater pipelines. An Arduino and Raspberry Pi dual configuration is implemented in the prototype which includes DC motors for robot maneuver, a 9-axis inertial measurement sensor for determining real-time orientation of the robot, position encoding sensors for distance measurement, and a camera for live feedback and anomaly detection in the pipeline. CAD software is used to create custom 3D printed components. Data is acquired by sensors connected to the Arduino UNO and processed on the Raspberry Pi through Python scripts. Results and data are discussed, as well as future plans and improvements for the in-pipe inspection robot.

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# Predicting Vault Apps Using Machine Learning

**Author(s)**: Dawson Jones

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## ABSTRACT

Vault apps are designed to safeguard personal information by concealing it within a seemingly harmless interface, like a calculator. Access to the hidden data is only granted when a secret password is entered. While these apps can protect privacy, they can also be misused for illicit purposes. The aim of our research is to employ machine learning techniques to differentiate between vault apps and standard apps. This involves analyzing characteristics from app data on the Aptoide app store, like what the app claims to do, its popularity, and the access it requires to a phone's features. We process this information to identify patterns that are typical of vault apps. Our machine learning algorithms have proven successful at spotting these apps with a high degree of accuracy. Additionally, we use various explainer models to pinpoint which characteristics are most indicative of a vault app. A major challenge in this research is the limited number of vault apps available for study. To expand our dataset, we look at apps recommended alongside known vault apps on Aptoide, with the hypothesis that these suggestions may also include vault apps. We also map out connections between apps, creating a network that helps our graph neural network algorithms learn and make predictions with more precision. Finally, we apply an analytical tool called GNNExplainer to understand better which features and connections most strongly influence our model's decisions.

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# Evaluation & Revitalization Plan of the Multicultural Mentorship Program Retreat

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## ABSTRACT

Multicultural Mentorship Program (MMP) is a peer mentoring program coordinated by Augusta University's Multicultural Student Engagement. The MMP assists with the first-year transition into college through peer mentorship and exclusive targeted programs for underrepresented students. One of the foundational targeted programs is the program retreat, which occurs annually before the start of the fall semester. Evaluating this year's MMP retreat allowed us to measure its efficiency in accomplishing the program's objectives, including community building, identity development, and college readiness. To evaluate the retreat, I conducted a thorough program evaluation, including a stakeholder and benchmark analysis, to assess if the retreat successfully met its stated goal. By collecting feedback from our mentees, mentors, and MSE staff members who attended the 2023 - 2024 MMP Retreat and performing a thorough evaluation of the retreat's strengths and areas for improvement, I intend to make knowledgeable decisions regarding next year's future retreat by focusing more on the stated aspirations of the program. I conducted informal interviews and surveys through Qualtrics, focusing on the retreats' strengths and weaknesses with those who helped plan and attend the retreat. The constructive feedback and shared experiences obtained from the attendees of the 2023 Multicultural Mentorship Program Retreat highlighted areas for improvement, including more allergy-free food selection, more interactive activities and icebreakers, inclusive mentor reveals, increased mentor-mentee interactions, communication throughout the retreat, and use of student's preferred names, and revealed insight on possible future retreat themes. The survey also revealed how mentees and mentors heard about MMP predominantly through Orientation, Email, and Social Media. Overall, by implementing feedback from the survey, we can enhance the retreat experience, plan the 2024 MMP Mentor/Mentee Retreat, and assist first-year, underrepresented students with their transition into AU.

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# Synthesis and Screening of α-Methylene Lactams as Covalent Inhibitors

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## ABSTRACT

Covalent inhibitors, such as acetaminophen (Tylenol) and penicillin, are an important class of drug compounds. While many drugs form easily reversible interactions with their biological target, covalent inhibitors make a chemical bond with their target molecule such as proteins. This difference allows covalent inhibitors to treat previously "undruggable" targets, lower dosages, and provide a prolonged effect. The goal of this project is to synthesize α-methylene lactams and screen them as potential covalent inhibitors. A lactam is a class of compound where a nitrogen atom is directly next to a carbon–oxygen double bond in a ring structure. The synthesis of the desired lactams requires four steps for each analogue. The first two steps for the synthesis of the first analogue resulted in average yields of 45% and 25%, respectively. Complete syntheses of several lactam analogues will be reported and their efficacy as covalent inhibitors in *in-vitro* and *in-vivo* assays.

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# Aminoacyl Benzotriazolides: Versatile Reagents for the Preparation of Drug Candidates

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## ABSTRACT

Developing effective drug candidates is a complex and critical process in the pharmaceutical industry. Aminoacyl benzotriazolides have become an area of significant interest for researchers due to their versatility and synthetic applicability in preparing potential drug candidates. These reagents offer unique advantages, including efficiency, versatility, and synthetic applicability, making them valuable tools in drug development. Aminoacyl benzotriazolides are versatile intermediates used in drug development. They help to form amide bonds with amines or other nucleophiles and have mild reaction conditions that enable compatibility with a wide range of functional groups. These reagents exhibit high reactivity, allowing efficient coupling reactions even with less reactive substrates. The selectivity of these reactions also provides for synthesizing drug candidates with high purity and structural integrity. Our research group has developed drug candidates using our in-house benzotriazole chemistry strategy. Cannabidiol is a phytocannabinoid known for its diverse biological applications, including its potential as an anticancer agent in preclinical studies. However, it is vital to acknowledge the limitations associated with its use, including low bioavailability. We have applied this strategy to cannabidiol (CBD) to improve its potency selectivity and eliminate potential adverse effects. We have successfully developed an optimized protocol for the synthesis of CBD conjugates.

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# How Music and Food Relate in Locally Owned Cultural Restaurants

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## ABSTRACT

Some ethnic restaurants in the Augusta area have music playing that does not match the culture of the food, which could be a sign of cultural dissonance. The purpose of this research was to identify the relationship between the music and food of a specific culture, and how both local restaurant owners and patrons felt if the music did not match the culture the food is originally from. Qualitative research was conducted for this study, including interviews of restaurant owners and patrons, as well as observation of the food and music present in the restaurants. The results showed that many of the interviewees have deep connections with both the food and music of the culture and note that the two strongly correlate with one another. Furthermore, if the music playing in a restaurant did not match the culture the food is from, it caused the interviewees to feel as though the restaurant was inauthentic and commercialized. This research shows the conscious and subconscious importance of background music to the overall dining experience in a restaurant.

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# VIRT DIRT: Virtual Reality Ceramics

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## ABSTRACT

Ceramic art is known for its personal relationship to its maker because of the fine motor skills demanded in pottery. From mixing the clay, prepping it for use, throwing or hand building, to firing and glazing, pottery requires skill and energy investment. How can this 30,000-year-old technique of ceramic making be more modernly accessible to those with motor disabilities? This study aims to explore techniques that allow ceramics to be more accessible to those with motor disabilities or sensory issues by the ever-growing technology of virtual reality 3D thermofilament printing and 3D clay filament printing to create ceramic forms. This research is relevant to expand on both the process of making, pushing the limits of the art form, learning its ways and limitations just as all other art forms do and expanding our knowledge with how we innovate and experiment with the technology at hand.

3-D printing with plastic and metal has been around for over 30 years but has only recently become available to the everyday person. This concept of 3-D printing has evolved into the newly innovative clay printing as a filament. There is limited research on this technique as ceramic making, but so far, clay-printed forms have shown more creative, complex, and precise designs than those of traditional pottery. With the help of digitalized computer-generated models, Artists can now create and modify digital media into tangible ceramic forms. Virtual reality has become a mainstream immersive device that allows the user to experience technology in an interactive medium personally. The results of this study yielded great evidence of motor and sensory accessibility but also has revealed inaccessibility due to labor intensive preparation, financial, and technical demands. Ultimately, the benefits of the technology were its ability to bring the ceramic process directly into people's homes and allow for collaborations over great distances. It also has the potential to alter the standard expectations and push the boundaries of ceramics and provide a unique viewing experience.

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# Molecular Hybridization of Fluoroquinolones to Target Cancer Cells

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## ABSTRACT

A novel drug design approach has been introduced to create an effective cancer treatment. The method combines existing compounds with antitumor properties and antibacterial compounds to produce molecularly hybridized conjugates. Ciprofloxacin and Norfloxacin are fluoroquinolone antibiotics that could be combined with an antitumor reagent to target cancer cells specifically. They have shown promise as anticancer agents by interfering with DNA replication and inducing programmed cell death in cancer cells. However, further research is necessary to comprehend their effectiveness and potential side effects fully. We utilized our rational drug design and molecular hybridization approach to synthesize molecules containing dichloroacetic acid, niacin, and fluoroquinolones as potential scaffolds. We developed an optimized multi-step synthetic route, synthesized a few molecules, and characterized them using spectroscopic techniques. The preliminary results are encouraging; these molecules could serve as lead compounds for further developing potential drug candidates.

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# Cell Size Affects Synthetic Cell-Cell Signal Output In Vivo

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## ABSTRACT

Cell-cell signaling and communication are integral to the existence of complex life. One such mechanism of cellular communication is that of juxtacrine signaling mediated by a ligand present within the cellular membrane coming into contact with and binding to a specific receptor on a neighboring cell. Synthetic Notch (synNotch), based on the native Notch signaling pathway, transduces a unique input signal in the receiving cell due to contact with a neighboring ligand cell to produce a custom gene expression output. Here, our work in collaboration with the Langridge lab focuses on the synNotch output patterns in the developing fruit fly larvae, which is visualized with green fluorescent protein (GFP). We have extracted cell size and shape parameters and measurements of the intensity of the GFP response to evaluate and quantify biophysical trends underlying this synthetic cell-cell signaling. Our results support our previous computational model predictions showing an increase in synNotch response with increasing cell size. As cells undergo dramatic changes in size and morphology during development, our results show that cell size could affect cellular communication.

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# Age Related Risk Factors of Alzheimer's Disease on the Claustrum

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**Faculty Sponsor(s):** Xin-Yun Lu, PhD

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## ABSTRACT

Alzheimer's disease (AD) is a notable age-related neurodegenerative disease, being the most common source of dementia among older individuals. AD is characterized by progressive loss of cognitive functions including memory and decision-making. Various factors have been attributed to the onset and progression of AD, but the most notable risk to the development of AD is age. Thus, understanding major causes of aging as it relates to AD would contribute to greater capability for treatment and a better understanding of the potential causes of AD. Despite widespread research, relatively little is known about how aging affects various aspects of the brain, and how it can affect the neuronal and glial populations in the brain. However, it is known that upon development of AD, the temporal region of the brain is the first region to undergo neurodegenerative changes. This study focused on a sub-cortical region of the brain, the claustrum (CLA), situated in the temporal brain region. Furthermore, this region is of interest due to its interconnectivity between various areas of the cortex and subcortex including the prefrontal cortex and the hippocampus that have also been implicated in AD. One major neural receptor implicated in the progression of AD includes the leptin receptor (LepR) and Leptin, its agonist, due to its relative absence in AD patients compared to non-AD patients in regions of the brain. Additional Research on the Claustrum, a LepR dense neural region, would deepen our knowledge of how the Leptin pathway in different brain regions is implicated in the development of Alzheimer's disease. The goal of this project is to test the hypothesis that the concentration of LepR decreases with age and to observe the degree to which LepR contributes to the connectivity of the Claustrum with other brain regions. The study will utilize reporter mice, called LepR-cre-Ai14-tdtomato mice, a cross between LepRb-IRES-Cre mice with an IRES-NLS-Cre cassette "knocked in" the 3' region to the LepRb stop codon and Ai14 –tdTomato mice. These reporter mice express tdTomato in LepRb-expressing cells (LepRb-tdTomato) and allow visualization of the LepR expressing neurons using fluorescence microscopy. The LepRb in the brain sections will be quantified against total neuronal population using immunohistochemistry through using indirect antibody binding of the neural protein binding antibody NeuN.

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# Performance Arts Showcase
# "La Rosa" and "Wrath & Whimsy"

**Presenter(s)**: Brody McLaughlin, CNAfME Student Orchestra

**Author(s)**: Brody McLaughlin

**Faculty Sponsor(s):** Robert Saunders, PhD and Martin David Jones, DMA

**Affiliation(s):** Department of Music, Augusta University

## ABSTRACT

The composer and music educator Leonard Bernstein once said, "Music can name the unnamable and communicate the unknowable." The original compositions I will perform have this quote in mind, exploring complexities of human emotions and relationships. "La Rosa" is a vibrant tango, delving into the passions of lust and fleeting romance. The pull between two individuals is undeniable, and the intense emotions an individual feels for someone else before knowing them is daunting. Its notes weave a passionate dance mirroring intense romance and desire. The music pulsates with a dominant marcato, creating an atmosphere of fervent emotion and alluring intensity, captivating all who listen. The piece draws from traditional tango harmonies and rhythmic motives; along with influences from several diverse selections such as the Allegro from Mozart's Symphony No. 25 and Arturo Márquez's Danzon No. 2. The composition won the state level for the Collegiate National Association for Music Education (CNAfME) Composition Competition and earned honorable mention for the Southeastern division. "Wrath & Whimsy" unfolds a poignant narrative of the heart's tumultuous journey. The intense beginning sets the scene for the first theme, a highly chromatic and fugal motif, portraying thunderous clashes. The music explodes, and unsure of itself after such an intense battle, teeters on the edge before sweeping into a luscious second theme. Giving our characters a respite, the second theme paints a pastoral scene. However, we are not at rest for long. The first theme weaves its way back into the textures' forefront. Erupting with the sounds of trumpets, bringing us right back to where we began, this time intensified by the "Dies Irae" or "Day of Wrath" theme from 9th century Gregorian chant. As the first theme dominates the orchestra, it struggles to maintain control until it explodes again in a violent outburst. The second theme makes a triumphant resurgence, marking the climax of the piece, reflecting the cyclical nature of love. The B section of the Scherzo from Gustav Mahler's Symphony No. 10 informs the second theme, and the larger form of "Wrath & Whimsy." Arranged for full orchestra, the piece is six minutes. It won the Georgia state Composition Competition sponsored by Georgia Music Educators Association (GMEA) and premiered at the 2024 annual state conference. I have already discussed getting equipment for the performance with Dr. Saunders. We would need a location like the amphitheater. As Richard Wagner said, "Imagination creates reality."

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# Testing of Northeastern Georgia Amphibian Species for Chytrid Fungus in Augusta, GA

**Presenter(s)**: Sruthi Medicherla

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**Faculty Sponsor(s):** Robert Cromer, PhD

**Affiliation(s):** Department of Biological Sciences, Augusta University

## ABSTRACT

Amphibians are some of the most important members of aquatic and terrestrial ecosystems due to their many ecological niches and varying roles as prey and predator in the food webs of wetland regions around the world. In particular, the amphibian populations of the Southeast have been experiencing severe losses and extinctions because of a single fungus: *Batrachochytrium salamandrivorans*. This species of causes a disease called amphibian chytridiomycosis, which primarily affects the delicate skin of amphibians, which is the organ by which amphibians take in oxygen and monitor their body temperatures as ectothermic organisms. In order to investigate the spread of this disease among local amphibian populations, we collected 34 amphibian specimens and swabbed their abdominal epithelium with sterile cotton swabs and sent the samples in for testing at the Research Associates Laboratory Inc. in Texas. The amphibians belonged to 13 different species and were found in 4 locations around the Augusta area. Per the notification from the Laboratory, none of the samples sent in contained the expected Chytrid Fungus. This indicates the need for more sample collections across a wider area, as the spread of chytridiomycosis is well-documented and is being researched in many institutions around the world, in an effort to save the amphibian species that uphold our ecosystems and biosphere.

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# Caring about Healthcare Professionals: A Survey of Georgia AHEC Preceptors' Mental Health and Wellbeing

**Author(s)**: Kaamya Mehra, Preshit Ambade, Zachary Hoffman, Brittany Ange, Denise Kornegay, Alyssa Ruffa, Nadine Odo, and Neil J. MacKinnon

**Faculty Sponsor(s):** Neil J. MacKinnon, PhD, Preshit Ambade, DrPH, Zachary Hoffman, MS, Brittany Ange, EDD, Denise Kornegay, MSW, Alyssa Ruffa, MPH, and Nadine Odo MPH

**Affiliation(s):** Office of the Provost

## ABSTRACT

Mental health and well-being are rising concerns in the United States healthcare workforce. Previous research has shown that many physicians have symptoms of burnout and are dissatisfied with their work-life balance. In October 2022, the US Surgeon General released a special report and framework on workplace well-being and mental health. Nationally, the Area Health Education Centers (AHEC) program helps develop a healthcare workforce of preceptors (physicians, nurses, etc.) for underserved areas. Our goal was to determine the workplace well-being and mental health of AHEC preceptors in Georgia. In Spring 2023, 22 questions aligned with the US Surgeon General's framework were included in a survey of Georgia AHEC preceptors. Preceptors responded on a 1 to 5 Likert scale from "strongly disagree" to "strongly agree". The survey instrument's internal consistency and validity were assessed, including Cronbach's alpha and Confirmatory Factor Analysis. The response rate was 97.8% with 585 respondents out of 596 preceptors surveyed answering the survey. The mean total score for the given observations is 85.88 (possible range of 22 to 110). The average total score increases with age, and males have higher well-being status than females. Asian and White practitioners score higher than Black and other race/ethnic practitioners. The well-being score is also higher among Physicians than the other professions. To our knowledge, this is the first survey instrument developed to use the US Surgeon General's new framework for workplace mental health and well-being. Overall, Georgia AHEC preceptors scored well on workplace mental health and well-being, although some areas of concern have been identified. We recommend that healthcare policy makers and decision makers use our results to enhance the workplace well-being and mental health of health professionals in Georgia.

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# Long Range Transmission of Environmental Data

**Author(s)**: Dean Meyer[1], Wes Byne[2], Oscar Flite[2], and Joseph Hauger[1]

**Faculty Sponsor(s):** Joseph Hauger, PhD

**Affiliation(s):** [1]Department of Physics and Biophysics, Augusta University; [2]City of Augusta, Utilities Department

## ABSTRACT

We develop a low-power, low-cost, open-source solution to transmit data collected from various environmental sensors researched and developed as part of a collaboration between Augusta University and Augusta Utilities. Over the past two years, we have progressed from short-range point-to-point communication to a Wireless LAN with transmission distances of more than 2 kilometers. We will also detail our plans to reduce cost through design and manufacture of fully custom solutions integrating power generation, data collection, and data transmission. These plans will better provide real-time data for the Augusta Utilities Department to meet stakeholder and regulatory requirements.

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# Identifying the Molecular Basis of BICD2 Associated SMALED2 Mutations

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## ABSTRACT

Microtubules are the 'railroad' tracks for various cargos such as proteins, vesicles, and mRNA to be transported within the cell. Molecular motor proteins such as Dynein and Kinesin are involved in the transport of these cargos. For this project, we mainly focus on Dynein which allows transport towards the minus end of the microtubules, which in most cells involves transport towards the perinuclear centrosome. For Dynein to gain motility, it requires the Dynactin complex and an activating cargo adaptor such as Bicaudal D (BicD in flies; BICD2 in humans). Several *BICD2* mutations have been found in patients diagnosed with Spinal Muscular Atrophy with Lower Extremity Predominance (SMALED2). In some patients, the disease is relatively mild, whereas in others it is more severe, presenting with contractures, hip dysplasia, brain abnormalities, cognitive impairment and even death. However, the underlying cause of the disease is unknown and currently no treatment is available.The purpose of this study is to understand the molecular mechanism of BICD2_ R747C mutant in SMALED2 development using a mammalian cell line model. First our immunostaining data suggests that the cellular localization of the mutant was altered. Whereas the wild-type protein was present throughout the cell, BICD2_R747C was highly enriched at the centrosome. We next determined the interactome of wild-type BICD2 and the R747C mutant using proximity biotin labeling. Numerous interactome changes were observed with BICD2_R747C in comparison to WT. Some of the interactors such as GRAMD1A, CSPP1 are increased more than two-fold in comparison to BICD2_WT and the others such as VPS41 and RanBP2 are reduced more than two-fold. We validated this result by western blotting. Overall, these results will provide insight into the character of the mutant as it relates to SMALED2 and Dynein dependent transport mechanism. This insight may help in the development of treatment strategies for the disorder.

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# Trytophan in Peanut Butter: Is it Enough to Improve Sleep in Shift Working Firefighters?

**Author(s)**: Tiffany Oberther, Austin Kohler, David Shuler, Andrew Moore, Nicole Peritore, and Maleah Holland-Winkler

**Faculty Sponsor(s):** Maleah Holland-Winkler, PhD, Jonathan Ruiz-Ramie, PhD, Carol Quinn, PhD, Andrew Moore, PhD, and Nicole Peritore, PhD

**Affiliation(s):** Department of Kinesiology, Augusta University

## ABSTRACT

Sleep is vital for mental health, physical health, quality of life, and safety. Firefighters are at a higher risk for chronic sleep disruption due to a combination of factors including rotating 24-hour on and 48-hour off work schedules, unpredictable and hazardous work obligations, and/or traumatic events experienced while on shift. Tryptophan is an amino acid found in peanuts that has been positively associated with sleep quality due to its influence on melatonin and serotonin levels in the body. Therefore, the purpose of this study was to determine the effect of consuming peanut butter at night on aspects of sleep in shift-working firefighters. 40 firefighters participated in this 8-week study and were randomized into a peanut butter group (n=20) or control group (n=20). An Actigraph GT3X sleep, and activity wristwatch was worn for 8 weeks (about 2 months) to assess sleep quality and quantity. Participants of both groups completed a baseline week of normal living before beginning the 7-week intervention. During the intervention, both groups were asked to stop eating two hours before bedtime. In addition, the peanut butter group was asked to consume a serving of peanut butter two hours before bedtime for five nights a week. SPSS version 29 was used to analyze the variables latency, efficiency, time in bed, time asleep, time until first awakening, number of awakenings, and time spent awake via separate linear mixed-effects models. Individual subjects were specified as a correlated random effect. Averages for each week were computed and designated as the repeated measures variable Time with 8 points (baseline and weeks 2-8). The fixed factors were Time and Group (Peanut butter or Control). There appeared to be a significant effect of Time on latency, $F_{7, 154.77} = 2.71$, $p = .011$, which was higher at week 8 (23.35 min, $CI_{95\%}$ = 13.43-33.23 min) than at baseline (8.98 min, $CI_{95\%}$ = 1.91 – 16.04 min). However, no time point differences were significant following Bonferroni adjustments. There were no main effects of Time or Group, or interaction effect, on any of the other variables. Peanut butter did not alter sleep variables compared to the control group in this study. However, the data does demonstrate abnormal sleep patterns firefighters and further research is needed to find simple strategies to improve sleep in this population. The Peanut Institute funded this study.

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# The Utility of Non-Systemic PDE5 Inhibitors for Colon Cancer Prevention

**Presenter:** Grace Oh

**Author(s)**: Grace Oh, Sakshi Shah, Laney Willis, and Kaylin Browning

**Faculty Sponsor(s):** Darren Browning, PhD

**Affiliation(s):** Department of Biochemistry and Molecular Biology, Augusta University

## ABSTRACT

Colon cancer is a major health burden in the Unites States with over 150,000 diagnosed annually and over 50,000 deaths due to advanced stage at diagnosis. Prevention modalities are crucial but currently unavailable for individuals at high risk. Phosphodiesterase 5 inhibitors (PDE5i) have been shown to prevent colorectal cancer in mice, but their side effects and drug-drug interactions make them unsuitable for daily consumption by otherwise healthy people. A polar-analog of sildenafil (Mal-sild) was recently reported to be non-systemic yet retained the ability to suppress proliferation in the intestinal epithelium. The present study aimed to determine whether Mal-sild could prevent intestinal cancer in a mouse model. *Apc*$^{MIN}$ mice were treated with Mal-sild in their drinking water from 4 to 14 weeks of age. Mal-sild was undetectable in the plasma but was measured in the feces, confirming the non-systemic pharmacokinetics of the compound. Oral administration of Mal-sild increased cGMP in the intestinal epithelium but did not affect body weight over the 10-week period of the study. Quantitation of tumors at 14 weeks revealed approximately 42% less polyps in the treated group compared to controls, but there was no significant difference in tumor size. The results indicate that the tumor suppressive effects of PDE5 inhibitors do not require systemic delivery, and these gut-targeted analogs can be developed for chemoprevention of colon cancer in people.

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# A Low-Cost, Low-Power Flow Velocity Sensor for Stream Flow Measurement

**Presenter**: Kaylee O'Steen

**Authors**: Kaylee O'Steen[2], Wes Byne[3], Oscar Flite[3], and Joseph Hauger[1]

**Faculty Sponsor**: Joseph Hauger, PhD

**Affiliations**: [1]Department of Physics and Biophysics, [2]School of Computer and Cyber Sciences, Augusta University; [3]City of Augusta, Utilities Department

**ABSTRACT**

Stream flow is an important quantity that affects the biological, chemical, and physical aspects of a stream. One component of stream flow is the flow velocity which varies with location, depth, and time. Commercially available flow velocity sensors are typically expensive and power hungry thus limiting their use for long-term data sampling at high spatial resolution. We have designed and tested a novel low-cost, low-power flow velocity sensor which uses an ordinary load cell to measure drag force acting on an attached cylindrical object. This drag force is proportional to the square of the flow velocity. Our design, calibration methods, and preliminary results will be presented.

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# Expression of Copper Transport Proteins in the Hippocampus and Cortex of Models for Alzheimer's Disease and Type 2 Diabetes

**Author(s)**: Shelle Outlaw, Md. Selim Hossain, Archita Das, Sudhahar Varadarajan, Mai Yamamoto, Ashiq M. Rafiq, Ferenc Deak, Masuko Ushio-Fukai, and Tohru Fukai

**Faculty Sponsor(s):** Masuko Ushio-Fukai, PhD, and Tohru Fukai, MD, PhD.

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## ABSTRACT

Alzheimer's disease (AD) is a prominent contributor to cognitive decline among the elderly population, characterized by the presence of amyloid-β (Aβ) as the predominant pathological protein. Copper (Cu), an essential nutrient, exhibits either accumulation or deficiency in AD brains. As excess Cu is toxic, its levels are tightly regulated by Cu transporter and chaperone proteins. Furthermore, Cu imbalance has been linked to the progression of type 2 diabetes mellitus (T2D), a significant risk factor for AD. However, the interplay among Cu metabolism, T2D, and AD remains largely unexplored. This study aimed to investigate the expression of Cu transport proteins (CTR1, Atox1, ATP7A) within the hippocampus and cortex of AD (3xTg) and T2D mouse models induced by a high-fat diet. Here we found increased expression of CTR1 (a Cu uptake transporter) (3.3-fold) and Atox1 (a Cu chaperone) (1.7-fold), with decreased expression of ATP7A (a Cu exporter) (1.91-fold) in the hippocampus of AD mice vs. controls. Conversely, CTR1 exhibited downregulation (74 %), while Atox1 and ATP7A remained unchanged in the cortex of AD mice vs. controls. Notably, both hippocampus and cortex of T2D mice exhibited upregulation of amyloid precursor protein (APP), indicative of Aβ accumulation in the brain of T2D. However, expression of CTR1, Atox1, and ATP7A was downregulated in the hippocampus, while their expression remained unaltered in the cortex of T2D mice vs. controls. In conclusion, our study underscores differential expression patterns of Cu transport proteins in the hippocampus and cortex of AD and T2D mice, suggesting a potential therapeutic avenue for AD treatment, with or without T2D, through the restoration of proper Cu homeostasis.

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# Racial Uplift or Self Uplift: Challenging the Black Elite's Hold on Progress

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**Affiliation(s):** Department of English and World Languages, Augusta University

## ABSTRACT

Within specific pockets of the Black community there are questions forming regarding identity. What constitutes the Black identity? Where did it come from? How was it formed? What is it affected by and where does it leave us in comparison with other communities? Is it *wrong* to have whatever constitutes the "Black Identity" follow our every move, and if so, is it *wrong* to want separation from it? There are no definitive answers for the burgeoning questions, just as there are no answers for the one that asks whether the Black community exists, or if we have separated ourselves far too much to ever consider having a *community* again. There are, however, a handful of Black authors that aim to tackle these questions that have lingered unsolved for decades, dating back to the Jim Crow era of the early 1900's. Scholars like Keeanga Yamahtta Taylor support the notion that this system is beyond repair, choosing to answer the aforementioned questions with an attitude that may fall in line with authors such as Margaret Walker, but falls short for other Black scholars like John Sibley Butler. Taylor and Walker may determine the *Black Identity* is one where Black individuals, originally bound together by suffering, stay because of tenacity in the face of suffering and the willingness to fight for change not just for the individual, but for the collective. Others, like Sibley, may suggest that it's unproductive to constantly think of oneself as part of a collective. This might be because he is not just *Black*, but he is an *upper-class Black*, a sentiment that means everything to certain parties, yet nothing at all to others. He may answer the question of the legitimacy of a *Black community* with the same gusto of the Protagonist within Ellison's *Invisible Man*, that there *is* a Black community, but that it owes its life to the Black bourgeoisie and to the people who have helped by becoming something akin to the "Talented Tenth" theory that W.E.B. Du Bois emphasized in his early career. Through his novel, Ellison aims to explore and potentially criticize class (or, at the very least criticize selfish versus selfless racial uplift). Despite being published in the 1950s, the novel is in direct correlation with what Taylor criticizes in her own contemporary scholarly book, *BlackLivesMatter to Black Liberation.* Other essays and literary works, particularly Walker's "For My People" and Ann Petry's *The Street* also criticize the issues of class with Walker focusing class disparities that were ever present in the 1940s and remain present *now* and Petry focusing on the aftermath of such exploitation. Taylor argues that the *Black Elite* are a part of a problem of the exploitation of Black people. Both Taylor and Walker, help us conclude that Ellison's *Invisible Man* and its protagonist are a textbook example of their criticisms of individuals in power, what power does for those who get it, and the warped system that hinges on detrimental self-uplift, while also potentially being seen as a point of pride for Sibley, and a warning for Petry.

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# A Woman's Role: Dissecting the Function Female Sexuality in *Sir Gawain and the Green Knight*

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## ABSTRACT

This paper analyzes the function of female sexuality in *Sir Gawain and the Green Knight.* To dissect the woman's role within the chivalric poem, the research focuses on the central female character of Morgan the Fay and her impact on the story. Using the edited version by J. R. R. Tolkien and E. V. Gordon, the paper uses the primary text as well as academic journals to explore the complex characterization of Morgan the Fay and the reception of her use of sexuality within the poem. The paper argues that female sexuality is the power wielded by Morgan the Fay that she uses to control and manipulate other characters in *Sir Gawain and the Green Knight.* Her character subverts expectations for female representation and sexuality from a text written in the Middle Ages. Given the popularity and age of *Sir Gawain and the Green Knight,* the paper explores the context of Morgan the Fay in the tradition of female characters set before and after.

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# Quantifying Shapes of 3D Tumor Cell Collectives

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## ABSTRACT

Cell-cell force, a relatively new frontier in biology, plays a surprising role in many biological processes. In particular, cell-cell adhesion forces can influence the morphology, organization and behavior of tumor cell collectives. By implementing an agent based simulation for cells incorporating features such as cell growth and division together with physical adhesive interaction between cells, we quantify the shapes of three-dimensional (3D) cell collective as it grows. To do so, we calculate the gyration tensor which is a 2nd order tensor that we diagonalize to find the lengths of the tumor principal axes. By investigating the eigenvalues of the gyration tensor for tumor spheroids at varying cell-cell adhesion strengths, we quantify shape descriptors such as asphericity, acylindricity, relative shape anisotropy, and the prolate parameter. We conclude from these shape descriptors that the asphericity and prolateness increases with growth irrespective of the adhesion strength. Additionally, we find that higher intercellular adhesion strength leads to a lower overall tumor collective size.

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# Feasibility of the Adapted Otago Exercise Program in Dementia

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## ABSTRACT

**Background**: Currently, there is no evidence-based exercise programs that are targeted to reduce falls among people living with dementia (PWD). This pilot randomized control trial (RCT) examined the 1) feasibility and acceptability, and 2) effect of exercise on cognition and falls (exploratory) relative to usual care alone among PWD.

**Methods**: We randomized 42 PWD into two groups: exercise (n=21) and usual care alone (n=21) in our pilot parallel, assessor blinded RCT (1:1) [NCT05488951]. The study was conducted at two residential care facilities in Augusta, Georgia: The Claiborne Assisted Living Facility and the Georgia War Veterans Nursing Home. Both feasibility (recruitment, data collection, dropout rates, adverse events, adherence) and acceptability (satisfaction) were examined after the study. A battery of cognitive tasks, Color-Word Stroop 3-2 (primary), Montreal Cognitive Assessment (MOCA); Trail-Making test, Digit Span Forward/Backward; Benton Judgment of Line Orientation; Boston Naming Test; Rey Auditory Verbal Learning Test; Digit Symbol Substitution Test, and the Health Utilities Index-3 (HUI-3), were completed at baseline and 6 months. A physical therapist-led exercise program adapted from the evidence-based Otago Exercise Program was prescribed to the exercise group (n=21). This consisted of 1 hour of strength, balance, and walking 3x/week for 6 months in groups of 5-7 PWD. After the study, an intent-to-treat (ITT; n=42) and per protocol analyses (n=9 with ≥2x/week exercise adherence, n=21 usual care) were performed, controlling for age, race, sex, and the MOCA.

**Results**: In terms of feasibility, the recruitment and enrollment were completed across the span of 7 months (36% female; 17% African Americans; Age:82.1±8.1years; MOCA:10.2±5.9points), with an attrition rate of 19%. The exercise adherence was moderate (60.2±34.5%; 47/78 exercise sessions). The RCT established protocol safety, with no adverse events related to the intervention. In terms of acceptability, satisfaction was good (4.2/5 points). The ITT analysis revealed no difference between the groups in the primary outcome measure, the Color-Word Stroop. However, better executive function (Digit Span Backwards) was seen following exercise relative to usual care ($p<0.05$). The per protocol analysis resulted in similar results in executive function and improvements in HUI-3 following exercise relative to usual care ($p<0.05$). There were no effects

on falls (exercise:13 falls, n=8 recurrent, n=1 injurious; usual care:13 falls, n=10 recurrent, n=4 injurious).

**Conclusion:** This pilot RCT study was feasible and acceptable. Exercise, in any amount, seems to have a positive impact on executive function (Digit Span Backwards). Benefits to quality of life are seen with increased adherence to exercise (~ 2x/week).

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# Essential Oils and Pain Pressure Threshold Feasibility Study: Methodology

**Presenter(s)**: Jasmine Patel[1], Brandi Bramwell[2], Ameya Agnihotri[1], and Julie Bishara[1]

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## ABSTRACT

Chronic pain is experienced by 20.9% of the adult population in the United States. Standard approaches to chronic pain include OTC and prescription medications; however, major side effects may occur and are not always effective in aiding pain. In previous studies, essential oils (EO) demonstrated pain reduction through topical application and inhalation. EOs moderate many aspects of pain signal transmission, including non-competing inhibition of 5-HT, AChE, and Substance P. Pain-Pressure Threshold (PPT) is the point where a non-painful stimulus activates local sensory neurons and induces nociception (pain). To discover potential effectiveness in decreasing pain, the research team suggested using PPT pre and post-EO topical application on healthy adults. A feasibility test is required due to a lack of supporting literature. The study's primary aim is to answer the research question: Is performing PPT testing with an EO that relieves pain feasible? Finding variations in EO PPT pre and post-measures is the secondary aim. This study is a quasi-experimental, one-group, pre and post-test design. Participants will be recruited from the southeastern United States using convenience sampling. The sample size will be ten healthy adults meeting inclusion and exclusion criteria. Participants scoring < 2 on the SF-MPQ-2 and the VAS will be enrolled in the study. Essential oils will be applied an inch down from the patient's antecubital fossa, located between the arm and forearm, and pressure will be applied. We will examine three conditions - control (untreated skin), intervention (EOs), and placebo (Jojoba). We will establish baseline pain scores using the FACES scale-Adult. During the first visit, participants' forearms will be subjected to manual algometry for reliability until FACES scores of "2" and "4" are regularly reported. At subsequent visits, participants' baseline FACES scores will be recorded, after which EOs will be applied for 20 minutes at a 10% dilution (in jojoba). Algometry will then be carried out until FACES scores of "2" and "4" are reported. There will be 16 EOs evaluated in all. Using SAS, statistical analyses will be conducted for reliability, pre and post-differences (T-tests), and demographic differences. The findings from this study will determine the feasibility of pre and post-EO topical application PPT testing. If deemed feasible, PPT testing will be utilized with other EOs, CO2 extracts, hydrosols, and herbal-infused oils, enabling the successful development of natural product formulations for pain.

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# Unraveling FXR Gene's Impact on Mouse Eye Blood Vessel Formation

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## ABSTRACT

Retinopathy of Prematurity (ROP) is an eye disease that may affect preterm/underweight infants and is a significant cause of blindness. When infants are born premature, their lungs may not be developed fully, and as a result, the preterm baby may be placed in a high-oxygen chamber to support lung development. Then several days later, the baby is taken out into normal room air conditions. This hyperoxic (high oxygen) condition followed by conditions of relative hypoxia (low oxygen) may result in neovascularization in the retina, retinal detachment or even blindness. Although there are treatments available for ROP, they are invasive and in some cases, recurrence of the disease is possible. The Farnesoid X Receptor (FXR) is a bile acid nuclear receptor involved in many bodily functions including angiogenesis in extraocular pathologies. Our previous studies have identified the role of bile acid metabolism in an experimental model of ROP (oxygen-induced retinopathy, OIR)**.** We hypothesize that alterations in retinal FXR signaling may play a key role in ROP pathological neovascularization. Seven days old (P7) wild-type (WT) and FXR Global Knockout (FXR-/- mice; strain C57BL/6J) were subjected to the OIR procedure. The OIR model consists of mice being placed in a 75% oxygen chamber from postnatal day 7 (P7) onwards for 5 days (until P12) when they will be brought back to RA. Retinas were collected at P12, P14 and P17 and retinal flat mounts were stained with isolectin B4 to study vascular distribution in these mice retinas. Angiotool, a computational tool, was used to analyze retinal flat-mount images such as avascular areas and neovascular tuft formation. Additionally, the formation of endothelial tip cells, vessel density, vascular sprouting, vessel junctions, and number of endpoints were analyzed. The RA WT and $FXR^{-/-}$ mice did not show any significant difference in retinal vasculature indicating that the absence of FXR does not affect normal vasculature development. However, $FXR^{-/-}$ OIR mice showed exaggerated response as evidenced by the increased number of neovascular tufts and avascular areas compared to OIR WT mice. Further unbiased vascular network analysis revealed that $FXR^{-/-}$ OIR mice had increased vessel length, junction density, and fewer endpoints compared to untreated OIR WT mice. Our data suggests that FXR signaling plays a significant role in OIR pathology and can be targeted as a new therapeutic tool in limiting ROP pathology.

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# Multi-Purposing Common Medicines: A Better Cure for Cancer?

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## ABSTRACT

Cancer is the second leading cause of death in the United States, claiming over 1,958,310 new cases and 609,820 deaths in 2023. Cancers of various organs are multistage, progressive, and often lethal diseases. Chemotherapy drugs are specific drugs for killing cancer cells by abrogating cell proliferation, but they become increasingly ineffective as the cancer cells evolve to become treatment-resistant. Some bioactive phytochemicals affect tumor cells by disrupting the nutrient metabolism in tumor cells. Repurposing some drugs used for treating diabetes and obesity is known to deprive tumor cells of metabolic energy and drive them to recycle their organelles (autophagy), which leads cancer cells to their death when combined with a hybrid natural phytochemical (4-N-methyl piperazine-Ursolic Acid, 4MU), delivering a one-two-punch to chemo drug-resistant cancers. We tested several combinations of a novel hybrid-phytochemical, 4-N-methyl Piperazine Ursolic Acid (UA4), developed in the laboratory with existing FDA-approved drugs to repurpose for cancer. These included a statin (an inhibitor of HMG-CoA reductase, a key enzyme in cholesterol synthesis), LY294002 (an inhibitor of PI3K), and an antidiabetic drug (metformin). We demonstrate a strong decrease in tumor cell survival in two human breast cancer models, an estrogen-receptor positive (MCF7) breast cancer cell line and a triple-negative (MDA-MB-231) breast cancer cell line. Our results show that these drug combinations enhance the antiproliferative activity of tumor cells from both breast cancer models. Ongoing studies are to demonstrate the mechanism of action of these combinations in breast cancer cells. Overall, the study will demonstrate the utility of repurposed drugs in specific combinations that overcome therapy limitations in multi-drug-resistant solid cancers.

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# Investigating the Expression of HCN Channels through Immunohistochemistry in Ovary & Testis: A Comparative Study

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## ABSTRACT

Hyperpolarization-activated cation (HCN) channels have a crucial role in regulating neuronal excitability and rhythmic activity in the brain and heart. There are four isoforms of HCN channels (HCN1-HCN4). Although the expression of HCN channels is well-documented in the brain, their expression in the ovary and testis, where the primary sex hormones are produced, remains largely unexplored. Our preliminary data revealed that HCN1 protein was highly expressed in the granulosa, theca, and stromal cells in the ovary. Additionally, it has been reported that HCN4 mRNA expression is significantly present in the testis. Thus, this project aims to investigate the expression patterns of HCN channels in both the ovary and testis, focusing on age-related changes. We will utilize adult (2-to- 3-month-old) and aged (14-to-15-month-old) male and female C57B/6J mice and employ immunohistochemistry. The expected outcome of this study is a comparative analysis of HCN channel expression in the ovary and testis with respect to age.*

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# Art Meets Science: Creating an Informational Animated Video to Educate Older Adults about Reducing their Fall Risk

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## ABSTRACT

Falling is a problem for older adults, but educating them on risk factors for falls and preventative strategies may reduce falls. However, few resources are available that incorporate new research evidence on risk factors and preventative strategies. The objective presented was to create a short video telling older adults about the ways to reduce their risk of falling. After the initial presentation of the problem and goal, the class began researching the genre of video, color themes, graphic styles, typography styles, and ways to illustrate the points being made such as making sure the chosen font was highly legible and echoed the audio rather than presenting new information; as well as writing the voice over script. Once the script was finalized and recorded in the Augusta University Podcast Lab, and a visual theme was picked, the group members were assigned sections to work on. We used both custom made and commercially available assets to put together the final video. Once we had finished the video, it was sent to the GAIT Laboratory and was reviewed by experts in the field, and final edits were made to reflect research evidence. Our final product was just over three minutes long, and includes a mixture of audio, animation, video, and text effects. It is now being used on online platforms to help educate older adults, with the goal of reducing falls and helping keep older adults independent for longer.

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# The Effect of Chronic Unpredictable Stress on Parvalbumin Neurons and Perineural Nets

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## ABSTRACT

Parvalbumin (PV)-expressing neurons are a group of interneurons characterized by fast-spiking, playing a crucial role in information processing in the brain. Mature PV neurons are typically enveloped in a mesh-like extracellular matrix structure called perineural nets (PNNs), which protect neurons against oxidative stress and are essential for maintaining the high-frequency firing of PV neurons. PV neurons are highly vulnerable to stressors and have been suggested to contribute to the pathology of neuropsychiatric disorders and neurodegenerative diseases. However, the current literature describing the changes in PV neurons and PNNs in different stress models is inconsistent. Furthermore, the detailed alterations of PNNs under chronic stress have never been thoroughly studied. This study aims to demonstrate the changes in PV neurons and PNNs in different brain regions following exposure to chronic unpredictable stress (CUS), a stress paradigm used to induce behavioral deficits such as anhedonia and behavioral despair. Male C57BL/6N mice at 10 months old were exposed to various types of stressors at different times of the day for 10 consecutive days. Control mice were briefly handled daily. On day 11, mice were transcardially perfused, and brains were cut into 40-µm coronal sections. Free-floating brain sections containing the hippocampus, medial prefrontal cortex, or entorhinal cortex were processed for immunostaining using anti-PV antibody to label PV neurons and Lectin from Wisteria floribunda (WFA) to label PNNs. The total number of PV neurons and the number of PV neurons positive for PNNs was determined using unbiased stereology. Considering degradation of PNNs might present as changes in intensity or integrity without decreasing the PNN-positive PV neurons, the average density of WFA will be analyzed by ImageJ, and the integrity will be further evaluated using high-magnification single-plane confocal images. This study will provide detailed information on how chronic stress influences PV neurons and PNNs.

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# Adulthood Traumatic Brain Injury Leads to Chronic Cerebral Atrophy, Cellular Senescence and Chronic Inflammation

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## ABSTRACT

Traumatic brain injury (TBI) stands as a prominent factor contributing to accidental disability and mortality on an international scale. Furthermore, patients continue to suffer from significant health challenges even months after the injury. In addition, TBI increases the risk of long-term consequences including neurodegenerative and cognitive impairment. However, the cellular and molecular pathways responsible for the long-term effects of TBI on the brain are still not understood. We have hypothesized that a single TBI induces sustained chronic cerebral atrophy, neuroinflammation and disrupts neuronal function. To test this, we induced TBI in young adult CD1 mice and assessed the cerebral atrophy, cerebral blood flow (CBF), and neuroinflammation in 12 months followed by pathological, histological, and MRI assessment. On MRI scan, these mice showed significant loss of tissue, reduced CBF and higher white matter injury compared to sham mice. We found these brains showed progressive atrophy, sustained astrogliosis, and chronic mild inflammation even after 1-year post-TBI. Because of progressive neurodegeneration and inflammation, these mice had shown early signs of cellular senescence which is the current focus of the lab to evaluate further. We, therefore, conclude that progressive pathology after adulthood TBI leads to cerebral atrophy, senescence, and chronic inflammation.

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# Scene Eleven: Who Stole the Tarts

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## ABSTRACT

A dreamlike, kaleidoscopic film, "Scene Eleven: Who Stole the Tarts," was produced for Theatre AUG's fall 2023 adaptation and staging of Alice's Adventures in Wonderland. In the scene, two live performers engaged with the film as it was being projected. The scene was an extension of an ongoing research project by CURS students Shiloh Reimche and Amber Jordan, under the instruction of Dr. Melanie Kitchens O'Meara. The film itself was conceived by O'Meara and Reimche and directed, shot, and edited by Reimche. Their research incorporated the life of writer Charles Dodgson and his real life muses, Alice Liddell and her sisters, as well as, various illustrations from different versions of the novel, especially those of Salvador Dali and other surrealist artists.

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# Investigating the Impact of Low Frequency Sound on Crustaceans

**Presenters**: Maggie Karraker[1] and Patrick Rimbey[2]

**Authors**: Maggie Karraker, Patrick Rimbey, Jessica Reichmuth, and Joseph Hauger

**Faculty Sponsors**: Joseph Hauger, PhD[3] and Jessica Reichmuth, PhD[1]

**Affiliations**: Department of Biological Sciences[1], Department of Physics and Biophysics[3], School of Computer and Cyber Sciences[2]

## ABSTRACT

There is building evidence suggesting that noise pollution has negative effects on the biological activity of most marine life. However, little to no research has been performed to measure these effects on crustaceans. For example, blue crabs (*Callinectes sapidus*) and speckled crabs (*Arenaeus cribrarius*) are important members of estuarine and coastal zone predatory guilds that are responsible for maintaining diversity in these biological communities. Currently, there is no research on the juvenile stages of either species of crab, but both species are often subjected to low frequency sounds, such as boat noise. Our investigation would be one of the first to experimentally determine the impact of chronic low-frequency noise on these ecologically and economically important species. To this end, we have designed and constructed a low-cost electronic device which can be configured to produce selectable sound frequencies and exposure times. The device uses a Wein bridge oscillator circuit and programmable feedback resistors to tune its output signal which is monitored and used to drive an audio speaker. Our design and preliminary test results will be presented.

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# Morally Grey Characters

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## ABSTRACT

The morally grey character is an attractive concept because it disrupts expected good/bad character binaries in literature. These complicated characters represent what it means to be human. A morally grey character makes errors and decisions that are evil or wrong, and as humans, we also make our own morally wrong decisions. Therefore, a representation of such a relatable character creates empathy in a reader. Empathy for others is what makes us human. An author giving a character their voice involves insight into their internal conflict which inevitably makes the character feel real. Such a character would be unpredictable, acting upon complicated choices not for the sake of a reader's approval but to emphasize the difficult choice they would make. Even though the term "morally grey character" would not have been used at his creation, Hamlet is the role model for such a complex character. The reinterpretation of this character as morally grey instead of simply as the main character transforms the entire narrative. The challenge between the notion of pure evil and pure good is the beauty of Hamlet. Hamlet's struggle with his father's death, his uncle's deception, and his loneliness and betrayal are relatable. Humans seek comfort in reading a representation of ourselves in fictional characters. The concept of morally grey characters has become more popular amongst readers whether they are written in romance, fantasy, science fiction, etc. More modern characters such as Severus Snape or Evelyn Hugo are written for the very purpose of portraying human complexity. Ultimately, the analysis of morally grey characters in literature offers a more nuanced perspective and reinterpretation of morality and character motivations.

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# A Role for Intestinal cGMP Signaling in Intestinal Aging

**Presenter(s):** Sakshi Shah

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**Faculty Sponsor(s):** Darren Browning, PhD

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## ABSTRACT

Since lifespan is increasing, the elderly population is also expected to increase dramatically, however aging associated frailty and diseases during the latter years compromise quality of life. Increased systemic inflammation associated with aging is a major driver of numerous age associated diseases, and a "leaky gut" is thought to be a major driver of this so called "inflammaging." Several laboratories have demonstrated that loss of intestinal cGMP signaling leads to a compromised epithelial barrier in mice, and pharmacologically increasing cGMP can increase intestinal barrier function. The present study aimed to determine whether cGMP signaling decreases in the intestinal epithelium during mouse aging, and whether increasing cGMP using phosphodiesterase 5 inhibitors can improve barrier function in elderly mice. Analysis of a published aging gut ssRNA study revealed that cGMP signaling components including guanylate cyclase c (GC-C), GC-C agonists, guanylin and uroguanylin, and downstream effector PKG2 were all decreased in relative expression in at least one type of colonocyte in elderly mice. To validate this finding, RT-qPCR was carried out using mucosa from young and old mice. Results demonstrated that the aged intestine was inflamed with higher IL-1 and IL-6 expression and confirmed loss of cGMP signaling components in the aged mice. Using a FITC-dextran permeability study in vivo, old mice exhibited a leaky gut barrier and higher systemic cytokine expression compared to younger mice, and treatment with sildenafil for 5 days normalized barrier function and reduced cytokine levels in the plasma. Results obtained support the notion that loss of cGMP signaling in the intestinal epithelium might contribute to inflammaging. In addition, augmenting gut cGMP levels using PDE5 inhibitors might be developed into a therapeutic option to slow aging-related diseases.

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# Visual and Information Theoretic Analysis of Musical Notes and Composition

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## ABSTRACT

A sequence of systematic vibrations can evoke an emotionally stirring musical experience due to the listener's ability to distinguish the different notes and patterns laid out in a sequence. While we usually experience music in an auditory fashion the perception of music through visual cues can allow us to differentiate notes from another unique perspective. In our two-pronged investigation, we first analyzed musical notes based on visual patterns formed by the vibrations of a Chladni plate. But the different notes we perceive as music is information. Thus, in our second method, to discern the notes we performed a quantitative analysis of compositions from different eras of music based on information entropy (also known as Shannon entropy). First, to visualize the musical patterns, we use a model inspired by the work of Ernest Chladni, who demonstrated the appearance of nodal lines on a vibrating, metal plate when a frequency is applied to it. In this study, the analytical harmonic solution for the vibrating square membrane with fixed edges is derived using the wave equation. The subsequent superimposed modes of cosine vibrations define the shape and characteristic features of the visible patterns. We associate these modes to specific frequencies that correspond to musical notes, such that an electronic keyboard of "Chladni frequencies" is created using *Mathematica*. With modes for each note on a keyboard defined, the nodal lines for the solutions are plotted. This gives rise to unique Chladni patterns for each note on the keyboard, allowing notes to be distinguished visually. However, simply visualizing the notes does not quantify this information. For this step, we conduct information entropy analysis on different songs, where the Shannon entropy of melodies is calculated to determine the distribution of notes. The calculated entropy of compositions from various composers is discussed to relate the musical complexity from different eras of music. Compositions with a wider range of distinct notes result in a higher entropy compared to compositions that are very repetitive in nature. Thus, classical compositions, such as Beethoven's "Moonlight Sonata", have higher entropy compared to modern day compositions, such as the Beatle's "Yellow Submarine", since the former is musically more complex. Thus, we are able to not only perceive music visually by analyzing the Chladni patterns from different notes, but we can also quantify the complexity contained within the structure of compositions from different eras of music by computing the Shannon entropy.

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# Designing and Synthesizing Potential Drug Candidates Using Molecular Hybridization

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## ABSTRACT

Developing new drugs is a complex and challenging process that involves many different stages, from the initial discovery to testing the drugs on people and getting approval from the government. Our team has been working on creating new drugs using special building blocks called indole and rhodamine, which have been shown to help make the drugs work better. We've made a set of compounds using an optimized synthetic protocol that were identified as potential antiviral agents and successfully fought COVID-19 viruses. We have developed a second generation of molecules using these scaffolds, the new generation of compounds identified as potential anti-inflammatory properties.

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# Peptides as Protein-Protein Interaction Inhibitors: Synthesis of Novel Nrf2 Blockers

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## ABSTRACT

Every medicine that has ever been used has at least one target in the body. The target may be a protein or DNA, for example. When a target can be therapeutically modulated by medicine, it is called a "druggable" target. Only a very small percentage of possible targets are druggable due to limitations in the traditional medicinal chemistry approach to drug discovery. Our group is interested in expanding the number of druggable targets by developing new approaches, including protein-protein interaction inhibitors. The nuclear factor erythroid-related factor 2 (Nrf2), a transcription factor used to counteract oxidative stress in cells, has been considered undruggable for more than two decades. Although it exerts positive effects in healthy cells, Nrf2 overactivation in cancer cells causes cancer progression and treatment resistance, leading to a poor prognosis for patients. Consequently, there is a need for the development of Nrf2 inhibitors or molecules that can stop the function of Nrf2. Given that Nrf2 is a challenging target to drug, the goal of our research project is to synthesize peptides that act as protein-protein interaction inhibitors and prevent Nrf2 to explicate its function. A microwave-assisted solid-phase peptide synthesizer has allowed for the quick synthesis of several peptides. We will report details of their synthesis, purification, and screening in Nrf2 chemoresistant cancer cells.

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# The Sensitivity of Mutant versus Wildtype in HNCC toward Drug AMG 232 and Alrizomadlin

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## ABSTRACT

Head and neck squamous carcinoma (HNSCC) is common among individuals who consume tobacco and alcohol. Squamous carcinoma arises from squamous cells lining the mucosal surface, comprising 90-95% of all head and neck cancers. AMG232 is a recently developed drug (2014) that inhibits cancer cell growth—inhibiting the MDM2/p53 interaction, resulting in compromised degradation of the tumor suppressor p53 so that p53 will exert more prolonged tumor suppressive effects in cancer cells. This thesis research aimed to determine how specific HNSCC patient-derived cultures (PDCs) react to the drug AMG232. First, we determined which PDCs were sensitive to AMG232 by measuring cell viability using MTT assay. The dose-response relationship of AMG232 in several HNSCC PDCs with different p53 genetic statuses was then determined. We found that p53-wildtype HNSCC PDC, PDC-25, was the most sensitive PDCs among all PDCs tested. Based on this result, we further tested PDCs' sensitivity towards another drug of the same class, Alrizomadlin, an inhibitor of the MDM2-p53 interaction and already in Phase 2 clinical trials. Importantly, we also found that PDC-25 was the most sensitive PDC to Alrizomadlin. Lastly, Western blotting was employed to determine changes in specific protein expression brought about by these drugs in the sensitive vs. resistant PDCs. From the trials, we concluded that TP53-wildtype PDCs were sensitive to p53-MDM2 inhibitors compared to TP53-mutant PDCs. Thus, this new class of MDM2-p53 interaction inhibitors holds excellent promise as potential precision medicines for TP53-wildtype HNSCC, representing nearly 15% of the HNSCC population.

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# Exploiting *HRAS*-mutated Head and Neck Squamous Cell Carcinoma with Tipifarnib, a Farnesyltransferase Inhibitor

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## ABSTRACT

Head and neck squamous cell carcinoma (HNSCC) represents a growing hazard to the population with a yearly estimated 932,000 new cases and 467,000 deaths as of 2020. HNSCC incidence is expected rise through 2040 to 1,370,000 new cases/year with 706,000 deaths (a 47% and 51% increase, respectively) [1]. Given the increasing odds of cancer occurrence, having reasonable cancer treatment options accessible and available to patients will become more important. Chemotherapy kills both rapidly dividing normal and cancer cells, resulting in unwanted side effects in patients. Hence, the desire to selectively target cancer cells leads to precision medicine development. Precision medicines work by targeting cancer cells that harbor a specific genetic mutation (HRAS, PI3K, BRCA-1/2, etc.).

Tipifarnib, a farnesyltransferase inhibitor, is suspected to be effective for HNSCC patients bearing tumoral HRAS gene mutations. Here, we examined the sensitivity of HNSCC patient-derived cultures (PDCs) with and without HRAS mutations to determine the relationship between HRAS-mutation status and tipifarnib activity in vitro. Cell growth inhibition following tipifarnib exposure was completed by cell viability assay (MTT assay). Genetic analysis was conducted for tipifarnib-sensitive PDCs. Signaling changes following 48-hour tipifarnib treatment was determined by Western blotting in tipifarnib-sensitive vs. insensitive PDCs. PDC48 (tipifarnib-sensitive) displayed a 2,281-fold increase in tipifarnib sensitivity than PDCs without HRAS mutation (PDC16 and PDC76) PDC48, compared to non-sensitive PDCs, required less drug to cause the same amount of growth inhibition. Our results demonstrated that HRAS-mutant HNSCC patient cultures were sensitive to tipifarnib compared to HRAS-wildtype HNSCC cells. Thus, tipifarnib represents a promising precision medicine for HNSCC patients whose tumors contain HRAS mutations.

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# Climate Stress and Ovarian Immunity

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## ABSTRACT

Scientific evidence strongly suggests that there is a rapid rise in the global average temperature. According to the literature, exposure to high ambient temperatures is related to impaired ovarian function and reduced ovarian reserve. However, the mechanism behind this process is still poorly understood. In this study, we analyzed the impact of high ambient temperature on cell senescence and T cell exhaustion process. For this analysis, six C57BL6 mice females, 10 weeks old, were divided into two groups for 30 days: normal temperature (NTC, n=3) that were maintained at 25ºC room temperature and high ambient temperature (HTC, n=3), maintained at 35ºC room temperature. After 30 days, the females were euthanized, and the ovaries collected for flow cytometry analysis. To identify senescence cells, anti-p16 and anti-p53 antibodies where used, while the detection of exhausted T cells occurred by expression of PD-1, LAG3 and TIM3. Statistical analysis occurred after analyzing the data using Flow Jo and GraphPad Prism. The tests used were T-test followed by Mann-Whitney and ANOVA followed by Sidak test. Our results showed that chronic exposure to high ambient temperature (35ºC) increased cell senescence marker p16 and the percentage of exhausted T cells in the ovary which might implicate and impairment of T cell function. These results show the impact that climate stress might have on the immune system and on mammals' reproductive success.

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# Traumatic Brain Injury Suppresses RBC-mediated Brain Oxygenation and Cerebral Circulation

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## ABSTRACT

Traumatic brain injury (TBI) leads to cerebral hypoxia and regional changes in cerebral blood flow (CBF) followed by the observed loss of erythroid rheology, and is clinically associated with increased morbidity and mortality. Given the role of calcium in RBC deformation, we hypothesized that modulation of Transient receptor potential vanilloid-1 (TRPV1), a cation channel and pain receptor cause calcium influx in RBCs and leads to loss of function by RBCs after TBI. We utilized moderate controlled-cortical impact model of mice for TBI. Briefly, a craniotomy was done in the right parietal bone and brain was impacted at 3 m/s with 85 ms dwell time and 3 mm depression using a 3 mm diameter convex tip to mimic a moderate to severe TBI. Cerebral hypoxia and passing RBCs were measured by Vevo Lazr-X. Mice were sacrificed at 5 days post-injury or otherwise noted, blood was collected, fixed for electron microscopy and imaging. RBC deformations were assessed by scanning electron microscopy with the help of SEM core. Statistical significance was determined at $p<0.05$. TBI mice showed higher number of deformed RBCs resulted because of erroneous erythropoiesis and expressed high TRPV1 and Phosphoinositide Interacting Regulator of TRP Channels (PIRT), which mirrored loss of their elasticity, restricted CBF and lack of cerebral oxygenation. Our results demonstrate a key role for erythroid TRPV1-PIRT in regulation of hypoxia and RBC function and may provide a therapeutic target and biomarker for loss of oxygenation and long-term TBI outcomes.

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# Perivascular Adipose Tissue in the Pathogenesis of Lupus Vasculopathy

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## ABSTRACT

Patients with systemic lupus erythematosus (SLE) are at high risk for cardiovascular disease (CVD), a leading cause of death in lupus patients. Positioned adjacent to blood vessels, perivascular adipose tissue (PVAT) can play a protective or pathogenic role in vascular disease. Notably, patients with lupus exhibit elevated quantities and densities (a marker of inflammation) of PVAT surrounding the thoracic aorta as compared to healthy control subjects. Through the utilization of a lupus-prone mouse model, our study presents evidence that active lupus promotes dysfunctional, inflamed thoracic PVAT, as evidenced by increased immune cell infiltration, reduced expression of adipogenic differentiation markers, adventitial hyperplasia, and a conversion from a brown-like (protective) to a white-like (pathogenic) phenotype in the thoracic aorta. Dysfunctional PVAT, in turn, impairs endothelium-dependent relaxation of the thoracic aorta of murine lupus in the context of systemic lupus. However, whether lupus PVAT directly regulates vascular function is unknown. For our methods, we employed a transplantation model with/without wire injury to explore the impact of lupus PVAT on endothelial function and neointima. Furthermore, we conducted bulk RNA-seq and flow cytometry of PVAT to investigate the role of immune cells in promoting lupus-associated vascular disease. Based on our findings, we demonstrated that PVAT from lupus mice with active disease directly impaired endothelial function and promoted local wire-induced neointima formation when transplanted to wild-type mice. Enrichment analysis revealed upregulated innate and adaptive immunity in murine lupus PVAT from bulk RNA-seq analysis. In addition, flow cytometry of lupus PVAT indicated that IFNγ-producing $CD8^+$ T cells predominated among T cell types and the frequency of PVAT $CD4^+CD25^+Foxp3^+$ regulatory T cells (Tregs) was strikingly decreased in active lupus PVAT. Meanwhile, Splenic Tregs did not differ between lupus and control mice, indicating that the decrease in PVAT Tregs was a tissue-specific rather than systemic effect. Moreover, down regulated mRNA expression of Il1rl1 (ST2), but not IL-33 was noticed in lupus PVAT. We concluded dysregulated immune systems in PVAT play a major role in the pathogenesis of lupus-associated vascular disease, especially elevated cytotoxic T cells and decreased Tregs. This finding suggests that IFNγ released by CD8+ T cells inhibits the ability of IL-33 to stimulate ST2 in Tregs, thus interrupting IL-33/ST2 signaling and promoting Treg cells deficiency in lupus PVAT, thus driving T cell activation, macrophage infiltration and PVAT inflammation in lupus mice.

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