INTERSECTIONS POSTER SYMPOSIUM

Thursday, July 30, 2026
10:00am - 12:00pm
Tinkham Veale University Center

CASE WESTERN RESERVE UNIVERSITY

Document Organization at a Glance

Welcome to the Summer 2026 Intersections Poster Symposium Presenter Index and Abstract Compendium. This document is divided into two primary sections to help you easily find presenters, projects, and abstracts. Additionally, the floor plan diagram can be found on the next page of the document.

Part 1: The Presenter Index

Located at the beginning of the document.

- **Alphabetical Order:** Presenters are listed from A to Z by their last names.
- **Interactive Links:** Click on any blue **Project Title** to jump directly to the full abstract text later in the document.
- **Quick Reference:** Includes the Poster Number, Keywords, and Faculty Project Mentor for at-a-glance browsing.

Part 2: The Poster Abstracts

Located immediately following the Presenter Index.

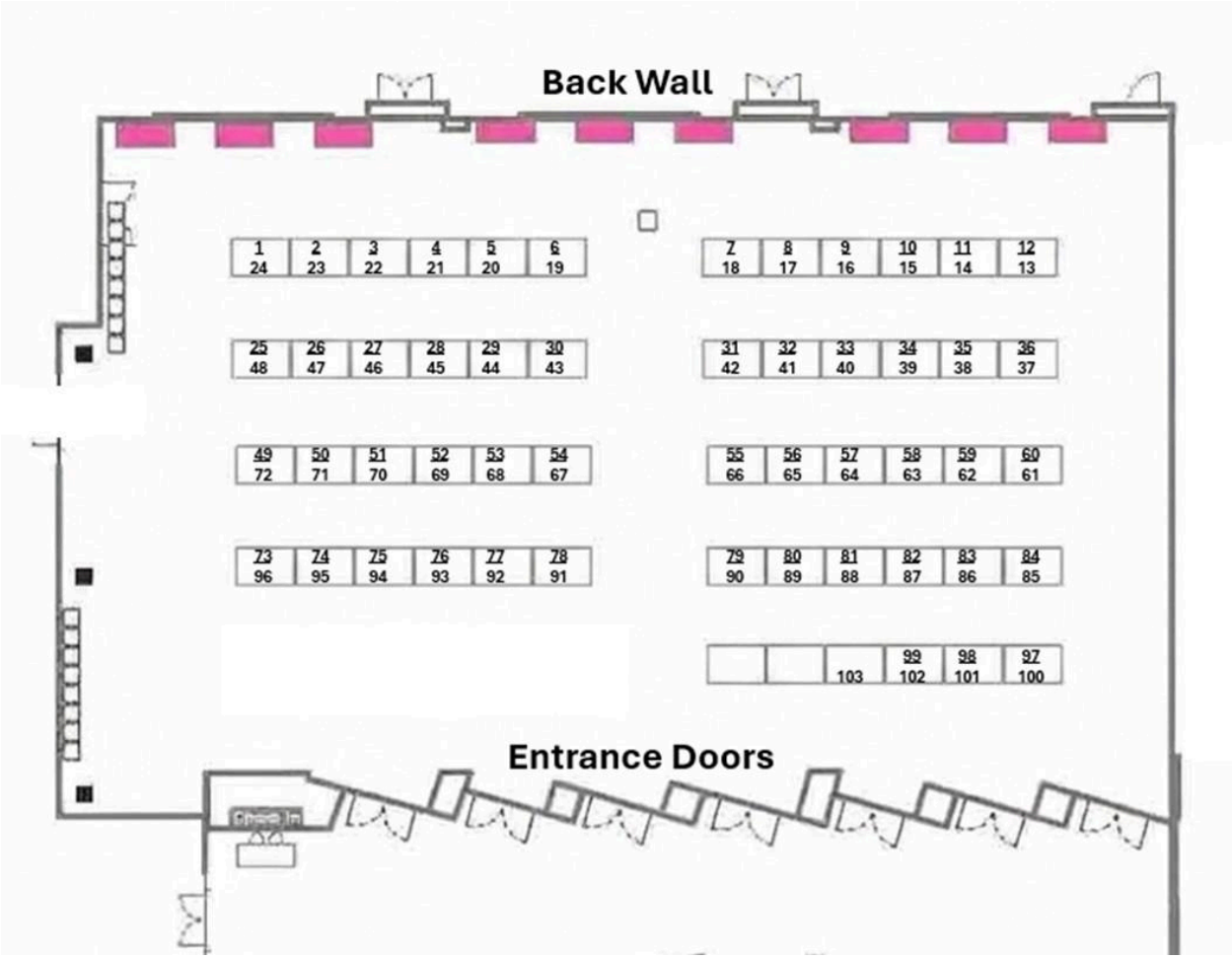
- **Sequential Order:** Abstracts are ordered numerically by Poster Number (Poster #1 through Poster #103) corresponding to their physical location at the symposium.
- **Detailed Information:** Contains the full text of the research abstract submitted by the presenter.

Quick Navigation Guide

Here is the fastest way to find what you are looking for:

If you are looking for a specific...	The best way to find it is:
Presenter's Name	Scroll through the A-Z **Presenter Index** at the top of the document.
Poster Number	Scroll down to the **Abstracts** section, ordered numerically 1-103.
Topic, Department, or Keyword	Use **Ctrl+F** (Windows) or **Cmd+F** (Mac) to search the document for specific terms (e.g., "Alzheimer's", "Machine learning").

Floor Plan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Entrance Doors

Presenter Index

Keywords: BRCA2, Extracellular Matrix, Breast Cancer
Faculty Project Mentor: Mihriban Karaayvaz (Cancer Biology)

Barrett, Rhylie — Poster #46
Project Title: Scientific Queries in NoSQL Databases
Keywords: XRD, NoSQL, ontology
Faculty Project Mentor: Ozan Dernek (Materials Science and Engineering)

Bartoe, Nico — Poster #61
Project Title: Impedimetric Microfluidic Flow Rate Sensor for Validation of Intracortical Neural Probe Drug Delivery
Keywords: Microfluidics, Neural engineering, Drug delivery
Faculty Project Mentor: Allison Hess-Dunning (Electrical, Computer and Systems Engineering)

Bauer, Kayleigh — Poster #14
Project Title: Establishing a Primary Rat Astrocyte Platform for Investigating the Molecular Pathology of Alexander Disease
Keywords: Glia, Leukodystrophy, In Vitro Disease Model
Faculty Project Mentor: Benjamin Clayton (Genetics and Genome Sciences)

Biswas, Rohan — Poster #40
Project Title: Development of a Novel Dual-Sensor Rectal Pressure Monitoring Device for Accessible Anorectal Manometry
Keywords: Anorectal manometry, Rectal pressure monitoring, Biomedical device
Faculty Project Mentor: Steve Majerus (Electrical, Computer and Systems Engineering)

Bryant, Khalil — Poster #46
Project Title: Scientific Queries in NoSQL Databases
Keywords: XRD, NoSQL, ontology
Faculty Project Mentor: Ozan Dernek (Materials Science and Engineering)

Bulusu, Pranati — Poster #87
Project Title: Evaluation of Two-Point Strength-Duration Fitting Methods for Efficient FES Activation Prediction
Keywords: Data analysis, EMG activation prediction, Two point curve fitting
Faculty Project Mentor: Abidemi Ajiboye (Biomedical Engineering)

Calabrese, Nicole — Poster #4
Project Title: Spatial ATAC-seq Analysis of PHLDA1-Related Changes in Chromatin Accessibility Identifies Zinc Finger Protein 637 as a Putative Node of Autophagy-Mediated Neuroprotection
Keywords: Aging, ATAC-seq, Autophagy

Faculty Project Mentor: Andrew Pieper (Neurosciences)

Chen, Matthew — Poster #81
Project Title: Evaluating the Effects of 3' Untranslated Region Mutations on Gene Expression of the Neurofibromatosis Type I (NF1) Gene
Keywords: NF1, UTR, Gene Expression
Faculty Project Mentor: Hua Lou (Genetics and Genome Sciences)
Capstone Instructor: Hua Lou (Genetics and Genome Sciences)

Choksey, Rhea — Poster #3
Project Title: Single Stranded DNA Production through Alkaline Denaturation for the Assembly of ABE-Encoded DNA Origami Nanostructures
Keywords: DNA Origami Nanostructures, Alkaline Denaturation, Single Stranded DNA
Faculty Project Mentor: Divita Mathur (Chemistry)

Cloonan, Penelope — Poster #59
Project Title: Special Delivery: Locating and Characterizing Virus-like Particles Created by a Fluorescent HIV-1 Gag-PABPC1 fusion
Keywords: RNA, Transcriptome, Particles
Faculty Project Mentor: Joseph Luna (Biochemistry RNA center)

Degenholtz, Annabel — Poster #35
Project Title: Defining Household Food Literacy
Keywords: Food Literacy, Nutrition, Food Management
Faculty Project Mentor: Melissa Pflugh Prescott (Nutrition)

Del Toro, Daniela — Poster #29
Project Title: Expression and Purification of His-tagged L-Lactate Oxidase from A. viridians in E. coli.
Keywords: lactate oxidase, protein expression, enzyme characterization
Faculty Project Mentor: David Lodowski (Nutrition)

Dinary, Fatema — Poster #2
Project Title: Effects of Pharmacological Chaperone Therapy Targeting the Retina on Retinitis Pigmentosa Physiopathology
Keywords: Retinitis Pigmentosa, Nonretinoid pharmacochaperones, Rhodopsin misfolding
Faculty Project Mentor: Beata Jastrzebska (Pharmacology)

Drazdik, Melanie — Poster #5
Project Title: The Effect of Heat Treatment and Surface Finish on Nitinol Fine Wire Fatigue
Keywords: Nitinol, Fatigue, Microscopy
Faculty Project Mentor: Janet Gbur (Materials Science and Engineering)

Duong, Julia — Poster #67
Project Title: Cereblon Deficiency Impairs Mitochondrial Homeostasis and Generates Neurodegenerative Molecular Signatures
Keywords: Cereblon, Mitochondria, Neurodegeneration
Faculty Project Mentor: Andrew Pieper (Psychiatry)

Ellis, Emi — Poster #17
Project Title: Evaluating the On-Target Off Tumor Effects of Bispecific Antibody Mediated Immunotherapy in Osteosarcoma
Keywords: Osteosarcoma, Immunotherapy, Bispecific Antibody
Faculty Project Mentor: Masahiro Hitomi (Molecular Medicine)

Esa, Adam — Poster #11
Project Title: Characterizing the Binding Interface of NAD+-bound 15-PGDH-SW209415 Complex Using Novel Multiplex CF3/OH Radical Footprinting
Keywords: Binding Interface, 15-PGDH, Radical Footprinting
Faculty Project Mentor: Janna Kiselar (Nutrition)

Ghati, Shreya — Poster #95
Project Title: Repurposing Metformin to Target O-GlcNAcylation-Dependent NF-ÎºB Signaling in Acute Myeloid Leukemia
Keywords: Acute Myeloid Leukemia, O-GlcNAcylation, NF-kB signaling
Faculty Project Mentor: Parameswaran Ramakrishnan (Pathology)

Girish, Rithu — Poster #12
Project Title: The Role of Microbial Intraspecies Diversity in Vaginal Health
Keywords: Vaginal Microbiome, Lactobacillus, Intraspecies Diversity
Faculty Project Mentor: Gina Lewin (Center for Global Health and Diseases)

Green, Caleb — Poster #88
Project Title: Zwitterionic Copolymer Membrane Characterization for Rare Earth Element Separation
Keywords: Membrane, Polymer, Seperation
Faculty Project Mentor: Christine Duval (Chemical and Biomolecular Engineering)

Gutta, Saanvi — Poster #52
Project Title: Non-pneumatic Dynamic Compression Device Promoting Lymphatic Drainage
Keywords: Lymphedema, Compression Therapy, Wearable Device
Faculty Project Mentor: Ozan Akkus (Mechanical and Aerospace Engineering)

Han, Sophia — Poster #67
Project Title: Cereblon Deficiency Impairs Mitochondrial Homeostasis and Generates

Neurodegenerative Molecular Signatures
Keywords: Cereblon, Mitochondria, Neurodegeneration
Faculty Project Mentor: Andrew Pieper (Psychiatry)

Hashem, Michelle N. — Poster #23
Project Title: Determining the Molecular Mechanisms Towards Treatment of Cardiac Valvular Ehlers-Danlos Syndrome
Keywords: Connective tissue, Cardiovascular, Extracellular Matrix
Faculty Project Mentor: Timothy Mead (Pediatrics)

Huang, Averie — Poster #24
Project Title: Metabolic Induction of Tumor Acidosis to Enhance PARP Inhibitor and Chemotherapy Efficacy
Keywords: PARPi, CAIX, Hypoxia
Faculty Project Mentor: Boaz Tirosh (Biochemistry)

Isaza, Izabella — Poster #57
Project Title: Developing an Alloxazine Derivative as Prospective Imaging-Guided Photodynamic Therapy Agent
Keywords: THP-Alloxazine, Photodynamic Therapy, Alloxazine
Faculty Project Mentor: Carlos Crespo-HernÃ¡ndez (Chemistry)

Iyer, Anya — Poster #26
Project Title: Vagus Nerve Stimulation for Acute Modulation of Bladder Function in SCI Rat Model
Keywords: Vagus Nerve Stimulation (VNS), Bladder Function Modulation, Neuroplasticity
Faculty Project Mentor: Ana Hernandez Reynoso (Biomedical Engineering)

Jackson, Janiyah — Poster #6
Project Title: Determining the Impact of Different Surgical Tools on Bending Pediatric Spinal Rods
Keywords: Spinal rods, Surgical tools, Microscopy
Faculty Project Mentor: Janet Gbur (Materials Science and Engineering)

Jaladhi, Sriharsha — Poster #92
Project Title: MultiCas12a-KRAB Multiplex Gene Perturbation in Prostate Cancer Cells
Keywords: CRISPR, Cancer, Multiplexing
Faculty Project Mentor: Liangqi Xie (Infection Biology)

Johnson, Oliver — Poster #15
Project Title: DEMON: Dynamic Exploration of Molecular Simulations Through Optimized Navigation

Keywords: Enhanced sampling, Molecular dynamics, Reinforcement learning
Faculty Project Mentor: Yihang Wang (Chemistry)

Jonnalagadda, Vikhyath — Poster #75
Project Title: Responsiveness and Mechanisms of TCR and IL-15 Stimulation by CD57+ CD8 T cells in PWH and PWoH
Keywords: HIV/Infectious Disease, CD57 Expression, Antigen Specific / Non-Specific Stimulation
Faculty Project Mentor: Michael Freeman (Infectious Diseases)

Jung, Grace — Poster #8
Project Title: From Cells to Skull: Cadherin-Mediated Cell-Cell Adhesion Regulates Apical Expansion of Mesenchymal Osteogenic Stem Cells During Frontal Bone Development
Keywords: N-cadherin, Collective Cell Migration, Frontal Bone Primordia
Faculty Project Mentor: Radhika Atit (Biology)

Kandula, Abhinav — Poster #77
Project Title: Hypothermic Oxygenated Perfusion Preserves Mitochondrial Function and Tissue architecture in Deceased Donor Uterus Grafts
Keywords: Uterus, Perfusion, Mitochondrial function
Faculty Project Mentor: Keyue Sun (Inflammation and Immunity)

Kao, Zoe — Poster #50
Project Title: Computational Fire Dynamics Study of Flame Spread Between Closely Spaced Solid Fuels in Microgravity
Keywords: Fire Dynamics, Flame Spread, CFD
Faculty Project Mentor: Ya-Ting Liao (Mechanical and Aerospace Engineering)

Karthikeyan, Rithika — Poster #78
Project Title: Characterizing High Dose Differences for tSNIP in Chronic Pain Rat Models: High-Resolution Gait Analysis Using CatWalk
Keywords: Chronic pain, Gait analysis, Photobiomodulation therapy
Faculty Project Mentor: Michael Moffitt (Biomedical Engineering)

Kella, Avyuth — Poster #32
Project Title: Inhibition of Bax-Induced Apoptosis Prolonged Photoreceptor Survival in a P23H Mouse Model of Retinitis Pigmentosa
Keywords: Retinitis Pigmentosa, P23H, Bax
Faculty Project Mentor: Shigemi Matsuyama (Visual Sciences Research Center)

Khouli, Alex — Poster #1
Project Title: The Digital Divide and Lung Transplant Access: Neighborhood Internet Access

and Income Inequality Before and After the Composite Allocation Score
Keywords: lung transplantation, health disparities, digital divide
Faculty Project Mentor: Wayne Tsuang (Quantitative Health Sciences)

Khouli, Alex — Poster #34
Project Title: Automated IMU Network Tracking for Foot Displacement Detection in Powered Wheelchairs
Keywords: IMU, Foot Displacement, Wheelchair Users
Faculty Project Mentor: Sandra Hnat (Biomedical Engineering)

Kim, Katherine — Poster #21
Project Title: BAX Deficiency Attenuates Photoreceptor Degeneration in Rd10 Mouse Model of Retinitis Pigmentosa (RP)
Keywords: Retinitis Pigmentosa, Retinal Degeneration, BAX
Faculty Project Mentor: Shigemi Matsuyama (Ophthalmology)

Kim, Grace — Poster #99
Project Title: Designing a Wireless Instrumented Walker to Measure Upper-Extremity Forces During SCI Walking
Keywords: Instrumented Walker, Gait Analysis, Wireless Force Sensing
Faculty Project Mentor: Nathaniel Makowski (Physical Medicine and Rehabilitation)

Kohl, Sofia — Poster #100
Project Title: Pre-Implantation Cytokine Profiling of Deceased Donor Organs: Associations With Graft Survival and Post-Transplant Hospital Course
Keywords: Post Graft Function, Cytokine Profiling, Transplantation
Faculty Project Mentor: James Reynolds (Medicine)

Kona, Riya — Poster #30
Project Title: Quantifying Differences in Hydrogen Peroxide and L-lactate Production across Oral Streptococci using an Optimized Reflectometric Assay
Keywords: Oral Microbiome, Streptococcus, Periodontitis
Faculty Project Mentor: Gina Lewin (Center for Global Health and Diseases)

Koyuturk, Armagan — Poster #63
Project Title: Uncertainty Quantification via an Efficient CUR-Based Gaussian Process Regression Framework for Predicting Î²-Phase Volume Fraction of Ti-6Al-4V Alloy
Keywords: Uncertainty Quantification, CUR Decomposition, Xray Diffraction
Faculty Project Mentor: Ayorinde Olatunde (Materials Science and Engineering)

Kulkarni, Riya — Poster #82
Project Title: Identification of Proteomic Changes in the Brain That Coincide with Early

Depression Preceding Cognitive Impairment in the TgF344-AD Rat Model of Alzheimer's Disease
Keywords: Alzheimer's Disease, Proteomic Markers, Bioanalysis
Faculty Project Mentor: Andrew Pieper (Psychiatry)

Kumar, Saanvi — Poster #58
Project Title: Evaluating the Glomerular Basement Membrane Structural Integrity in Timp3 Mutant Kidneys
Keywords: Timp3, Glomerular Basement Membrane, Sorsby fundus dystrophy
Faculty Project Mentor: Oliver Wessely (Molecular Biology and Microbiology)

Kunduru, Hansika — Poster #25
Project Title: Malnutrition and Neurodevelopmental Outcomes in Preterm Infants: A Preliminary Analysis
Keywords: Malnutrition, Preterm infants, Neurodevelopmental outcomes
Faculty Project Mentor: Stephanie Merlino (Nutrition)

Lample, Jacob — Poster #97
Project Title: Semantic Data Management (SDM) Framework for the Degradation and Reliability Assessment of Multilayer Ceramic Capacitors (MLCCs)
Keywords: Ceramic Capacitors, Data Management, Reliability Assessment
Faculty Project Mentor: Roger French (Materials Science and Engineering)

Lee, Noah — Poster #60
Project Title: Ontology Framework for Standardizing X-ray Diffraction Metadata
Keywords: Ontology, X-ray, Synchrotron
Faculty Project Mentor: Jonah Bachman (Materials Science and Engineering)

Lin, Milton — Poster #94
Project Title: Molecular Analysis of 45 Clinically Relevant GABAa Receptor α1-Subunit Mutations
Keywords: GABAA receptor, epilepsy, seizure
Faculty Project Mentor: Megan Wang (Physiology & Biophysics)

Littlejohn, Anthony — Poster #47
Project Title: Computational Chemistry Studies of Caffeine Adsorption on Metal Surfaces
Keywords: Caffeine, Metal, Computationa
Faculty Project Mentor: Rob Warburton, (Chemical and Biomolecular Engineering)

López, Leiniz — Poster #89
Project Title: Fentanyl Modulation of CARD8 Inflammasome-induced Pyroptosis in Primary Human CD4+ T Cells

Keywords: CARD8 inflammasome, Pyroptosis, Fentanyl
Faculty Project Mentor: Alan Levine (Molecular Biology and Microbiology)

Lou, Eileen — Poster #27
Project Title: Pathways and Genetic Markers of Cellular Transport in Astrocytes of ALS and FTD
Keywords: ALS/FTD, Astrocytes, IL-17
Faculty Project Mentor: Aaron Burberry (Pathology)

Ludwig, Allison — Poster #51
Project Title: Development of a Reversible PDMS-Acrylic Package for Mechanically Adaptive Microfluidic Neural Probes
Keywords: Microfluidics, Neural Probe, Reversible Seal
Faculty Project Mentor: Allison Hess-Dunning (Electrical, Computer and Systems Engineering)

Ludwig, Lauren — Poster #84
Project Title: Assessment of Binding of a Small Molecule Inhibitor to MYO18A In Vitro
Keywords: Myosin 18A Signaling, GOLPH3 Pathway, Click Chemistry
Faculty Project Mentor: Seth Field (Medicine)

Lukang, Madeleine — Poster #71
Project Title: Modular Microfluidic Device Designed for Localized Analysis of Organ-on-a-Chip
Keywords: Organ-on-a-Chip, Microfluidics, 3D printing
Faculty Project Mentor: Melinda Lake-Speers (Mechanical and Aerospace Engineering)

Mao, Karis — Poster #79
Project Title: Immunofluorescence Analysis of Zbtb16 Expression in the Mouse Brain Following Mild Traumatic Brain Injury
Keywords: TBI, Immunofluorescence, Zbtb16
Faculty Project Mentor: Andrew Pieper (Psychiatry)

Marks, Pearl — Poster #48
Project Title: Development and Validation of Miniaturized Mechanically Adaptive Microfluidic Neural Probes
Keywords: Mechanically adaptive probes, Microfluidic drug delivery, Device miniaturization
Faculty Project Mentor: Allison Hess-Dunning (Biomedical Engineering)

Marshall, Braelyn — Poster #68
Project Title: Dark IV analysis of thermally cycled PV samples
Keywords: materials, photovoltaic, degradation
Faculty Project Mentor: Peter Burdick (Materials Science and Engineering)

Martin, Paris A. — Poster #28
Project Title: Interventions to Address the Unmet Needs of Informal Caregivers of Individuals with Alzheimer's Disease and Related Dementias in Long-Term Care: A Scoping Review
Keywords: Alzheimer's disease and related dementias (ADRD), Informal caregivers, Caregiver interventions
Faculty Project Mentor: Siobhan Aaron (Nursing)

Matos, Finn — Poster #44
Project Title: Using Ontologies and Exploratory Data Analysis to Optimize 3D Printing Ink Development
Keywords: Ontology, Ink, CEMENTO
Faculty Project Mentor: Jube Augustino (Materials Science and Engineering)

Matos, Camila Acosta — Poster #76
Project Title: Investigating the Functional Role of Bifidobacterium in the Vaginal Microbiome Using a Metatranscriptomic Database
Keywords: vaginal microbiome, metatranscriptomics, microbial ecology
Faculty Project Mentor: Gina Lewin (Pathology)

Mckee, Enzo — Poster #43
Project Title: Shear-Induced Ordering in Monodisperse Dense Suspensions: Impact of Frictional Contacts
Keywords: soft matter physics, dense suspensions, shear-induced ordering
Faculty Project Mentor: Abhinendra Singh (Macromolecular Science and Engineering)

Mei, Yongyi — Poster #54
Project Title: Ontology-Based Linked Data Modeling and Analysis of Global Fertilizer Trade
Keywords: Semantic Web, RDF, Cemento
Faculty Project Mentor: Erika Barcelos (Materials Science and Engineering)

Mellick, Benjamin — Poster #74
Project Title: Running a Mechanical Parameter Scan of a Hydrogel Two-Photon Polymerization Resin using Tensile Expansion Microscopy
Keywords: Tensile Expansion Microscopy, Two-Photon Polymerization, Microscale Tension Testing
Faculty Project Mentor: Lydia Kisley (Physics)

Minami, Owen — Poster #16
Project Title: Python-Controlled 4-Axis Beam Mapper for Microwave Detector Characterization
Keywords: Cosmic Microwave Background (CMB) Instrumentation, Detector Beam Mapping, Automated Instrument Testing
Faculty Project Mentor: John Ruhl (Physics)

Mishra, Yash — Poster #18
Project Title: Dysregulated Glyoxalase Pathway Metabolism in C9orf72 Knockout ALS Model Mice
Keywords: Methylglyoxal, C9orf72, Amyotrophic Lateral Sclerosis
Faculty Project Mentor: Vincent Monnier (Pathology)

Misra, Nikhil J. — Poster #33
Project Title: Evaluation and Validation of a Customizable Corset for Lower Limb Exoskeletons
Keywords: Rehabilitations, Wearable Robotics, Spinal Cord Injuries
Faculty Project Mentor: Sandra Hnat (Biomedical Engineering)

Modi, Kangana — Poster #73
Project Title: Effect of Choline as a Broad Neuroprotectant in Neonatal Cerebellar Development
Keywords: Choline, Hyperbilirubinemia, Neuroprotectant
Faculty Project Mentor: Cynthia Bearer (Medicine)

Moradia, Tej — Poster #36
Project Title: A Domed-Valley Kresling Origami Pattern for Deployable Spacecraft Booms
Keywords: Deployable, Bistability, Curved Origami
Faculty Project Mentor: Changyong Cao (Mechanical and Aerospace Engineering)

Mula, Rudra Sai — Poster #49
Project Title: Comparative Fascicular Microanatomy of the Posterior Tibial Nerve in Pig and Human Cadavers: Implications for PTNS Electrode Design
Keywords: Peripheral Nerve Stimulation, Tibial Nerve, Fascicular Anatomy
Faculty Project Mentor: Andrew Shoffstall (Biomedical Engineering)

Myneni, Vanshika — Poster #42
Project Title: Assessing Cross-Sensor Reliability for Geospatial Analysis
Keywords: Satellite, Vegetation Index, Resolution
Faculty Project Mentor: Olatunde Akanbi (Materials Science and Engineering)

Nawaz, Abdul — Poster #86
Project Title: Cobalt Substitution of Murine BCO2 for Structural Trapping of Zeaxanthin
Keywords: Carotenoid metabolism, Metal substitution, Substrate trapping
Faculty Project Mentor: Johannes von Lintig (Pharmacology)

Nguyen, Kaylee — Poster #55
Project Title: Evaluating Multi-Strain Enrichment for Bacteriophage Isolation from Gardnerella and Prevotella
Keywords: vaginal microbiome, bacterial vaginosis, phage isolation
Faculty Project Mentor: Gina Lewin (Center for Global Health and Diseases)

Panchal, Misha — Poster #96
Project Title: Characterizing the il11b-stat3 Signaling Axis in the Zebrafish Retina After Acute Injury
Keywords: Regenerative models, retina, zebrafish
Faculty Project Mentor: Gregory Konar (Ophthalmology)

Parker, Michael — Poster #56
Project Title: Data Curation for Molecular Discovery and Property Prediction
Keywords: Energetic materials, Graph Neural Networks, electron-withdrawing groups
Faculty Project Mentor: Quynh Tran (Materials Science and Engineering)

Patel, Aaryan — Poster #7
Project Title: Synthesis of Lipoic Acid Conjugates for Complex Polymer Architectures
Keywords: Lipoic Acid Conjugates, Hyperbranched Polymer, Thermal Characterization
Faculty Project Mentor: Metin Karayilan (Chemistry)

Pillane, Tayseera — Poster #10
Project Title: Effects of Substrate Preparation on Ink Adhesion of Aerosol Jet Printed Circuits
Keywords: Aerosol jet printing, Adhesion, Surface roughness
Faculty Project Mentor: Janet Gbur (Materials Science and Engineering)

Proweller, Talia — Poster #101
Project Title: Measuring Acetylated Tau Plasma Levels in Collegiate Athletes after Mild Traumatic Brain Injury
Keywords: TBI, acetylated tau, biomarkers
Faculty Project Mentor: Zea Bud (Psychiatry)

Rabara, Viveka — Poster #31
Project Title: Delivery of Spermidine to the Brain Using Nanoparticles Enhances Phagocytosis of Microglia and Reduces Traumatic Brain Injury Symptoms
Keywords: Immune Response, Metabolism, Traumatic Brain Injury
Faculty Project Mentor: Abhinav Acharya (Biomedical Engineering)

Rak, Alex — Poster #90
Project Title: Understanding Diffusion Through Cellulose Nanocomposite Materials Toward Neural Probe-Based Drug Delivery Applications
Keywords: Microfluidics, Neural, Nanocomposite
Faculty Project Mentor: Melinda Lake-Speers (Mechanical and Aerospace Engineering)

Ramakrishnan, Tejashree — Poster #10
Project Title: Effects of Substrate Preparation on Ink Adhesion of Aerosol Jet Printed Circuits
Keywords: Aerosol jet printing, Adhesion, Surface roughness

Faculty Project Mentor: Janet Gbur (Materials Science and Engineering)

Rezvani, Parsa — Poster #102
Project Title: Wild-type IDH1 Inhibition Induces BRCAness In Pancreatic Cancer
Keywords: Pancreatic ductal adenocarcinoma (PDAC), BRCAness, Wild-type IDH1
Faculty Project Mentor: Mehrdad Zarei (Surgery)

Rodman, Thomas — Poster #98
Project Title: Characterization of Microglia in QPRT Knockout and Overexpression Mice Models
Keywords: Microglia, Metabolism, QPRT
Faculty Project Mentor: Chinyere Iweka (Pharmacology)

Rodríguez-Quiles, Rania — Poster #72
Project Title: HIV Tat Site-specific Mutations Reveal Mechanisms of 7SK snRNP Remodeling and Viral Transactivation
Keywords: Human Immunodeficiency Virus Tat, P-TEFb, Latency reversal
Faculty Project Mentor: Uri Mbonye (Molecular Biology and Microbiology)

Rubanenko, Gabriel — Poster #79
Project Title: Immunofluorescence Analysis of Zbtb16 Expression in the Mouse Brain Following Mild Traumatic Brain Injury
Keywords: TBI, Immunofluorescence, Zbtb16
Faculty Project Mentor: Andrew Pieper (Psychiatry)

Rudolph, Yusef — Poster #64
Project Title: Verification of Chemical Data for Energetic Materials in a Reference Database
Keywords: Verification, Energetic Material, Chemical Data
Faculty Project Mentor: Quynh Tran (Materials Science and Engineering)

Sah, Siddharth — Poster #70
Project Title: Clustering of Counter-Rotating Particles in Dense Suspensions During Discontinuous Shear Thickening and Jamming
Keywords: DST, Jamming, Clustering
Faculty Project Mentor: Abhinendra Singh (Macromolecular Science and Engineering)

Schellhouse, Alyssa — Poster #62
Project Title: Automated Detection of Stair Negotiation Errors Using Machine Learning-Based Video Analysis
Keywords: Machine Learning, Gait Analysis, Rehabilitation
Faculty Project Mentor: Hamid Charkhkar (Biomedical Engineering)

Schiek, Julia — Poster #31
Project Title: Delivery of Spermidine to the Brain Using Nanoparticles Enhances Phagocytosis of Microglia and Reduces Traumatic Brain Injury Symptoms
Keywords: Immune Response, Metabolism, Traumatic Brain Injury
Faculty Project Mentor: Abhinav Acharya (Biomedical Engineering)

Schneidler, Austin — Poster #65
Project Title: Designing an Intelligent Power Module for Control of Micromotor used in Brain Targeted Low-Flow Rate Drug Delivery
Keywords: Bioelectronics, Embedded Systems, Hardware Miniaturization
Faculty Project Mentor: Allison Hess-Dunning (Electrical, Computer and Systems Engineering)

Sherlock, Abbott — Poster #37
Project Title: Validation of a Predictive Gene Signature for Collateral Drug Responses in Osteosarcoma
Keywords: Osteosarcoma, Collateral Drug Response, Gene Signatures
Faculty Project Mentor: Zachary Burke (Translational Hematology and Oncology)

Shulman, Josiah — Poster #103
Project Title: Investigating the Reproductive Timelines of Beluga Whales
Keywords: ovulation, menopause, micro-CT
Faculty Project Mentor: Lisa Cooper (Biology)

Sidhu, Amrinpreet — Poster #93
Project Title: Metabolic Licensing of HIV Latency Reversal in Primary Memory CD4+ T Cells
Keywords: mTORC1 Signaling, HIV Latency, Lysosomal Trafficking
Faculty Project Mentor: Uri Mbonye (Molecular Biology and Microbiology)

Tadese, Abdul Baasit — Poster #66
Project Title: Validation and Standardization of JSON Datasets for Energetic Compounds Using the Energetic Materials Encyclopedia
Keywords: Energetic Compounds, Chemical structures, Functional groups
Faculty Project Mentor: Quynh D. Tran (Materials Science and Engineering)

Takizawa, Koki — Poster #41
Project Title: Developing H2S Detection and NMR Methods for Evaluating Enzyme-Mimicking Nanocatalysts
Keywords: Nanocatalysts, Enzyme Mimicry, Healthspan Extension
Faculty Project Mentor: Vijay Krishna (Biomedical Engineering)

Tang, Maya — Poster #83
Project Title: Ethanol Selection for Gut Microbes Containing 7Î±-HSDH and 7Î²-HSDH as a

Potential Mechanism for Attenuated Cholestatic Liver Injury in the Humanized Bile Acid Cyp2c70-/- Mouse Model
Keywords: Bile Acids, Cholestatic Liver Disease, Ethanol
Faculty Project Mentor: J. Mark Brown (Molecular Medicine)

Thirumalai, Vaibhav — Poster #24
Project Title: Metabolic Induction of Tumor Acidosis to Enhance PARP Inhibitor and Chemotherapy Efficacy
Keywords: PARPi, CAIX, Hypoxia
Faculty Project Mentor: Boaz Tirosh (Biochemistry)

Tirado-Alicea, Julianys — Poster #85
Project Title: A transcriptomic approach to identify potential mechanisms driving psychiatric comorbidity in virologically suppressed people living with HIV.
Keywords: HIV, Mood Disorders, Transcriptomic Signatures
Faculty Project Mentor: Cheryl Cameron (Nutrition)

Torres, Paulina Rullán — Poster #69
Project Title: *Lactobacillus iners* Microbe-Microbe Interactions and Inter-Strain Variation May Play a Role in HIV Susceptibility
Keywords: Vaginal Microbiome, Human Immunodeficiency Virus, Microbe-Microbe Interactions
Faculty Project Mentor: Gina Lewin (Center for Global Health and Diseases)

Trehan, Keirstin — Poster #39
Project Title: Automating Calibration of Sensorized Wheelchair Footplates for Lower-Extremity Displacement Detection
Keywords: Calibration, Sensors, Wheelchairs
Faculty Project Mentor: Steve Majerus (Electrical, Computer and Systems Engineering)

Wang, Sophia — Poster #19
Project Title: Predicting IVF Implantation Success Using Transfer Learning Across Vaginal Microbiome Datasets
Keywords: IVF, Transfer Learning, Vaginal Microbiome
Faculty Project Mentor: Douglas Brubaker (Pathology)

Wong, Ava Mei — Poster #38
Project Title: Impact of Modified Curriculum on Research Participation among RDN Alumni of the Combined Dietetic Internship/Master's Degree Program
Keywords: Research, Registered dietitian nutritionist, combined dietetic masters program
Faculty Project Mentor: Rosa Hand (Nutrition)

Worley, Armiyah — Poster #45
Project Title: Improving Direct Ink Writing Formulations with Knowledge Graphs
Keywords: Exploratory Data Analysis, Direct ink writing, knowledge graph
Faculty Project Mentor: Jube Augustino (Materials Science and Engineering)

Xu, Cindy — Poster #9
Project Title: Designing Optimal Preconditioning for in vitro Cardiovascular Pacing Lead Testing
Keywords: lead extraction, oxidative degradation, microscopy
Faculty Project Mentor: Janet Gbur (Materials Science and Engineering)

Xu, Jiani — Poster #60
Project Title: Ontology Framework for Standardizing X-ray Diffraction Metadata
Keywords: Ontology, X-ray, Synchrotron
Faculty Project Mentor: Jonah Bachman (Materials Science and Engineering)

Poster #1

The Digital Divide and Lung Transplant Access: Neighborhood Internet Access and Income Inequality Before and After the Composite Allocation Score

Alex Khouli, Health Equity and Policy; Rocio López, MS, MPH, Department of Surgery, University of Colorado Anschutz Medical Campus; Jesse D. Schold, PhD, MStat, MEd, Department of Surgery, University of Colorado Anschutz Medical Campus; Jacqueline W. Curtis, PhD, Department of Population and Quantitative Health Sciences, Case Western Reserve University; Wayne M. Tsuang, MD, PhD, Department of Pulmonary and Critical Care Medicine, Cleveland Clinic

Lung transplantation is a life-saving therapy for patients with end-stage lung disease, however, donor lungs still remain scarce. This means that allocation policy plays a critical role in who receives a transplant and when. In March of 2023, the Lung Allocation Score (LAS) was replaced with the Composite Allocation Score (CAS), a points-based framework meant to reduce the role of geography in transplant access. Whether this transition affected the influence of neighborhood-level socioeconomic conditions on waitlist outcomes remains unknown. This study evaluated whether household internet access and the Gini index of income inequality, measured at the ZIP-code level, were associated with time to lung transplantation or waitlist attrition (death or removal due to illness) before and after the implementation of CAS. We analyzed the Scientific Registry of Transplant Recipients data for 11,676 adults listed for lung-only transplantation between January 1, 2021 and November 29, 2024. This comprised of 6,176 candidates in the LAS-era and 5,500 candidates in the CAS-era. ZIP-code of residence was linked to the 2020 Agency for Healthcare Research and Quality Social Determinants of Health Database to obtain the percentage of households without internet access and the Gini index. Fine-Gray competing-risks regression models, adjusted for demographic and clinical covariates, estimated associations between each exposure and outcomes within each era. Residing in an area with a higher percentage of households without internet access was associated with a lower likelihood of transplant during the LAS era ($p<0.001$) but not during the CAS era ($p=0.97$). The Gini index showed no significant association with either outcome in either era. These findings suggest that the change in lung allocation policy from the LAS to the CAS may have reduced disparities in transplant access linked to local digital connectivity, which represents a potential equity benefit of the new allocation framework.

Faculty Project Mentor: Dr. Wayne M. Tsuang, Department of Pulmonary and Critical Care Medicine, Cleveland Clinic

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Poster #2

Effects of Pharmacological Chaperone Therapy Targeting the Retina on Retinitis Pigmentosa Physiopathology

Fatema Dinary, Nutritional Biochemistry and Metabolism; Dr. Beata Jastrzebska, Department of Pharmacology, School of Medicine, Case Western Reserve University

Retinitis Pigmentosa (RP) comprises a group of rare, blinding diseases that cause progressive vision loss and are currently untreatable. Patients first present with nyctalopia, which later develops into peripheral blind spots, tunnel vision, and ultimately leads to legal blindness in adulthood. Many forms of RP are caused by pathogenic variants in genes encoding proteins essential for photoreceptor function, including *RHO*, the gene encoding rhodopsin. These mutations often result in protein misfolding, endoplasmic reticulum retention, and subsequent photoreceptor degeneration. Previous studies from our laboratory identified a small-molecule non-retinoid pharmacological chaperone, JC4, that crosses the blood-retina barrier and promotes proper rhodopsin folding. Preliminary data suggest that this compound stabilizes rod opsins and improves the plasma membrane expression of 26/123 tested clinical RP variants *in vitro*. Importantly, JC4 demonstrates beneficial therapeutic effects in the mouse model of RP. A biological retinoid and an analog of the native ligand, 9-*cis*-retinal, promotes protein folding and maturation in rhodopsin but has limited therapeutic potential due to instability in light and toxicity at high concentrations. Given that JC4 has a K_D comparable to 9-*cis*-retinal and works to improve the internal protein structure network, it represents a promising therapeutic candidate for treating RP. To further investigate its mechanism of action, NIH3T3 cells expressing either wild-type rhodopsin or the RP-associated N78I rhodopsin variant were treated with JC4 or 9-*cis*-retinal. Following incubation, cells were harvested and rhodopsin expression was assessed via immunoblotting. Our initial results demonstrate that JC4 effectively rescues protein expression of rhodopsin comparable to 9-*cis*-retinal. Thus, the aim of this project is to determine whether non-retinoid pharmacochaperone JC4 can mimic the stabilizing effect of 9-*cis*-retinal in poorly characterized N78I rhodopsin variant.

Faculty Project Mentor: Dr. Beata Jastrzebska, Department of Pharmacology, School of Medicine, Case Western Reserve University

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Poster #3

Single Stranded DNA Production through Alkaline Denaturation for the Assembly of ABE-Encoded DNA Origami Nanostructures

Rhea Choksey, Chemistry and Chemical Biology; Kayla Neyra, Chemistry; Dr. Divita Mathur, Department of Chemistry, Case Western Reserve University.

DNA origami nanostructures are being increasingly used for gene delivery. These structures allow for a specific gene to be encoded, like an adenine base editor (ABE) gene that corrects point mutations in cellular genetic sequences. DNA origami nanostructures are created with a long, single-stranded DNA (ssDNA) called the scaffold strand and a set of complementary oligonucleotides called staple strands. The scaffold has a gene of interest encoded, and the staple strands are designed to induce the folding of the scaffold into a predetermined shape. Creating long, custom ssDNA scaffolds is challenging since many methods produce low yields. Polymerase Chain Reaction (PCR) is a method that amplifies a precursor double-stranded DNA (dsDNA). Yet methods to isolate a ssDNA from this dsDNA amplicon are lacking. Herein the goal is to determine how to separate the two strands of dsDNA to obtain the desired strand with the encoded gene of interest. We hypothesize that a strongly alkaline sodium hydroxide (NaOH) solution will allow separating the constituent strands within a dsDNA precursor and allow isolation of the target ssDNA scaffold strand. NaOH-driven denaturation occurs due to high concentrations of hydroxyl ions present, which deprotonate base pairs, thereby separating them. A biotinylated primer tags the non-target ssDNA during PCR, enabling pull-down via streptavidin-coated magnetic beads. Thus, after denaturation, the target ssDNA will remain in solution, while the other stays bound to the beads. While trying to determine the optimal NaOH concentration, we found that 10x Streptavidin beads to PCR products will effectively bind the DNA after shaking for 10 minutes. Hydrochloric acid (HCl) will also neutralize NaOH at equimolar concentrations for further analysis of ssDNA through gel electrophoresis. This scaffold will allow the formation of DNA origami nanostructures encoding the ABE gene will be delivered to cells to target point mutations in the future.

Faculty Project Mentor: Dr. Divita Mathur, Department of Chemistry, Case Western Reserve University

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Poster #4

Spatial ATAC-seq Analysis of PHLDA1-Related Changes in Chromatin Accessibility Identifies Zinc Finger Protein 637 as a Putative Node of Autophagy-Mediated Neuroprotection

Nicole Calabrese, Neuroscience; Dr. Andrew Pieper, Department of Psychiatry, Harrington Discovery Institute, University Hospitals.

Our lab has shown that pleckstrin-homology-like domain family A member 1 (PHLDA1), also known as T cell death–associated gene 51 (TDAG51), is a noncanonical mediator of autophagy, with increased expression in human brain tissue associated with aging, traumatic brain injury, Parkinson's disease, and Alzheimer's disease (AD). Autophagy is the process by which autophagosomes sequester and deliver pathologically aggregated proteins to lysosomes for degradation. This is essential for neuronal proteostasis and is markedly impaired in multiple neurodegenerative diseases associated with dementia. Dementia affects ~11% of adults over 65, and a central pathological feature across dementia-related disorders is the accumulation of misfolded proteins. Thus, restoring autophagic function represents a promising broad-spectrum neuroprotective strategy. We have demonstrated that PHLDA1 competitively binds to WDFY3 at the ATG5 interaction site, interrupting the clearance of aggregated proteins by impairing ATG5-mediated autophagy. Genetic elimination of *phlda1* in the 5xFAD AD mouse model of AD restores neuronal survival and cognition, but the epigenomic mechanisms underlying this neuroprotection remain unknown. To investigate how PHLDA1 deficiency may alter gene regulation in the brain, we performed spatial ATAC-seq on coronal brain sections from *phlda1*$^{+/+}$, *phlda1*$^{+/-}$, and *phlda1*$^{-/-}$ mice to assess chromatin accessibility across six major brain cell types. Loss of *phlda1* resulted in extensive cell-type-specific changes in chromatin accessibility, with microglia showing the most marked changes. Transcription factor binding site analysis identified zinc finger protein 637 (*zfp637*) as one of the most significantly altered motifs, with increased accessibility from wild type to heterozygous to knockout across all six cell types. *Zfp637* sites were predominantly located in intronic and distal intergenic regions and were enriched near calcium-signaling and autophagy-related genes. These findings suggest that *Zfp637* may be involved in regulatory changes related to calcium signaling and autophagy occurring as a result of PHLDA1 loss, providing a potential link to PHLDA1-mediated neuroprotection.

Faculty Project Mentor: Dr. Andrew Pieper, Department of Psychiatry, Harrington Discovery Institute, University Hospitals.

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Poster #5

The Effect of Heat Treatment and Surface Finish on Nitinol Fine Wire Fatigue

Melanie Drazdik, Notre Dame Cathedral Latin School; Dr. Janet L. Gbur, Dept. of Materials Science and Engineering, Case Western Reserve University

Nitinol is an alloy made up of nominally equal parts nickel and titanium. It is recognized for its unique properties such as shape memory and superelasticity, which make Nitinol valued for applications, such as orthodontics, heart stents, and actuators. Despite the widespread use of Nitinol, the effects of surface finish and manufacturing processes on its fatigue life are not yet fully understood and remain an important factor for future applications. This study investigates how surface condition and processing methods affect the fatigue behavior of Nitinol wire. Various finishes of Nitinol, including black oxide, light oxide, and etched were evaluated. The wires were also manufactured using either cold-drawn or straight annealed processing methods. Optical microscopy and profilometry were conducted to analyze wire surface features and surface roughness in the region of interest before and after testing. Fully reversed flex bending fatigue was performed using six different mandrel diameters (1.20 mm, 4.73 mm, 7.96 mm, 12.71 mm, 15.91 mm, and 19.11 mm), while maintaining a constant rate of 1 Hz. Three replicates of each sample were tested and the number of cycles to failure for each specimen was recorded and plotted to illustrate fatigue performance. The effects of heat treatment and surface finish on the respective fatigue behavior are reported in addition to wire fractography. Findings of this study will improve the understanding of the relationship between surface finish and fatigue resistance in Nitinol wires to provide guidance for future applications.

Faculty Project Mentor: Dr. Janet L. Gbur, Dept. of Materials Science and Engineering, Case Western Reserve University

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Poster #6

Determining the Impact of Different Surgical Tools on Bending Pediatric Spinal Rods

Janiyah Jackson, Cleveland School of Science and Medicine, John Hay High School; Eesha Reddy, Materials Science and Engineering; Priya Lakshmi Jayakumar, Pediatric Orthopedics, University Hospitals; Anna Henry, OrthoPediatrics; Michael Glotzbecker, Pediatric Orthopedics, University Hospitals; Christina Hardesty, Pediatric Orthopedics, University Hospitals; and Janet L. Gbur, Dept. of Materials Science and Engineering, Case Western Reserve University.

Spinal deformities are an abnormal curvature and/or rotation of the spine with scoliosis, the most common representing 80% of pediatric patients. Although mild scoliosis can be treated with bracing, patients with more severe curvature may require surgery to improve their health. This surgery also carries a high risk of complications. In some treatments, a spinal rod may be implanted to stabilize the spine and provide support, but before they are implanted, the rods must be bent with surgical tools. These tools may leave scratches or indents on the spinal rods. Marks made by these tools may initiate fatigue cracks and lead to premature failure. Characterizing the marks helps show how rod bending during surgery may affect the durability and long-term performance of spinal implants used in scoliosis treatment. For this work, ASTM F136 Titanium-6Aluminun–4Vanadium ELI rods (5.5 mm, 6.0 mm diameter) and ASTM F1537 Cobalt–28Chromium–6Molybdenum rods (4.5 mm, 5.5 mm, 6.0 mm diameter) were bent by two surgeons using a French bender, tabletop bender, or in situ bender. Each bent rod was visually examined looking for surface marks. Optical microscopy was used to image any scratches, indents, or other surface defects. All defects were counted, measured, and compared between the two materials, the three surgical tools, and the two surgeons. Future work will include fatigue testing the bent rods. This study will help show how different surgical tools affect rod bending and may affect the durability and long-term performance of spinal implants used in scoliosis treatment.

Faculty Project Mentor: Dr. Janet L. Gbur, Dept. of Materials Science and Engineering, Case Western Reserve University

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Poster #7

Synthesis of Lipoic Acid Conjugates for Complex Polymer Architectures

Aaryan Patel, Chemical Biology; Bablu Hasan, Dept. of Chemistry, Case Western Reserve University; Dr. Metin Karayilan, Dept. of Chemistry, Case Western Reserve University

Branched polymer architectures provide a powerful platform for enabling unique material properties and diverse applications, particularly in the specialty chemicals sector. Consequently, the development of synthetic strategies for controlling polymer architecture has become an important goal. In this work, we report the synthesis and purification of a novel lipoic acid–photoinitiator conjugate (PI-LA), prepared by coupling lipoic acid, a naturally occurring organosulfur compound, with the commercial photoinitiator Irgacure 2959. This conjugate serves as a branching monomer that generates reactive radicals under thermal and photochemical conditions.

PI-LA was copolymerized with vinyl comonomers, n-butyl acrylate (nBA) and methyl methacrylate (MMA), using thermal and photochemical approaches to form branched prepolymers and investigate polymerization mechanisms. In the first approach, thermal polymerization was used to prepare PI-LA-containing prepolymers, which were characterized by 1H nuclear magnetic resonance (NMR) spectroscopy and size exclusion chromatography (SEC) to confirm polymerization and determine molecular weight and dispersity. Thermogravimetric analysis (TGA) and differential scanning calorimetry (DSC) were used to evaluate thermal stability and glass transition behavior. The resulting prepolymers were then subjected to a second photopolymerization step, with successful post-polymerization confirmed by increases in average molecular weight and changes in thermal properties. In a complementary approach, the reaction sequence was reversed by initiating the first polymerization photochemically followed by thermal polymerization, enabling comparison of architecture development as a function of polymerization order.

This work demonstrates a versatile two-step polymerization strategy using a lipoic acid–photoinitiator conjugate as a branching monomer to access branched polymer systems with tunable architectural features. Because polymerization of lipoic acid introduces disulfide linkages that are susceptible to thiol–disulfide exchange and reductive degradation, we will further investigate the degradation behavior of these branched polymers under reductive environments relevant to cancer cells using glutathione. These studies will provide insight into branch-by-branch versus stochastic degradation pathways, highlighting the potential of PI-LA-based branched polymers for drug delivery.

Faculty Project Mentor: Dr. Metin Karayilan, Dept. of Chemistry, Case Western Reserve University

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Poster #8

From Cells to Skull: Cadherin-Mediated Cell-Cell Adhesion Regulates Apical Expansion of Mesenchymal Osteogenic Stem Cells During Frontal Bone Development

Grace Jung, Biology; Deepa Chitre, Biology; Dr. Radhika Atit, Department of Biology, Case Western Reserve University

During development, migration of the osteogenic progenitors rapidly drives the apical expansion of the frontal bone to form the skull roof, or the calvaria, which encloses the brain. In other contexts, collective cell migration coincides with the expression of N-cadherin, a cell-cell adhesion protein. Previous work in the Atit lab has shown that N-cadherin protein expression is highly enriched in frontal bone primordia as it rapidly expands in the mouse embryo. Whether N-cadherin is specifically required for apical expansion of the calvaria remains unknown. I hypothesize that N-cadherin is required for collective cell migration of the calvarial osteogenic progenitors for the efficient apical expansion of the frontal bone primordia. By using inducible genetic tools, I have deleted N-cadherin in embryonic mouse cranial mesenchyme that contain calvarial osteoblast progenitors before apical expansion of the frontal bone primordia. We anticipate that conditional N-cadherin mutants will have efficient deletion of N-cadherin in the cranial mesenchyme. Preliminary data show that compared to the control, the mutants qualitatively have shortened and widened shape of the frontal bone primordia that was visualized by alkaline phosphatase (ALP) staining. Ongoing studies will quantify the defects and validate the deletion of N-cadherin. If the mutants provide functional evidence that N-cadherin contributes to efficient apical expansion of the frontal bone primordia at the tissue level *in vivo*, next studies will need to test that N-cadherin is required for collective cell migration of calvarial osteoblasts at the cellular level *in vitro*. Thus, these studies will demonstrate N-cadherin-mediated cell-cell adhesion regulates collective cell migration of calvarial osteoblasts to promote apical expansion of skull bones. These findings provide new insight underlying skull defects, and inform therapeutic strategies to repair and regenerate skull bones. Faculty Project Mentor: Dr. Radhika Atit, Department of Biology, Case Western Reserve University (CWRU)

Funding was provided by Sponsored Summer Research Programs (SSRP), CWRU Undergraduate Research Office (GJ). This work was supported by National Institutes of Health/National Institute of Dental and Craniofacial Research (R01 DE032670 R.P.A)

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Poster #9

Designing Optimal Preconditioning for in vitro Cardiovascular Pacing Lead Testing

Cindy Xu, Biomedical Engineering and Materials Science and Engineering; Tauheed Ahmed, Biomedical Engineering; Chase Kulsakdinun, Mechanical Engineering; Justin Zimmerman, Materials Science and Engineering; Janet L. Gbur, Dept. of Materials Science and Engineering, Case Western Reserve University

The prevalence of cardiac implantable electronic devices is rising, with over 1.2 million implants occurring annually. While these devices provide life-altering therapy, the transvenous leads may require removal due to device upgrades, malfunction, and infection. When leads fail, they must be removed via transvenous lead extraction, which is a high-risk procedure since lead fracture can cause catastrophic vascular injuries. Over time, the outer jacket of the leads may degrade, which plays a key role in how leads behave during extraction. By preconditioning the leads using simulated oxidative stress, one can better model the degradation that occurs inside the body, allowing for better mechanical testing of lead extraction methods.
This time-series study aimed to quantify the rate of degradation of the outer jacket under accelerated oxidative stress, simulating years of biological exposure over 30 days. This project isolated seven different lead jacket materials, including polyurethanes and silicones. Two specimens of each jacket material were tested. One sample was soaked in a Fenton reagent of 0.1M $CoCl_2$ in 20% H_2O_2 to cause oxidative degradation, simulating active immune foreign body responses. The other sample was soaked in a phosphate-buffered saline solution to cause hydrolytic degradation, replicating a passive chemical response. All samples were held at 37°C. Every 3-4 days, 2 cm sections of the lead jacket were removed for analysis, and the solutions were replaced to maintain effectiveness. The outer jackets were characterized before and after soak. This included laser profilometry to analyze surface roughness and optical microscopy to image failure points. The aim is to identify at what stage in soaking the degradation of the lead jacket most closely matches an explanted lead, which will allow for a standardized preconditioning process to inform more realistic mechanical testing procedures.

Faculty Project Mentor: Janet L. Gbur, Dept. of Materials Science and Engineering, Case Western Reserve University

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Poster #10

Effects of Substrate Preparation on Ink Adhesion of Aerosol Jet Printed Circuits

Tayseera Pillane, Mechanical Engineering; Cindy Xu, Biomedical Engineering and Materials Science and Engineering; **Tejashree Ramakrishnan**, Strongsville High School; Aidan D. Selkirk, Mechanical Engineering; Janet L. Gbur,Dept. of Materials Science and Engineering, Case Western Reserve University

Despite resolving the key limitations of traditional lithography, aerosol jet printing (AJP) is yet to advance to industry scale operations, thus requiring further research. Aerosol jet printing is an additive manufacturing technique that deposits aerosolized conductive inks onto non-planar surfaces to fabricate electronic devices intended for flexible, conductive applications. This work investigates the influence of Kapton surface roughness on the quality of AJP printed circuits using a silver particle-free ink. Substrates were prepared using 800 and 1200 sandpaper grit sizes to increase surface area. To accompany the sanding process, three different cleaning procedures were used including combinations of soapy water, isopropyl alcohol, and acetone, with sonication. Surface topography was characterized using profilometry to quantify roughness and evaluate the effects of substrate preparation. Circuits were printed and imaged using optical microscopy. To further evaluate ink adhesion, tape tests were conducted using adhesive tape applied to and removed from a 5 × 5 crosshatch pattern mimicking ASTM F2252 and ASTM D3359 standards. The remnants were analyzed using ImageJ to quantify ink and substrate separation.

Mechanical reliability was assessed through static bend testing, in which strain gauges were printed on varying substrate surface roughnesses. Then, specimens were bent over 10 mm, 5.25 mm, and 1.92 mm diameter rods. Electrical resistance of each specimen was measured before and after bending with the use of a four-point probe method. Changes in electrical resistance were used to evaluate the ability of the printed features to maintain functionality under applied strain. Increased surface roughness is expected to improve ink adhesion by increasing the available surface area, thereby improving mechanical adhesion. Understanding the relationship between substrate surface roughness and printed feature quality is essential for improving the reproducibility and performance of AJP-fabricated sensors. The findings of this study will aid in improving the reliability of AJP printed electronics.

Faculty Project Mentor: Janet L. Gbur; Dept. of Materials Science and Engineering, Case Western Reserve University

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Poster #11

Characterizing the Binding Interface of NAD+-bound 15-PGDH-SW209415 Complex Using Novel Multiplex CF3/OH Radical Footprinting

Adam Esa, Nutritional Biochemistry and Metabolism; Dr. Rohit Jain, Department of Nutrition; Dr. Janna Kiselar, Department of Nutrition, Case Western Reserve University

15-hydroxyprostaglandin dehydrogenase (15-PGDH) is an enzyme that regulates prostaglandin E_2(PGE_2). SW209415 is a small-molecule inhibitor of 15-PGDH that increases PGE_2 levels by limiting its degradation, supporting its potential therapeutic relevance in conditions such as sarcopenia and pulmonary fibrosis. Previous studies indicate that SW209415 binds within the active-site region of NADH-bound 15-PGDH, promoting closure of the α10–α12 lid domain and stabilization of the dimer interface. However, the NADH-bound 15-PGDH-SW209415 complex exhibits greater thermal stability than the corresponding NAD^+-bound complex, suggesting that cofactor identity may alter active-site residue positioning, lid-domain dynamics, or inhibitor interactions with key binding-site residues. This study aims to characterize the binding interface between SW209415 and NAD^+-bound 15-PGDH using novel multiplex CF_3/OH labeling chemistry and reverse-phase liquid chromatography coupled with tandem mass spectrometry (LC-MS/MS). Preliminary data indicate that SW209415 interacts with a similar set of residues in NADH-bound 15-PGDH and NAD^+-bound 15-PGDH. However, key residues involved in inhibitor binding, such as F185, exhibit weaker drug-associated protection in NAD^+-bound complex than in the NADH-bound complex. These findings suggest that SW209415 interacts less strongly with the active-site region of NAD^+-bound 15-PGDH than with that of NADH-bound 15-PGDH. In addition, footprinting analysis of the NAD^+-bound 15-PGDH-SW209415 complex shows no drug-associated increase in protection at the dimer-interface residues Y116 and W100. Thus, the NAD^+-bound complex does not exhibit the same increase in dimer-interface interaction upon inhibitor binding as observed in the NADH-bound complex. Overall, weaker interactions at the dimer interface and key active-site residues in the presence of NAD^+ may contribute to the lower thermal stability of the NAD^+-bound 15-PGDH-SW209415 complex relative to the NADH-bound 15-PGDH-SW209415 complex.

Faculty Project Mentor: Dr. Janna Kiselar, Department of Nutrition, Case Western School of Medicine

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Poster #12

The Role of Microbial Intraspecies Diversity in Vaginal Health

Rithu Girish, Biology; Anya Wojtowiak, Department of Molecular Biology and Microbiology; Dr. Gina Lewin, PhD, Department of Pathology, Center for Global Health and Diseases, School of Medicine, Case Western Reserve University

Bacterial vaginosis (BV) is the most common vaginal disorder, affecting 30% of reproductive-age women with a 50% recurrence rate post-treatment. BV is characterized by a shift from an optimal *Lactobacillus*-dominated (LD) vaginal microbial community to a polymicrobial, non-*Lactobacillus*-dominated (nLD) community. Disturbances such as antibiotic exposure may cause an LD vaginal microbiome to become unstable and shift toward nLD. Literature shows that an individual's *Lactobacillus* population is diverse, but the impact of this within-host bacterial genetic variation remains largely unexplored. Here, we propose that greater *L. crispatus* intraspecies diversity in antimicrobial resistance profiles enhances population-level resistance, thereby promoting vaginal microbiome stability. We are testing this hypothesis by comparing the phenotypic diversity of 15 unique *L. crispatus* strains isolated from a single LD individual and 12 publicly available strains isolated across different individuals. To characterize variation among strains, single-strain growth curves and minimum inhibitory concentration assays with ampicillin and clindamycin were performed. Preliminary results show that strains exhibit different lag times under identical, undisturbed growth conditions. Additionally, clindamycin resistance varied up to 4-fold across strains. These differences suggest that genetically distinct strains may respond differently to environmental disturbances, potentially influencing overall community stability. To evaluate whether phenotypic diversity contributes to the stability of the vaginal microbiome, we are constructing mixed-strain mock communities by combining genetically distinct *L. crispatus* strains with varying clindamycin resistance phenotypes. Ongoing experiments are comparing the fitness of two-strain mock communities exposed to clindamycin, and next steps will extend these analyses to multi-strain communities. Semiquantitative PCR will be used to track individual strain abundance after antibiotic exposure to clarify the mechanisms by which intraspecies diversity influences population-level antibiotic resistance. These experiments will determine if intraspecies diversity promotes community stability. Understanding how intraspecies diversity shapes vaginal microbiome stability may inform strategies to improve microbiome-based interventions for BV.

Faculty Project Mentor: Dr. Gina Lewin, PhD, Department of Pathology, Center for Global Health and Diseases, School of Medicine, Case Western Reserve University

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Poster #13

Determining the Mechanical Properties of Mycelium-Based Biocomposites

Nate Armstrong, Hawken Upper School; Jordan Beer, Supply Chain Management; Chris Maurer, redhouse studio; Dr. Janet L. Gbur, Dept. of Materials Science and Engineering, Case Western Reserve University

The fashion industry is the 7th largest producer of material waste in the United States, and over 92 million tons are produced globally each year. Compared to other waste producing industries, such as plastics, paper, and food, textiles lack established recycling methods. One approach, using cellulose re-spinning is limited by its need for uniform, clean materials. As a result, only 20% of textile waste is recycled. This project used fungal-based bioremediation technology to transform textile waste into sustainable building materials. Donated T-shirts were cut into small segments, ground into fibers, and used as the primary substrate for mycelium growth. The mycelium breaks down and binds the fibers together. After the growth cycle, the materials were pressed and thermally cured to create individual blocks. The blocks were evaluated for moisture content using ASTM D4442 and density and specific gravity according to ASTM D2395. Specimens were analyzed under a digital optical microscope, and defects were identified that could alter mechanical properties. Then, blocks were evaluated under axial compression to understand the materials strain hardening and densification under load. After testing, specimens were measured and characterized with optical microscopy. Findings from this study are a first step towards developing biocomposites as construction materials and establishing an effective method for utilizing textile waste.

Faculty Project Mentor: Dr. Janet L. Gbur, Dept. of Materials Science and Engineering, Case Western Reserve University

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Poster #14

Establishing a Primary Rat Astrocyte Platform for Investigating the Molecular Pathology of Alexander Disease

Kayleigh Bauer[1], Biomedical Engineering; Benjamin Clayton[1]

[1]Department of Genetics and Genome Sciences, Case Western Reserve University School of Medicine, Cleveland, OH

Alexander Disease (AxD) is a rare pediatric leukodystrophy involving the breakdown of central nervous system (CNS) myelin accompanied with progressive cognitive decline, motor deficits, and seizures, typically in early infancy. AxD pathology originates in astrocytes, a glial cell type involved in maintaining CNS homeostasis. Specifically, the disease is caused by mutations in the gene encoding glial fibrillary acidic protein (*GFAP*), which is an astrocyte-specific intermediate filament protein. *GFAP* mutations in AxD uniquely lead to the formation of mutant GFAP clusters, termed Rosenthal fibers (RFs).
Current research suggests that *GFAP* mutations drive the myelination defects found in AxD, but it remains unclear how astrocyte pathology disrupts oligodendrocytes, the myelinating cells of the CNS.
There exists a need for an *in vitro* platform to study pathological astrocytes found in AxD. The R237H rat model, modeling the orthologous R239H *GFAP* mutation found in early-onset human AxD, demonstrates white matter, motor, and cognitive deficits similar to those seen in humans. This project utilizes the R237H rat model to establish the first primary astrocyte platform for AxD. To achieve this, I have demonstrated the feasibility of isolating primary astrocytes from R237H rat pups. Ongoing work focuses on validating the cultures by confirming Rosenthal fiber (RF) formation and astrocyte marker expression, while optimizing the isolation protocol to improve cell yield and proliferative capacity.
Afterwards, this model will be used to explore the relationship between pathological astrocytes and oligodendrocytes in AxD, which will offer valuable insight into the disease mechanism and potential therapeutic targets.

Project Mentor: Benjamin Clayton, PhD, Department of Genetics and Genome Sciences, Case Western Reserve University School of Medicine

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Poster #15

DEMON: Dynamic Exploration of Molecular Simulations Through Optimized Navigation

Oliver Johnson, Physics; Arnav Brahmasandra, Dept. of Chemical Engineering, University of California, Berkeley; Sulekha Kosliya Muhammed, Dept. of Chemistry, Case Western Reserve University; Dr. Yihang Wang, Dept. of Chemistry, Case Western Reserve University

Biomolecular processes such as protein conformational changes generally occur on timescales inaccessible to conventional molecular dynamics simulation because transitions across high free-energy barriers are exceedingly rare. Enhanced sampling methods can accelerate these simulations, but many require predefined collective variables, system-specific progress coordinates, or other engineered features. We develop DEMON (Dynamic Exploration of Molecular Simulations through Optimized Navigation), a reinforcement learning framework that learns to allocate simulation effort across an ensemble of molecular trajectories by selecting replicas to clone while other replicas are pruned. Molecular representations are learned directly from atomic trajectory data, enabling the agent to generalize across chemically distinct systems without hand-crafted features or reaction coordinates. On synthetic energy landscapes varying in dimension and barrier structure, a discrete soft actor-critic agent achieves consistently stronger exploration performance than random replica selection. Furthermore, DEMON demonstrates zero-shot generalization by achieving comparable reward performance on both in- and out-of-distribution landscapes during evaluation. Current work extends this proof of concept to atomistic simulations of small peptide biomolecules, validating DEMON's ability to accelerate exploration in real molecular systems.

Faculty Project Mentor: Dr. Yihang Wang, Dept. of Chemistry, Case Western Reserve University

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Poster #16

Python-Controlled 4-Axis Beam Mapper for Microwave Detector Characterization

Owen Minami, Physics and Electrical Engineering

The cosmic microwave background (CMB) is the faint, leftover thermal radiation emitted early in the universe's history. It carries an enormous amount of information about the events that took place shortly after the Big Bang, as well as the age of the universe, the concentration of dark matter and dark energy, and the rate at which the universe is expanding. Studying the CMB requires sensitive instruments with detectors capable of measuring microwave radiation. Before these detectors are deployed on telescopes for CMB observations, it is critical that they undergo extensive testing to ensure they function as intended. One such test involves mapping the response of the detectors over the range of angles at which light will hit them. In order to obtain precise and efficient measurements at these angles, a 4-axis, Python-controlled beam mapping system was developed to enable automated pointing of a microwave-emitting thermal source to a detector array. The system consists of a thermal source pointed by an altitude-azimuth stage, which sits on an x-y stage, controlled such that the thermal source is always pointing at the same point on the detector array as both stages move. This allows the measurement of the detector response as a function of incidence angle. Design of the beam mapping system started with defining the goals of the system, then moved to computer-aided design, component validation, assembly, and finally testing. The system successfully achieved its goal to accurately orient with sub-degree precision at a price point far lower than commercial products would have provided.

Faculty Project Mentors: John Ruhl, Department of Physics, Case Western Reserve University; Johanna Nagy, Department of Physics, Case Western Reserve University

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Poster #17

Evaluating the On-Target Off Tumor Effects of Bispecific Antibody Mediated Immunotherapy in Osteosarcoma

Emi Ellis, Biology; Masahiro Hitomi, Molecular Medicine, Case Western Reserve University; Timothy Cripe, Hematology/Oncology/Blood and Marrow Transplant, Nationwide Children's Hospital, Department of Pediatrics, The Ohio State University College of Medicine; Jacob Scott, Molecular Medicine, Case Western Reserve University; and Zachary Burke, Lerner College of Medicine

Osteosarcoma (OS) is an aggressive bone cancer with limited treatment options especially for relapse or refractory disease. Immunotargeting therapy is a promising avenue for second line treatment development. Bispecific antibodies (BsAb), which simultaneously engage T cells and surface tumor antigens on OS cells, are a potential approach to induce selective tumor killing. In any approach of tumor immunotargeting it is important to ensure normal cells are not the target of therapy. This study aims to quantify the BsAb mediated cytotoxic effect on non-tumor cells. Preliminary experiments demonstrate OS cells can be targeted and killed by human epidermal growth factor receptor 2 (HER2)/CD3 and/or disialoganglioside 2 (GD2)/CD3 BsAb mediated T cell activation. We also found FDA approved HER2 trafficking modulating drugs, can induce HER2 expression in some OS cell lines and enhance the cytotoxic effect of the BsAb. To test our hypothesis that normal, non-OS cells are protected from HER2/CD3 and GD2/CD3 BsAb mediated cytotoxicity due to insufficient surface antigen expression; we chose two human lung fibroblast cell lines as normal examples because unintended immunotargeting side effects are often due to damaging effects on the lung. Through quantitative analysis of immunofluorescence staining and flow cytometry, initial results demonstrate HER2 and GD2 surface expression is not induced by HER2 trafficking modulating drugs in normal human lung fibroblasts. The cell killing effect of co-culturing with T cells in the presence or absence of HER2/CD3 or GD2/CD3 BsAb will be tested and quantified with normal lung fibroblasts and compared to those from OS cells. Co-culturing OS cells that were well targeted in initial experiments and normal lung fibroblasts while differentially labeling with fluorescent dyes, will determine which cell types are targeted by the bispecific mediated killing. Results will highlight critical requirements toward safe OS immunotargeting therapies.

Faculty Project Mentor: Dr. Masahiro Hitomi, Dept. Molecular Medicine, Case Western Reserve University School of Medicine

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Poster #18

Dysregulated Glyoxalase Pathway Metabolism in C9orf72 Knockout ALS Model Mice

Yash Mishra, Biochemistry; Dr. Deepitha Nelson, Department of Pathology, Case Western Reserve University; Dr. Aaron Burberry, Department of Pathology, Case Western Reserve University; Dr. Vincent M. Monnier, Department of Pathology, Case Western Reserve University

C9orf72 hexanucleotide repeat expansions are the most common genetic cause of familial ALS and frontotemporal dementia (FTD). Prior work in the Monnier and Burberry Labs have correlated C9orf72 knockout with elevated advanced glycation end products (AGEs), products formed by the non-enzymatic reaction of reactive carbonyls with proteins and nucleic acids. Methylglyoxal (MGO), a toxic dicarbonyl byproduct of glycolysis, is the principal driver of AGE formation and a source of glycative and oxidative stress. Its detoxification proceeds through the glyoxalase pathway, producing D-lactate as the terminal product. Allen (2019) demonstrated downregulation of GLO1 and GLO2 in C9orf72 ALS patient-derived induced astrocytes and neurons, suggesting impaired MGO clearance in this disease. Gut microbiome composition has been established as a modulator of the neuroinflammatory phenotype in C9orf72-deficient mice. We hypothesize that C9orf72 deficiency drives genotype-dependent MGO accumulation via glyoxalase pathway dysregulation, and that gut microbiome composition further modulates this metabolic phenotype.
MGO concentrations were quantified by LC-MS/MS using an isotope dilution protocol (Thornalley, 2014) in liver, kidney, skeletal muscle, cardiac muscle, and plasma homogenates from wildtype (WT), heterozygous (HET), and knockout (KO) mice housed under germ-free (GF) or reconstituted microbiome (CWRU) conditions. A D-lactate assay (Megazyme K-DATE) is concurrently being validated across the same tissues to quantify glyoxalase pathway flux. MGO was elevated in kidney ($P<0.05$) and liver ($P<0.0001$) of KO mice relative to WT. In the liver, reconstitution with feces lowered MGO levels in WT but not KO mice (Liver: $p<0.001$) suggesting WT mice but not KO mice are able to induce glyoxalase activity. CWRU (Liver: $P<0.001$). Remaining tissue results and D-lactate validation are ongoing. The emergence of microbiome condition as a variable suggests a microbiome axis in ALS associated MGO accumulation. D-lactate quantification will clarify the extent of glyoxalase pathway dysregulation.

Faculty Project Mentor: Dr. Vincent M. Monnier, Department of Pathology, Department of Biochemistry, Case Western Reserve University

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Poster #19

Predicting IVF Implantation Success Using Transfer Learning Across Vaginal Microbiome Datasets

Sophia Wang, Biochemistry; Dr. Douglas Brubaker, Department of Pathology, Center for Global Health and Diseases, Case Western Reserve University School of Medicine

In vitro fertilization (IVF) is an infertility treatment where mature eggs are collected, fertilized with sperm in a laboratory, and transferred back into a woman's uterus as an embryo. Most women fail the first cycle of IVF, so there is a need for a reliable way to predict IVF outcome. Due to this, we developed random forest models to predict IVF implantation success from combinations of clinical factors and vaginal microbe abundances. We then wanted to test whether transfer learning can improve prediction accuracy, so we applied ssGSEA to RNA expression data from a separate vaginal microbiome dataset (Partners PrEP) to generate pathway activity scores and correlated those scores with the microbe abundances of the same dataset. Those correlation scores were projected onto a VMFI patient cohort to obtain inferred Hallmark, KEGG Legacy, and KEGG Medicus pathway scores. We then tested whether these pathway scores, both alone and with combinations of clinical and microbe features, improved model performance over clinical and microbiome features alone. Models were evaluated across the full cohort and within specific fertility conditions. Mean AUC values across all models ranged from 0.46 to 0.76, and no model simultaneously achieved a sensitivity and specificity above 0.70. Slight AUC improvements within certain condition subgroups were observed, such as PCOS (Hallmark pathway + clinical features AUC = 0.734), control (KEGG Legacy full feature AUC = 0.719), and fallopian tube obstruction patients (KEGG Legacy pathway + clinical AUC = 0.758). However, these models had poor sensitivities despite their high specificities, limiting their overall predictive ability. Therefore, the transfer learning-derived pathway scores did not improve the prediction of IVF implantation success over clinical and vaginal microbiome features alone. Furthermore, combinations of clinical factors and vaginal microbiome composition, with or without pathway scores, did not yield models that can reliably predict IVF outcomes.

Faculty Project Mentor: Dr. Douglas Brubaker, Department of Pathology, Center for Global Health and Diseases, Case Western Reserve University School of Medicine

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Poster #20

BRCA2 Haploinsufficiency Alters the Periepithelial Collagen Microenvironment in Preneoplastic Breast Tissue

Aritra Bagchi, Biology; Resul Ozbilgic, Department of Cancer Sciences, Cleveland Clinic Research Institute; Murat Yildrim, Department of Neuroscience, Cleveland Clinic Research Institute; Mihriban Karaayvaz, Department of Cancer Sciences, Cleveland Clinic Research Institute

BRCA2 germline mutations increase the lifetime risk of hereditary breast cancer by up to 70%. While BRCA2 is best known for its role in DNA repair, our previous spatial transcriptomic analyses suggest that BRCA2 haploinsufficiency alters extracellular matrix (ECM) programs at the epithelial-stromal interface before malignant transformation. Because collagen is the principal structural component of the ECM and regulates tissue architecture, epithelial behavior, and mechanotransduction, we hypothesized that BRCA2 haploinsufficiency remodels the periepithelial collagen microenvironment in preneoplastic breast tissue. To test this hypothesis, we analyzed age-matched preneoplastic breast tissues from BRCA2 mutation carriers and wild-type (WT) controls using Masson's Trichrome staining and Collagen I and III immunohistochemistry within a multimodal computational pathology framework. Spatial analyses quantified collagen architecture and composition as a function of epithelial distance in both ductal and lobular compartments. Collagen architecture and Collagen I/III abundance exhibited distinct spatial distributions between WT and BRCA2 tissues in ductal and lobular compartments. Fiber density and curvature showed the greatest differences, with BRCA2 tissues displaying denser, less curved collagen fibers. Although Collagen III abundance followed similar patterns in ductal regions, lobular regions demonstrated distinct remodeling, with WT tissues showing a progressive decline in Collagen III abundance, whereas BRCA2 tissues exhibited an initial increase followed by a stable distribution with increasing epithelial distance. Together, these findings demonstrate that BRCA2 haploinsufficiency reshapes the periepithelial collagen microenvironment before malignant transformation through compartment-specific remodeling of fibrillar collagen. These results identify extracellular matrix remodeling as an early feature of BRCA2-associated breast cancer initiation and provide new insight into how the stromal microenvironment may contribute to hereditary breast tumorigenesis.

Faculty Project Mentor: Mihriban Karaayvaz, Department of Cancer Sciences, Cleveland Clinic Research Institute

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Poster #21

BAX Deficiency Attenuates Photoreceptor Degeneration in Rd10 Mouse Model of Retinitis Pigmentosa (RP)

Katherine Kim, Neuroscience; Hakuto Higuchi, Biology; Samyak Jain, Biochemistry; Avyuth Kella, Biology; Anastasia Diener, Biomedical Engineering; Mieko Matsuyama, Jonah Scott-McKean, Shigemi Matsuyama, Dept. of Ophthalmology and Visual Science, CWRU School of Medicine.

Retinitis Pigmentosa (RP) is a group of genetic disorders characterized by progressive photoreceptor degeneration and vision loss. There are no gene-agnostic therapies effective for RP due to the lack of understanding of the central cell death signaling in the photoreceptor. Although BAX has been implicated in photoreceptor apoptosis, there are no genetic studies validating the bona fide role of Bax in RP pathogenesis. In this study, we generated Bax-deficient mice in one of the mouse models of RP (rd10 mouse) to determine the role of Bax in RP.

Rd10 mice carry a Pde6b mutation that causes photoreceptor degeneration, making them a widely used model of Retinitis Pigmentosa in humans. Rd10 mice with varying Bax genotypes (BAX +/+, BAX +/-, BAX -/-) were housed in a dark room until PND (postnatal day) 30, and moved to a light-dark (12hr cycle) room. Eyes were collected at PND 30 (before light exposure), 35, and 50, and the progression of the light-induced photoreceptor degeneration was assessed by histology using hematoxylin-eosin (HE)-stained sections.

Rd10 (Bax+/+) mice exhibited progressive photoreceptor degeneration. BAX knockout mice exhibited an initial delay in photoreceptor degeneration, indicating early protection against apoptosis. However, this protective effect diminished at later time points during P40–P50, resulting in progressive thinning of the photoreceptor layers. In contrast, BAX heterozygous mice demonstrated sustained preservation of retinal structure over time, suggesting partial reduction of BAX provides more durable retinal protection than complete loss of BAX. Since Bax has multiple biological activities regulating mitochondrial function and cell division, in addition to inducing apoptosis, the complete deletion of the Bax gene may cause unwanted side effects, thereby weakening the cytoprotective effects of inhibiting Bax-induced apoptosis. For therapeutic development, a novel Bax inhibitor that selectively blocks Bax's apoptosis-inducing activity will be necessary.

Faculty Project Mentor: Shigemi Matsuyama, Ophthalmology, Case Western Reserve

University School of Medicine

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Poster #22

Dissecting Pericyte-Specific Control of Cortical Capillary Perfusion in an Alzheimer's Disease Mouse Model

Pranav Annapillai, Neuroscience; Alice Hollow Dawson, Neuroscience; Ronit Ganguli, Neuroscience; Quinn Watercutter, Neuroscience; Jeanne-Marie Rigopoulos, Neuroscience; Dr. Delnia Ahmadpour, Dept. of Neurosciences, Cleveland Clinic Research; Dr. Evi Paouri, Dept. of Neurosciences, Cleveland Clinic Research; Sarah Stanko, Dept. of Neurosciences, Cleveland Clinic Research, Dr. Andy Shih Center for Developmental Biology and Regenerative Medicine, Seattle Children's Research Institute; Dr. Anusha Mishra, Department of Neurology, Jungers Center for Neurosciences Research, Oregon Health & Science University; Dr. Dimitrios Davalos, Dept. of Neurosciences, Cleveland Clinic Research

The brain relies on a dense capillary network for oxygen and nutrient supply. Dynamic regulation of capillary diameter is essential for maintaining balanced blood flow across the microvascular network, and impaired capillary perfusion is increasingly recognized as a contributor to central nervous system (CNS) diseases, including Alzheimer's disease (AD). Although amyloid-β deposition is a central feature of AD, cerebrovascular dysfunction occurs before extensive amyloid-β accumulation or symptom onset, suggesting it contributes to disease onset and progression. Pericytes cover >90% of the brain microvasculature and are key regulators of cerebral blood flow (CBF) through vasoactive signaling pathways. In AD, early CBF deficits have been linked to pericyte-mediated vasoconstriction, but prior evidence rests on acute application of vasoactive mediators to tissue, and on systemic non-cell-specific pharmacology. Whether/which specific vasoactive receptors in capillary pericytes are causally required for this deficit –independently of upstream arterioles and the systemic circulation– remain unexplored *in vivo*. To measure capillary perfusion at single-vessel resolution, we performed *in vivo* two-photon line-scan imaging in the mouse cortex, quantifying red blood cell (RBC) flux and velocity from the slope and displacement of RBC shadows in line-scan kymographs, and the diameter of the same vessels. Compared to age-matched wildtype controls, 7-month-old female 5xFAD mice showed reduced capillary perfusion: decreased RBC flux and velocity and narrower diameters, reproducing prior reports and validating readouts and baseline conditions for subsequent causal experiments. Building on our finding that a specific vasoactive mediator is dysregulated in the AD brain, we have deleted its receptor selectively in CNS pericytes using a novel genetic tool that spares vascular smooth muscle and peripheral pericytes. Combining deep, layer-resolved imaging with behavioral testing, ongoing and future experiments will determine whether this pericyte-specific molecular pathway mediates the vascular dysfunction observed in AD and dissect its physiological role from its contribution to AD pathology.

Faculty Project Mentors: Dr. Dimitrios Davalos, Dept. of Neurosciences, Cleveland Clinic Research

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Poster #23

Determining the Molecular Mechanisms Towards Treatment of Cardiac Valvular Ehlers-Danlos Syndrome

Michelle N. Hashem, Biochemistry; Ana D. Alcocer, Department of Pediatrics, Case Western Reserve University School of Medicine; Trisha Karanjkar, Biology; Elizabeth

H. Rush, Department Biology Case Western Reserve University College of Arts and Sciences; Deborah E. Seifert, Department of Pediatrics, Case Western Reserve University School of Medicine; Russell A. Norris, Department of Regenerative Medicine and Cell Biology, Medical University of South Carolina; Timothy J. Mead, Department of Pediatrics, Case Western Reserve University School of Medicine

Ehlers-Danlos syndrome (EDS) is a hereditary connective tissue disorder that primarily affects the skin, blood vessels and joints. Structural birth defects and clinical features include joint hypermobility, joint dislocation, skin hyperextensibility and tissue fragility. Cardiac valvular Ehlers-Danlos syndrome (cvEDS) is caused by a nonsense mutation in both copies of the *COL1A2* gene, resulting in alterations of the pro-α2(I) collagen chain. Cardiovascular complications of cvEDS include aortic and mitral valve insufficiency and additional abnormalities in connective tissue, including skin fragility. CRISPR-Cas9 genetic editing was utilized to introduce the most common cvEDS human variant in both copies of the *Col1a2* gene, resulting in Col1a2E1207*/E1207* (termed cvEDS^{MT}) mice. cvEDS^{MT} embryos were recovered at approximately half the expected Mendelian ratio at both embryonic day 18.5 and postnatal day 7. Histological and immunofluorescence analyses reveal that cvEDS^{MT} heart valves are enlarged with increased proteoglycan abundance and disorganized collagen alignment and content at embryonic day 18.5 and 1 month of age. In addition, 1 month old cvEDS KO skin has reduced collagen content, developing into dermal lesions by 6 months of age. Stretch-to-failure assays on the skin reveal failure of cvEDS^{MT} skin at lower forces compared to wild type. Bulk RNA sequencing of 1 month old whole heart tissue revealed reduced expression of *Col1a2* and differential expression of other connective tissue-related genes in cvEDS KO mice, such as *Fibulin-5*, *Aggrecan* and *Fgfr*4. Therefore, we have successfully generated a novel preclinical model of cvEDS. Future directions consist of functional analyses, including micro-CT and joint hypermobility gait analysis, as well as uncovering targets for therapeutic intervention.

Faculty mentor: Timothy J. Mead, Ph.D., Department of Pediatrics, Case Western Reserve University School of Medicine

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Poster #24

Metabolic Induction of Tumor Acidosis to Enhance PARP Inhibitor And Chemotherapy Efficacy

Vaibhav Thirumalai, Biochemistry; **Averie Huang**, Biochemistry; Dr. Boaz Tirosh, Department of Biochemistry, Case Western Reserve University.

The modulation of intracellular pH is a key attribute of therapeutic resistance in hypoxic tumor cells and a promising target for new treatments. Previous studies have linked lower intracellular pH to inactivation of poly(ADP-ribose) polymerases (PARPs), a family of polymerases linked to DNA damage repair. This project investigates whether effecting intracellular acidification can be exploited as a therapeutic vulnerability in BRCA1/2 mutant ovarian and breast cancers, as their deficiency in homologous recombination repair sensitizes them to PARP inhibition. Additionally, we hypothesize that acidosis will sensitize BRCA proficient cancers to PARP inhibitors (collectively, PARPi) as well. We induce acidosis by coupling carbonic anhydrase IX (CAIX) inhibition with pharmacological modulation of mitochondrial metabolism by stimulating oxidative phosphorylation (OXPHOS) or by inducing controlled mitochondrial uncoupling. We investigate the optimal methodology for inducing hypoxia, through hypoxic chambers and cobalt chloride, a known chemical hypoxia mimetic. Preliminary experiments have shown promising cytostatic effects when combining CAIX inhibition and metabolic modulators in triple-negative breast cancer cells. Future experiments will aim to quantify the pH alteration and cytostatic effects of this combination and work to integrate PARPi to promote genomic instability in multiple cancer cell lines.

Faculty Project Mentor: Dr. Boaz Tirosh, Department of Biochemistry, Case Western Reserve University.

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Poster #25

Malnutrition and Neurodevelopmental Outcomes in Preterm Infants: A Preliminary Analysis

Hansika Kunduru, Nutritional Biochemistry and Metabolism; Emma Wheeler, BA, Case Western Reserve University School of Medicine; Dr. Stephanie Merlino Barr, PhD, MS, RDN, LD, Dept. of Neonatology, MetroHealth Medical Center

Poor growth and suboptimal nutrition are associated with worse neurodevelopmental outcomes in preterm infants, but the relationship between neonatal malnutrition diagnoses and standardized developmental assessments remains unclear. This study evaluated whether malnutrition is associated with poorer developmental outcomes in preterm infants.
In this retrospective cohort study, preterm infants admitted to a level III NICU were assessed for malnutrition using the 2018 neonatal diagnostic criteria. Developmental outcomes were measured with the Bayley Scales of Infant and Toddler Development, Fourth Edition. Differences in developmental outcome categories (typical vs. below average/significant delay) by malnutrition status were analyzed using Fisher's exact test in R.
Among 33 infants with Gross Motor Bayley scores (mean birth gestational age 27 2/7 weeks, birthweight 938 g), 45% (15/33) were diagnosed with malnutrition. At a mean corrected age of 20.9 months (min-max 8.3-39.8 months), 61% had typical scores, 18% below average scores, and 21% had significant delays. Among 16 infants with Fine Motor scores (mean birth gestational age 27 4/7 weeks, birthweight 987 g), 44% (7/16) had malnutrition. At a mean age of 18.9 months (min-max 6.9-33.37 months), 63% had typical scores and 37% below average scores. No significant association was found between malnutrition and Gross Motor outcomes (OR 1.72, 95% CI 0.34–8.99) or Fine Motor outcomes (OR 1.46, 95% CI 0.12–17.71).
In this preliminary analysis, neonatal malnutrition diagnoses were not significantly associated with later motor developmental outcomes. Larger studies are needed to better evaluate the relationship between malnutrition and neurodevelopment in preterm infants.

Faculty Project Mentor: Dr. Stephanie Merlino Barr, PhD, MS, RDN, LD, Department of Neonatology, MetroHealth Medical Center

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Poster #26

Vagus Nerve Stimulation for Acute Modulation of Bladder Function in SCI Rat Models

Anya Iyer, Neuroscience; Pranav Akella, Biomedical Engineering; Mia Sargusingh, Biomedical Engineering; Dr. Ana Hernandez Reynoso, Biomedical Engineering Department, Case Western Reserve University School of Engineering

Neurogenic lower urinary tract dysfunction is one of the most common and debilitating complications of spinal cord injury (SCI), often resulting in incontinence, recurrent urinary tract infections, and increased risk of renal damage. Current treatment strategies focus on symptom management and are associated with risks and reduced quality of life. Therefore, addressing NLUTD remains a top priority among the SCI population.
One potential therapeutic approach is vagus nerve stimulation (VNS). VNS is being investigated as a therapy for many disorders due to the vagus nerve innervates many organ systems. In healthy people, the vagus nerve does not innervate the bladder. After SCI, studies suggest the vagus nerve provides afferent innervation to the bladder. We hypothesize that stimulation of these afferent fibers can modulate bladder function.
In this study, female Sprague-Dawley rats with a thoracic T9 contusion spinal cord injury of 225 kdynes are used to investigate the acute effects of vagus nerve stimulation (VNS) on bladder function. Animals are assigned to either a VNS treatment group or a sham stimulation group. Following a four-week recovery period and implantation of a VNS cuff electrode, cystometric recordings via transurethral catheterization are collected during a 1-2h baseline, 1h therapy, and 1 h post-therapy phases. Bladder pressure, bladder capacity, and voiding efficiency are measured and analyzed using laboratory-developed software to assess changes in lower urinary tract function.
This study aims to determine whether acute VNS can modulate bladder function following SCI. Because this study is ongoing, data collection and analysis are still in progress. These findings will provide preliminary insight into whether the vagus nerve is a viable target for treating NLUTD after SCI, and whether further optimization of stimulation parameters is needed for improving bladder function.

Faculty Mentor: Dr. Ana Hernandez Reynoso, Biomedical Engineering Department, Case Western Reserve University, Case School of Engineering

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Poster #27

Pathways and Genetic Markers of Cellular Transport in Astrocytes of ALS and FTD

Eileen Lou, Round Rock High School; Sara Ramiah, Biochemistry

The most common genetic cause of Amyotrophic lateral sclerosis (ALS) and Frontotemporal dementia (FTD) is a hexanucleotide repeat expansion in the C9ORF72 gene. Patients with ALS and FTD frequently develop neuroinflammation and autoimmune dysregulation, along with other neurological symptoms. There is significant evidence to suggest that Interleukin 17A (IL-17A), a pro-inflammatory cytokine, plays a critical role in disease progression. Astrocytes, the star-shaped glial cells that support neurons throughout the central nervous system, are also thought to contribute to neurodegeneration. However, the molecular pathways and genetic markers that define disease-associated astrocyte populations remain poorly understood.

To investigate the genotype-dependent changes in astrocyte gene expression on IL-17A and C9orf72, we first used single-cell RNA sequencing to categorize all cells in the forebrains of sixteen mice (n=3-5/genotype) into their respective cell types. Then, we isolated the astrocytes and sorted them into subclusters based on top genetic markers. By comparing common subcluster types between the different genotypes, we identified genotype-dependent changes in genes associated with cellular transport, with lipid transport emerging as one of the most significantly affected pathways.

Faculty Project Mentor: Dr. Aaron Burberry, Department of Pathology, Case Western Reserve University

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Poster #28

Interventions to Address the Unmet Needs of Informal Caregivers of Individuals with Alzheimer's Disease and Related Dementias in Long-Term Care: A Scoping Review

Paris A. Martin, Nursing; Siobhan Aaron, PhD, MBA, RN, FNP-BC, Frances Payne Bolton School of Nursing, Case Western Reserve University

Informal caregivers of individuals with Alzheimer's disease and related dementias (ADRD) continue to experience significant emotional, informational, and practical challenges even after their family member transitions to a nursing home or assisted living facility. Although placement may reduce some caregiving responsibilities, caregivers often remain actively involved in care coordination, decision-making, and advocacy while facing persistent unmet needs. This scoping review aims to identify and map interventions described in the literature that address the unmet needs of informal caregivers of individuals with ADRD residing in long-term care settings.
This scoping review follows the Joanna Briggs Institute methodology and is guided by the Population, Concept, Context (PCC) framework. The population includes informal caregivers of individuals with ADRD, the concept focuses on interventions addressing caregiver unmet needs, and the context is nursing homes and assisted living facilities. Comprehensive database searches identified 197 records for screening. Studies are being screened in Covidence using predefined inclusion and exclusion criteria. Data extraction will summarize study characteristics, intervention components, caregiver outcomes, and the unmet needs addressed by each intervention.
Screening and data extraction are currently ongoing. It is anticipated that this review will identify the types of interventions available to support informal caregivers of individuals with ADRD following long-term care placement, describe the caregiver needs these interventions target, and identify gaps in the existing evidence. The findings will inform future intervention development, guide clinical practice, and provide recommendations for future research aimed at improving support for informal caregivers throughout the long-term care trajectory.

Faculty Project Mentor: Siobhan Aaron, PhD, MBA, RN, FNP-BC, Frances Payne Bolton School of Nursing, Case Western Reserve University

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Poster #29

Expression and Purification of His-tagged L-Lactate Oxidase from A. viridians in E. coli.

Daniela Del Toro, Nutritional Biochemistry and Metabolism; Dr. Thomas Kowatz, Department of Nutrition, School of Medicine; Dr.David Lodowski, Center for Proteomics and Bioinformatics, Department of Nutrition, School of Medicine; Quinn Chapman, Department of Pharmacology, School of Medicine, Case Western Reserve University

Lactate detection is essential in critical care where elevated lactate signals conditions like tissue hypoperfusion, hypoxia, and sepsis. Lactate levels can also serve as a diagnostic marker for the measurement of anaerobic capacity during exercise. Sensors that can in real time sense blood lactate are thus of great importance and interest regarding athletic optimization and diagnostic applications. Lactate oxidase (LOx) is an FMN-dependent enzyme that catalyzes lactate to pyruvate and hydrogen peroxide, forming the enzymatic basis of most clinical lactate biosensors. Reliable lactate quantification depends on access to LOx in a form pure and stable enough for both diagnostic and structural applications. In this project an efficient expression and purification system for histidine-tagged LOx from Aerococcus viridians is reported. A codon optimized construct was expressed in E. coli and purified using a two-step strategy combining nickel affinity and size exclusion chromatography. This construct removes several reactive sites that make the wild type LOx enzyme less optimal for use in a sensor. This approach consistently yielded highly pure concentrated LOx suitable for additional characterization such as crystallization studies which could provide deeper insight into the enzymes structure and function.

Faculty Project Mentor: Dr. David Lodowski, Center for Proteomics and Bioinformatics, Department of Nutrition, School of Medicine, Case Western Reserve University

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Poster #30

Quantifying Differences in Hydrogen Peroxide and L-lactate Production across Oral streptococci using an Optimized Reflectometric Assay

Riya Kona, Biology; Hana Soto, Biochemistry and Political Science; Grace Heine, Department of Molecular Biology and Microbiology; Dr. Gina Lewin, Center for Global Health and Diseases and Department of Pathology.

Interactions among bacteria in the oral microbiome influence the development and progression of periodontal disease. *Streptococcus*, the most abundant bacterial genus in the oral cavity, interacts with *Aggregatibacter actinomycetemcomitans* (*Aa*), a pathogen associated with a severe form of periodontitis. For example, hydrogen peroxide (H_2O_2) production from the symbiont *Streptococcus gordonii* inhibits microbial growth. However, *Aa* produces the enzyme catalase to detoxify H_2O_2 and can respire H_2O_2, increasing *Aa*'s fitness and virulence. *S. gordonii* also produces L-lactate, which *Aa* uses as a carbon source, creating a cross-feeding relationship that benefits the pathogen. Despite this knowledge, individuals harbor diverse communities of oral streptococci; thus, variation in metabolite production across these different strains and species may influence interactions with *Aa*. Specifically, previous data show that diverse streptococci vary in fitness when cocultured with *Aa* and induce differential fitness of *Aa*. This project aims to compare H_2O_2 and L-lactate production across diverse oral streptococcal species in order to better understand these differing interactions. To accomplish this, we are using an optimized reflectometric assay that allows for accurate measurement and comparison of metabolite production across streptococcal members. Streptococcal cultures were grown in chemically defined media, washed to remove residual metabolites, back-diluted to mid-log phase, and normalized by optical density before metabolite measurements are collected using a reflectometric meter. Standard curves generated from known concentrations of H_2O_2 and L-lactate were then used to quantify metabolite concentration across species. Current results show differences in metabolite concentrations across diverse streptococci, including up to 6-fold differences in H_2O_2. We expect that further work may help explain previously observed differences in their interactions with *Aa*. Understanding these metabolic relationships will provide insight into how variation across the oral streptococci influences the persistence of *Aa* and the microbial interactions that contribute to periodontal disease.

Faculty Project Mentor: Dr. Gina Lewin, Center for Global Health and Diseases and Department of Pathology

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Poster #31

Delivery of Spermidine to the Brain Using Nanoparticles Enhances Phagocytosis of Microglia and Reduces Traumatic Brain Injury Symptoms

Taravat Khodaei, Department of Biomedical Engineering, Case Western Reserve University; Madhan Mohan Chandra Sekhar Jaggarapu, Department of Biomedical Engineering, Case Western Reserve University; **Julia Schiek**, Biochemistry; **Viveka Rabara**, Systems Biology; Abhirami Thumsi, Department of Biomedical Engineering, Case Western Reserve University; Sanmoy Pathak, Department of Pathology, Case Western Reserve University; Abhirami Suresh, Department of Biomedical Engineering, Case Western Reserve University; Huikang Qian, Department of Biology, Case Western Reserve University; Abhinav P. Acharya, Department of Pathology, Case Western Reserve University

Traumatic Brain Injury (TBI) induces metabolic and functional changes in microglia, which exacerbates the symptoms, and modulating these cells in the brain is extremely challenging. Herein, we have developed poly(lactic-co-glycolic acid)-based transferrin receptor targeting nanoparticles that accumulate in the vicinity of the brain to deliver spermidine (PSAT NPs), which then enhances microglial mitochondrial function and reduces microglial activation. The PSAT NPs were able to reduce CD86 pro-inflammatory expression, increase CD206 anti-inflammatory signal, upregulate TREM2 expression, and enhance phagocytosis of dead neurons *in vitro*. In a weight drop TBI mouse model, PSAT NPs improved multiple behavioral indications and RNAseq identified transcripts with reduced microglial activation profile, and upregulated mitochondrial oxidation. These data demonstrate that modulating metabolism and function of microglia in the context of TBI can be achieved using nanoparticles delivering spermidine.

Faculty Project Mentor: Abhinav Acharya, Department of Pathology, Case Western Reserve University

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Poster #32

Inhibition of Bax-Induced Apoptosis Prolonged Photoreceptor Survival in a P23H Mouse Model of Retinitis Pigmentosa

Avyuth Kella, Biology; Hakuto Higuchi, Biology; Samyak Jain, Biochemistry; Katherine Kim, Neuroscience; Anastasia Diener, Biomedical Engineering; Mieko Matsuyama, Jonah Scott-McKean, Shigemi Matsuyama, Dept. of Ophthalmology and Visual Science, CWRU

School of Medicine.

Retinitis pigmentosa is a group of retinal degenerative disorders characterized by the progressive loss of rod and cone photoreceptors, resulting in severe vision impairment and, ultimately, blindness. Although advances have improved our understanding of retinitis pigmentosa, effective treatments that prevent photoreceptor degeneration remain limited. In this study, we investigated the role of the apoptotic protein Bax in a P23H mouse model to examine the mechanism of retinal cell death and identify potential therapeutic targets.
The P23H mouse model carries a mutation that substitutes the 23rd amino acid from proline to histidine, producing misfolded rhodopsin protein. This mutation closely resembles one of the most common causes of retinitis pigmentosa in humans. Three P23H genotypes differing in Bax expression were examined: Bax wild type (WT), Bax heterozygous (Het), and Bax knockout (KO). Hematoxylin and eosin (H&E)-stained retinal sections from postnatal day 40–50 mice were analyzed by comparing the thickness of the outer nuclear layer (ONL), which contains photoreceptor nuclei, and the inner nuclear layer (INL) across the three groups.
As observed in retinitis pigmentosa, the P23H mutation caused progressive ONL degeneration. Partial loss of Bax in Bax Het attenuated photoreceptor degeneration compared with Bax WT, suggesting that reducing Bax-mediated apoptosis provides sustained protection. On the other hand, complete Bax deletion in Bax KO produced an initial protective effect, but failed to prevent degeneration at later stages, indicating that the complete absence of Bax during retinal development may have long-term consequences. Since Bax has multiple biological functions, including regulation of mitochondrial activity and cell division, as well as induction of apoptosis, complete loss of Bax may cause abnormalities even when apoptosis is suppressed. These findings suggest that selective inhibition of the apoptosis-inducing activity of Bax is an ideal strategy to prolong the survival of photoreceptors in RP.

Faculty Project Mentor: Shigemi Matsuyama, Dept. of Ophthalmology and Visual Science, CWRU School of Medicine.

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Poster #33

Evaluation and Validation of a Customizable Corset for Lower Limb Exoskeletons

Nikhil J. Misra, Mechanical Engineering; Marshaun N. Fitzpatrick, Dept. of Mechanical and Aerospace Engineering, Case Western Reserve University; Dr. Sandra K. Hnat, Dept. of Biomedical Engineering, Case Western Reserve University; Dr. Roger D. Quinn, Dept. of Mechanical and Aerospace Engineering, Case Western Reserve University

Lower extremity exoskeletons enable walking for patients with spinal cord injuries. However, misalignments of the exoskeleton are a common and serious problem for users as it can cause discomfort and abnormal gait patterns. To address fitment challenges and reduce donning and doffing time, a quick-adjust pelvic band was designed for a motor-assisted hybrid neuroprosthesis (MAHNP exoskeleton). This project focuses on evaluating the adjustable corset through user testing, motion capture analysis, and user perceptions of the device. The first experimental procedure involves the participant walking overground for 3 minutes while wearing the corset before providing qualitative and quantitative feedback through a survey evaluating perceived comfort and ease of use. We perform this experimental protocol through repeated trials with multiple neurotypical participants. The second form of data collection includes motion capture to estimate lower-limb kinematics (hip, knee, and ankle positions) of both the participant and the MAHNP to evaluate alignment. These trials will be conducted in the Motion Study Laboratory at LSCVAMC using VICON's motion capture system.
MATLAB functions were developed to analyze the VICON data and determine alignment between user's joints and the exoskeleton motors to ensure fitment. Two separate sessions are planned for these trials: one while wearing a rigid pelvic band from the ReWalk exoskeleton and the other while wearing the adjustable corset. Having both datasets will allow for comparison and proof of reliability of the adjustable corset. Time trials will then be conducted, comparing the time it takes to install three rigid pelvic bands of varying sizes, the current exoskeleton standard, to the time it takes to adjust the corset to the same three measurements. After finalizing production of the corset and performing initial tests, we plan to conduct each experiment with at least one neurotypical participant to begin validation of both the corset and experimental procedures.

Faculty Project Mentor: Dr. Sandra K. Hnat, Department of Biomedical Engineering, Case Western Reserve University

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Poster #34

The Digital Divide and Lung Transplant Access: Neighborhood Internet Access and Income Inequality Before and After the Composite Allocation Score

Alex Khouli, Health Equity and Policy; Rocio López, MS, MPH, Department of Surgery, University of Colorado Anschutz Medical Campus; Jesse D. Schold, PhD, MStat, MEd, Department of Surgery, University of Colorado Anschutz Medical Campus; Jacqueline W. Curtis, PhD, Department of Population and Quantitative Health Sciences, Case Western Reserve University; Wayne M. Tsuang, MD, PhD, Department of Pulmonary and Critical Care Medicine, Cleveland Clinic

Lung transplantation is a life-saving therapy for patients with end-stage lung disease, however, donor lungs still remain scarce. This means that allocation policy plays a critical role in who receives a transplant and when. In March of 2023, the Lung Allocation Score (LAS) was replaced with the Composite Allocation Score (CAS), a points-based framework meant to reduce the role of geography in transplant access. Whether this transition affected the influence of neighborhood-level socioeconomic conditions on waitlist outcomes remains unknown. This study evaluated whether household internet access and the Gini index of income inequality, measured at the ZIP-code level, were associated with time to lung transplantation or waitlist attrition (death or removal due to illness) before and after the implementation of CAS. We analyzed the Scientific Registry of Transplant Recipients data for 11,676 adults listed for lung-only transplantation between January 1, 2021 and November 29, 2024. This comprised of 6,176 candidates in the LAS-era and 5,500 candidates in the CAS-era. ZIP-code of residence was linked to the 2020 Agency for Healthcare Research and Quality Social Determinants of Health Database to obtain the percentage of households without internet access and the Gini index. Fine-Gray competing-risks regression models, adjusted for demographic and clinical covariates, estimated associations between each exposure and outcomes within each era. Residing in an area with a higher percentage of households without internet access was associated with a lower likelihood of transplant during the LAS era ($p<0.001$) but not during the CAS era ($p=0.97$). The Gini index showed no significant association with either outcome in either era. These findings suggest that the change in lung allocation policy from the LAS to the CAS may have reduced disparities in transplant access linked to local digital connectivity, which represents a potential equity benefit of the new allocation framework.

Faculty Project Mentor: Dr. Wayne M. Tsuang, Department of Pulmonary and Critical Care Medicine, Cleveland Clinic

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Poster #35

Defining Household Food Literacy

Annabel Degenholtz, BS Candidate in Nutrition, Dr. Melissa Pflugh Prescott, Dept. of Nutrition, Case Western Reserve University; Dr. Brenna Ellison, Dept. of Agricultural Economics, Purdue University; Dr. Karen Byrd, Dept. of Agricultural Economics, Purdue University; and Rebecca Naab, Dept. of Nutrition, Case Western Reserve University

This research aims to develop a definition of Household Food Literacy (HFL) and identify items within the Food Literacy, Environment, and Waste (FLEW) Assessment that fit this definition.

Food literacy (FL) has many existing definitions. A 2017 scoping review found 38 articles, each providing unique FL definitions. The authors identified six FL themes across the definitions: skills/behavior, food/health choices, culture, knowledge, emotions, and food systems.

We evaluated definitions from the review to find those related to one's capacity to produce nourishing and affordable daily meals for their household. Next, we combined components of the most relevant FL definitions to define HFL and surmised FL themes germane to HFL. Finally, we reviewed the FLEW Assessment to determine items that aligned best with our definition and explored the relative frequency of each HFL theme and attributes assessed by the instrument.

We defined HFL as a set of interrelated attributes developed over a lifespan, empowering food resiliency, which sustains the food management practices required to produce nutritious, appetizing, and affordable daily meals for one's household.

We identified 42 FLEW Assessment items related to HFL. We coded each item based on relevance to HFL themes and attributes. About 12%(n=5) of items related to food safety, 21.43%(n=9) to nutrition/energy balance, 40.50%(n=17) to food/financial efficiency, 19.05%(n=8) to preparing food/cooking, and 9.52%(n=4) to resilience. We found that 16.67%(n=7) of the items related to skills, 45.24%(n=19) to behaviors, 21.43%(n=9) to knowledge, and 16.67(n=7) to attitudes. Food and financial efficiency were represented the most in the FLEW Assessment, while resilience was the least represented. Of the attributes, behaviors were the most well-represented, followed by skills. Future research is needed to examine whether the selected HFL FLEW Assessment items have predictive validity for relevant outcomes, like dietary quality and food waste volumes.

Faculty Project Mentor: Melissa Pflugh Prescott, PhD, Dept. of Nutrition, Case Western Reserve University

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Poster #36

A Domed-Valley Kresling Origami Pattern for Deployable Spacecraft Booms

Tej Moradia, Mechanical and Aerospace Engineering

Small spacecraft often need structures far longer than themselves, such as antennas or sensor booms, that must fold compactly for launch and extend in orbit. Origami tubes based on the Kresling fold pattern are promising because they can be bistable, resting stably in both a compact and an extended shape without continuous power. However, when built from stiff printable materials, these tubes crack at their fold lines during the snap-through motion that switches between shapes. This project develops a new fold pattern, the domed-valley Kresling, that stores part of its snap-through energy in gentle panel bending rather than entirely in fold-line stretch. A reproducible computational pipeline combining bar-and-hinge modeling, shell finite element analysis, and parametric design sweeps yields an energy-barrier scaling law governed by a single dimensionless constant. This law predicts a design's snap-through barrier without simulation and quantifies the strength-versus-durability conflict inherent to the plain pattern. In a controlled finite element comparison, the new pattern nearly doubles the energy barrier of a plain Kresling tube of identical size and material using only the change in crease geometry.

Faculty Project Mentor: Dr. Changyong Cao, Department of Mechanical and Aerospace Engineering, Case Western Reserve University.

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Poster #37

Validation of a Predictive Gene Signature for Collateral Drug Responses in Osteosarcoma

Abbott Sherlock, Department of Chemistry & Chemical Biology, Cornell University, CanSUR Program, Case Western Reserve University; Jarrell Imamura BA, Genomic Sciences and Systems Biology, Cleveland Clinic Research, Cleveland Clinic; Kristi Lin-Rahardja PhD, Genomic Sciences and Systems Biology, Cleveland Clinic Research, Cleveland Clinic; Zachary Burke MD, Genomic Sciences and Systems Biology, Cleveland Clinic Research, Cleveland Clinic, Cleveland Clinic Lerner College of Medicine, Case Western Reserve University, Department of Orthopedic Surgery, Cleveland Clinic.

Osteosarcoma (OS) is the most common primary malignant bone tumor in children and adolescents. The first-line treatment is a multimodal approach including surgery and chemotherapy with methotrexate, doxorubicin, and cisplatin (MAP); there are no standardized second-line treatments. Personalized selection of second-line agents using a predictive gene expression signature may improve treatment outcomes. Previously, we developed a predictive gene expression signature model using an OS cell line, MG63.3. We aim to validate this model in a new, patient-derived cell line, OS13A.

We evolved chemotherapy resistance *in vitro* through the exposure of an OS cell line, OS13A, to clinically relevant alternating doses of cisplatin with doxorubicin and methotrexate. At the end of each treatment cycle, resistance to MAP therapy and collateral drug responses were quantified, and transcriptomic data were collected. These assays were performed across three independent evolutionary replicates and three solvent-treated control replicates.

The next step in this experiment is to use the transcriptomic data collected throughout the evolutionary process with the previously developed model to validate predictive gene signature modeling. Validation should also be expanded to additional OS cell lines, either commercially available or patient-derived.

Faculty Project Mentor: Zachary Burke, MD, Cleveland Clinic Lerner College of Medicine.

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Poster #38

Impact of Modified Curriculum on Research Participation among RDN Alumni of the Combined Dietetic Internship/Master's Degree Program

Ava Mei Wong, Nutritional Biochemistry and Metabolism; Dr. Rosa Hand, Dept. Nutrition, Case Western Reserve University.

Research is key to establishing the evidence-base for nutrition practice, and yet, Registered Dietitian Nutritionists (RDN) research involvement is limited. Proposed barriers to research range from education and training to barriers in the workplace. At CWRU, the Combined Dietetic Internship and Masters Degree Program (CDI/MDP) provides students with the required supervised practice experience towards earning the RDN credential along with hands-on instruction and research experience, with the goal of producing RDNs that are confident researchers. The objective of this study was to assess the extent to which graduates of the CDI/MDP program are involved in research as compared to the general RDN population. This was a cross-sectional study of graduates of the CWRU CDI/MDP program from January 2018 to 2024. We emailed and sent LinkedIn messages to ninety-eight graduates from this timeframe, inviting them to take an anonymous survey on Qualtrics that assessed their involvement in research, barriers to research, and confidence in research skills, using validated tools CRAI-19, RCC, and RIQ. The study was deemed exempt by the CWRU IRB (STUDY20260827); participants read and agreed to a consent statement before proceeding and were offered a twenty-dollar Amazon gift card as an incentive to complete the survey. As of abstract submission, thirty-eight responses have been collected. Analysis and results will be included in the poster submission. We expect to compare the research involvement of graduates to the general RDN population using the same validated tools and previous literature. Eventually, we expect to be able to compare the outcomes of this cohort of graduates to a previous cohort that underwent different research training.

Faculty Project Mentor: Dr. Rosa Hand, Dept. Nutrition, Case Western Reserve University.

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Poster #39

Automating Calibration of Sensorized Wheelchair Footplates for Lower-Extremity Displacement Detection

Keirstin Trehan, Biomedical Engineering, The Ohio State University; Advanced Platform Technology Center, Louis Stokes Cleveland VA Medical Center

Individuals with spinal cord injury or disorders who use powered wheelchairs may be unable to feel, see, or independently correct when their feet become displaced from wheelchair footplates. SoleTracker is a sensor-based assistive technology developed to detect lower-extremity displacement and alert users before injury occurs. This project focused on improving the calibration and testing workflow for SoleTracker footplates to ensure sensor outputs are interpreted more consistently during system development. Each footplate contains 20 force-sensitive resistors (FSRs) and 14 proximity sensors that require calibration to ensure proper operation and provide values in standardized units for detection algorithms. FSRs detect when the foot is in contact with the footplate, while proximity sensors support detection of partial or complete foot displacement when force readings alone may not fully describe foot position. Calibration development combined electrical verification, sensor testing, and mechanical fixture design. Footplate communication with desktop recording software was verified, and sensor mappings were corrected to ensure recorded values matched physical sensor locations. Mass loading trials were performed on FSRs to identify baseline readings, saturation behavior, usable response ranges, and differences in sensor performance across footplate locations. Proximity sensor calibration goals were developed to characterize response to foot position, shoe sole materials, and ambient light. To improve testing efficiency and repeatability, 3D calibration fixtures were designed in Onshape using SoleTracker footplate geometry. The force-sensor fixture used a footplate-shaped base, guide rods, a moving top plate, compression springs, travel collars, and plungers aligned with FSR locations to apply controlled loads to multiple sensors. A related proximity-sensor testing setup used the same base geometry to evaluate proximity sensor response under controlled target distances, foot positions, surface conditions, and ambient light levels. Together, these designs support SoleTracker development by creating a calibration workflow and a mechanical design that can be used for system testing and optimization.

Faculty Project Mentor: Dr. Steve Majerus, Department of Electrical, Computer and Systems Engineering, Case Western Reserve University and Advanced Platform Technology Center, Louis Stokes Cleveland VA Medical Center

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Poster #40

Development of a Novel Dual-Sensor Rectal Pressure Monitoring Device for Accessible Anorectal Manometry

Rohan Biswas, Biomedical Engineering and Electrical Engineering, Case Western Reserve University; Advanced Platform Technology Center, Louis Stokes Cleveland VA Medical Center

Fecal incontinence and chronic constipation affect nearly 20% of adults in North America, and accurate diagnosis is needed for effective treatment planning. Unfortunately, measuring rectal and anal pressures currently requires bulky equipment usually only available at specialized hospitals. Furthermore, the catheter-based test is non-physiologic, distressing to the patient, and often fails to accurately reproduce reported symptoms. Because of this, many patients face long, frustrating delays just to get an accurate diagnosis. To bridge this gap, this study introduces a catheter-free device that uses two advanced pressure sensors to record anal sphincter and rectal pressures simultaneously and in real time. This system is intended to record exactly how these muscles behave while a patient rests, squeezes, or simulates a bowel movement in their daily activities for improved diagnosis. The device is small, flexible, and fully wireless to maximize patient comfort. Interior circuitry is integrated on a custom, flexible circuit board, and current work focuses on testing the prototype for sensor accuracy, wireless stability, and precise pressure calibration. Ultimately, this tool aims to replace traditional hospital equipment, improving access to accurate diagnosis for patients with fecal incontinence.

Faculty Project Mentor: Dr. Steve Majerus, Department of Electrical, Computer, and Systems Engineering, Case Western Reserve University; Advanced Platform Technology Center, Louis Stokes Cleveland VA Medical Center

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Poster #41

Developing H2S Detection and NMR Methods for Evaluating Enzyme-Mimicking Nanocatalysts

Koki Takizawa, Biomedical Engineering, Cleveland Clinic Research

Aging is associated with declining metabolic enzyme activity, contributing to cardiovascular, neurodegenerative, and metabolic diseases as well as reduced healthspan. Carbon-sulfur lyases catabolize sulfur-containing amino acids such as cysteine to produce pyruvate, ammonia, and hydrogen sulfide (H_2S), a gasotransmitter important in cardiovascular and neuronal signaling. Enzyme-mimicking nanocatalysts offer greater stability and compositional tunability than natural enzymes. Their evaluation requires reliable detection of H_2S and confirmation of the accompanying reaction products.

Lead acetate paper is commonly used for colorimetric detection of H_2S, but lead is toxic, environmentally persistent, and poorly suited for routine screening. We therefore developed and characterized bismuth acetate paper as a lower-toxicity alternative. Using a 0.2 mM sodium sulfide (Na_2S) standard, the temporal response profile of the bismuth acetate paper was mapped across time points from 30 seconds to 24 hours and compared with lead acetate paper. The assay demonstrated reliable, reproducible signal generation at all tested intervals, permitting determination of saturation kinetics of the colorimetric response. When applied to bimetallic nanocatalysts, the assay identified iridium-platinum, and to a lesser extent, gold-rhodium as lead candidates that catabolize cysteine to generate H_2S above the negative control.

Detection of H_2S alone, however, is not sufficient to confirm that a nanocatalyst mimics the lyase pathway. To address this, we performed time-resolved ^1H nuclear magnetic resonance (NMR) analysis of cysteine incubated with a representative nanocatalyst. Progressive disappearance of cysteine peaks accompanied by the appearance of new product peaks demonstrates catalytic turnover.

Together, the bismuth acetate assay and complementary NMR platform provide an integrated framework for evaluating enzyme-mimicking nanocatalysts. Future work will identify co-products observed with NMR, test prioritized bimetallic candidates, assess substrate selectivity, and correlate catalytic activity with nanocatalyst size and composition.

Faculty Project Mentor: Dr. Vijay Krishna, Biomedical Engineering, Cleveland Clinic Research

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Poster #42

Assessing Cross-Sensor Reliability for Geospatial Analysis

Vanshika Myneni, Olatunde Akanbi, Erika Barcelos

Satellite derived vegetation and moisture indices are critical for modern environmental models. This is especially true for models that rely on combining data from multiple satellite systems to generate complete, continuous images of the Earth's surface. However, disparities in spatial, temporal, and spectral resolution across different sensor platforms create challenges for data integration. This study evaluates the consistency and cross-sensor reliability of five commonly used vegetation and moisture indices (Normalized Difference Vegetation Index (NDVI), Green Normalized Difference Vegetation Index (GNDVI), Enhanced Vegetation Index (EVI), Normalized Difference Water Index (NDWI), and Soil Adjusted Vegetation Index (SAVI)), by directly comparing how the same index performs across four satellite platforms: MODIS Aqua, MODIS Terra, Landsat, and Sentinel-2. Focusing on Lake County, Ohio, for the year 2024, the research utilizes R for spatial data processing and statistical analysis. To assess how similar platforms align, cross-sensor agreement was quantified at the pixel level by plotting values against each other to calculate correlation (R^2), Root Mean Squared Error (RMSE), and systematic bias. Additionally, Bland-Altman analysis was conducted to evaluate sensor interchangeability. While this study focuses on 2024 data, the established framework is designed to be fully scalable and reusable for cross sensor validation in other years and regions.

Faculty Project Mentor: Erika Barcelos, Department of Materials Science

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Poster #43

Shear-Induced Ordering in Monodisperse Dense Suspensions: Impact of Frictional Contacts

Enzo Mckee, Mechanical Engineering; Ria Duggal, Chemical Engineering; Dr. Abhishek Sharma, Department of Chemical Engineering, The Cooper Union for the Advancement of Science and Art

Shear-induced ordering occurs in dense suspensions of equal-sized (monodisperse) particles, where applied shear organizes them into crystalline two-dimensional layers. These layers slide easily past one another, so as strain is applied the viscosity passes through a shear-induced peak and then decreases as the suspension orders. Stress-activated frictional contacts have the opposite effect, driving shear thickening. However, prior studies of ordering have largely focused on frictionless particles, so how order and friction compete remains poorly understood.

In this study, we use Lubrication Flow-Discrete Element Method (LF-DEM) simulations of a two-dimensional suspension at a packing fraction of 0.78 under imposed shear stress, with a critical load model in which friction activates only above a threshold contact force. We track local structure with the bond-orientational order parameters ψ_6 and ψ_4, their spatial correlation $G_6(r)$, and the normal force carried by each particle.

Across four orders of magnitude in applied stress, our simulations indicate that the crossover from an ordered, shear-thinning state to a disordered, shear-thickening state coincides with the onset of frictional contacts. At the particle level, we observe that hexatic order is nearly independent of a particle's load, while tetratic order is weakly suppressed by it, suggesting that friction may disrupt ordering collectively rather than one particle at a time. The order is also dynamic, cyclically forming and melting about once per unit strain, and short-range order re-emerges at the highest stresses even as long-range order is lost. These observations are the focus of ongoing analysis.

By clarifying how friction competes with ordering, this work aims to inform the processing of dense particulate materials such as concrete and slurries.

Faculty Project Mentor: Abhinendra Singh, Department of Macromolecular Science and Engineering, Case Western Reserve University

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Poster #44

Using Ontologies and Exploratory Data Analysis to Optimize 3D Printing Ink Development

Finn Matos, Jube Augustino, Quynh D. Tran, Laura Bruckman, Materials Science and Engineering, Case Western Reserve University

Optimizing 3D printing inks is a complex and time-consuming process that often relies on trial and error. Developing an effective ink formulation is essential because these materials are used in a wide range of applications, including flexible materials, electronics, catalysis, biomedical devices, and structural components. The methods used in this project included exploratory data analysis (EDA), draw.io, CEMENTO, and ontology development. EDA was used to explore and visualize formulation data, allowing patterns, trends, and relationships between variables to be identified before drawing conclusions. We used draw.io to create diagrams that represented the relationships between concepts, classes, and properties. The diagrams were imported into CEMENTO, an open-source Python package that converts diagrams into ontology files and identifies syntax errors. An ontology is a formal framework that defines the concepts, entities, and relationships within a specific domain, providing structure and meaning to the data. Unlike graphs, which primarily illustrate relationships, ontologies also define the rules and semantics that govern those relationships. Through this project, I learned how to perform exploratory data analysis to visualize formulation properties and gain insights from experimental data. I also developed diagrams in draw.io to organize key concepts and definitions, then used CEMENTO to convert those diagrams into ontologies and refine them by resolving modeling errors. In the future, this work could be expanded by developing a more comprehensive ontology that incorporates additional formulation data, enabling more efficient ink optimization and reducing the need for trial-and-error experimentation.

Faculty Project Mentor: Laura S. Bruckman, Materials Science and Engineering, Case Western Reserve University

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Poster #45

Improving Direct Ink Writing Formulations with Knowledge Graphs

Armiyah Worley, Jube Augustino, Quynh D. Tran, Laura S. Bruckman, Materials Science and Engineering Department, Case Western Reserve University

Direct ink writing (DIW) is a type of 3D printing technique used to create parts and products from formulated inks. Formulation science focuses on creating and testing inks for the printing process. The right ink formulation is important because the material must have the correct thickness, flow, and stability. Our overall goal is to use data to find the best ink formulation to have a successful 3D printing. We used 3 methods to do this: Exploratory Data Analysis (EDA), ontology development, and knowledge graphs. Exploratory Data Analysis is used to study the dataset and find patterns in the information. An ontology is used to organize information about direct ink writing formulations and their relationships. The ontology and dataset were put together to create a knowledge graph which provides a structured way to connect and analyze information. The knowledge graph connects information in a more organized way. It helps people understand how formulation materials affect the printing process and the final product. It can support reasoning systems by connecting information and helping users make better decisions during formulation discovery. In the future, this system can help make formulation development faster and easier by helping researchers choose the best formulations based on the data. More direct ink writing formulation data can be added to the knowledge graph to work better and provide better results. Overall, this project shows how knowledge graphs can help organize data and support research in direct ink writing formulation.

Faculty Project Mentor: Laura S. Bruckman, Materials Science and Engineering, Case Western Reserve University

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Poster #46

Scientific Queries in NoSQL Databases

Rhylie Barrett, St Martin de Porres High School; **Khalil Bryant**, John Hay Science and Medicine

The project focuses on learning about X-ray Diffraction, also known as XRD data, and using this as an example case for ontology development. Ontology is a formal way of defining concepts and the relationships between them so computers can understand information more consistently instead of only storing values as plain text. This connects to the FAIR principles, which means data should be findable, accessible, interoperable, and reusable. We first looked over common XRD terms and defined each term. After that, we used a Python script to automatically place the terms and definitions into a Turtle (.ttl) ontology file.

SPARQL can then be used as a query language to ask questions to aknowledge graph that is guided by the ontology. This process creates structured relationships between concepts, allowing computers to better understand how XRD terms are connected and use that information to answer questions more accurately. While humans can naturally recognize relationships between ideas, computers need those connections to be clearly defined. Building a well-structured ontology helps researchers systematically FAIRify their data to be shared, reused avoid repeating experiments, and understand other people's work more easily. For large volumes of data the NoSQL structure helps with speed because of so much data floating around it connects everything together with efficiency.
The overall goal of this work is to help computers understand the meaning of XRD concepts and how they are connected. While humans can naturally recognize relationships between terms, computers require those relationships to be explicitly defined. By building a well-structured ontology, we can enable computers to understand information from the ground up, making scientific data easier to find, access, include, and reuse.

Faculty Project Mentor: Ozan Dernek, Materials Science and Engineering, Case Western Reserve University

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Poster #47

Computational Chemistry Studies of Caffeine Adsorption on Metal Surfaces

Anthony Littlejohn; Mahmudul Hasan; Terry Idahor

This project investigates how caffeine interacts with different metals in water using computational chemistry. Although caffeine is most familiar as the stimulant in coffee and tea, recent research suggests it plays a more surprising chemical role: when dissolved in water, it can speed up the rate at which certain metal electrocatalysts produce hydrogen. The reason for this effect is still unclear. One hypothesis is that caffeine adsorbs onto the metal surface, changing how the metal reacts; another is that caffeine stays dissolved in solution and acts from there. While these effects are challenging to understand experimentally, computational chemistry can give molecular-level insight into the chemical interactions between metal surfaces and caffeine. If caffeine behaves differently depending on the metal, that difference could explain the unexpected results in previous experiments. I will present on caffeine adsorption trends across different metals surfaces to understand how caffeinated interfaces might influence catalytic hydrogen production rates.

Faculty Project Mentor: Rob Warburton

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Poster #48

Development and Validation of Miniaturized Mechanically Adaptive Microfluidic Neural Probes

Pearl Marks, Neuroscience; Mali Ya Mungu Ocoko, Department of Biomedical Engineering, Case Western Reserve University, Advanced Platform Technology Center, Louis Stokes Cleveland VA Medical Center; Jeffrey Capadona, Department of Biomedical Engineering, Case Western Reserve University, Advanced Platform Technology Center, Louis Stokes Cleveland VA Medical Center; Allison Hess-Dunning, Department of Electrical Engineering, Department of Biomedical Engineering, Case Western Reserve University, Advanced Platform Technology Center, Louis Stokes Cleveland VA Medical Center

Brain–machine interfaces (BMIs) restore motor function after spinal cord injury by bypassing damaged spinal pathways and enabling direct communication between the central nervous system and external devices. However, invasive probe implantation triggers neuroinflammation characterized by immune cell recruitment, glial scarring, and reactive oxygen species. A primary contributor is the mechanical mismatch between implant and brain tissue, limiting long-term device performance. Our lab previously developed a mechanically adaptive microfluidic neural probe capable of localized, continuous drug delivery, with in vivo performance comparable to conventional silicon-based devices. Further miniaturization may reduce tissue displacement and the foreign body response, improving chronic integration, but could compromise stiffness required for implantation and fluid delivery.
To evaluate whether reducing probe dimensions from 300 × 100 μm to 120 × 90 μm compromised mechanical integrity or fluidic performance, the miniaturized probe was benchmarked against our validated design. Probes were fabricated from a mechanically adaptive PVAc-CNC polymer nanocomposite. Insertion force testing evaluated buckling mechanics and implantation capability. Fluid-flow characterization served as a stress test, quantifying pressure required for infusion. Stability testing evaluated structural integrity and sustained fluid delivery. Mechanical testing demonstrated a critical buckling force of 93.37 ± 40.35 mN, greatly exceeding the 1.26–3.35 mN required for neural implantation. Fluid-flow characterization demonstrated consistent, localized delivery, requiring 97.58 ± 22.55 g to achieve flow versus 136.86 ± 17.78 g for standard probes. Accelerated stability testing at 10 μL/hr demonstrated sustained delivery over five days, equivalent to ~333 days at the intended 0.15 μL/hr rate, indicating miniaturization did not compromise long-term fluidic function. Similar insertion, fluid-flow, and stability performance indicate functional equivalence despite reduced device size. Miniaturized mechanically adaptive probes represent a promising platform for long-term, localized drug delivery that mitigates neuroinflammation and improves the longevity of implantable BMIs.

Faculty Project Mentors: Jeffrey Capadona, Department of Biomedical Engineering, Case Western Reserve University, Advanced Platform Technology Center, Louis Stokes Cleveland VA Medical Center; Allison Hess-Dunning, Department of Electrical Engineering, Department of Biomedical Engineering, Case Western Reserve University, Advanced Platform Technology Center, Louis Stokes Cleveland VA Medical Center

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Poster #49

Comparative Fascicular Microanatomy of the Posterior Tibial Nerve in Pig and Human Cadavers: Implications for PTNS Electrode Design

Rudra Sai Mula, Biomedical Engineering; Dr. Aniruddha Upadhye, Department of Biomedical Engineering

Background: Posterior tibial nerve stimulation (PTNS) is an established treatment for overactive bladder (OAB), but its efficacy depends on accurate electrode placement and selective activation of target nerve fascicles. Pig models are widely used in preclinical PTNS research; however, differences in fascicular and fiber anatomy between pigs and humans may limit the translatability of stimulation strategies developed in these models. Characterizing species differences in fascicle size, fascicle count, connective tissue thickness, and fiber distribution is therefore essential for optimizing electrode design and stimulation parameters. During PTNS implantation, electrodes are positioned around the exposed posterior tibial nerve (PTN) using external anatomical landmarks, as internal fascicular organization is not visible intraoperatively. A more detailed understanding of fascicular morphology and organization could improve electrode placement, increase stimulation selectivity, and reduce unintended activation of neighboring fascicles.
Methods: PTN segments were harvested from fixed human cadavers and fresh pig specimens. In both species, the leg was dissected to expose the full length of the PTN. Using the medial malleolus as the distal landmark, a 9 cm nerve segment was measured with calipers and transected at the medial malleolus and 9 cm proximal to it. Harvested nerves were fixed in formaldehyde for 48 hours and stained with phosphotungstic acid (PTA), which binds collagen to enhance contrast of fascicular structures. Stained nerves were mounted on custom grids, secured in a vertical microCT holder, and imaged at 55 kV, 119 µA, and 500 ms exposure at 11.4 µm voxel resolution, enabling non-destructive visualization of internal nerve architecture. Resulting images were exported as DICOM files and analyzed in Fiji (ImageJ) to manually quantify fascicle count, size, and spatial layout. Measurements were compared between species and across the length of the surgical window.
Ethics: Pig tissue was collected post-mortem under IACUC-approved protocols for secondary use. Human tissue was obtained through the Anatomical Gift Program from donated cadavers. The study was submitted for IRB review and determined exempt as non-human subjects research.

Faculty Project Mentor: Andrew Shoffstall, Dept. of Biomedical Engineering, Case Western Reserve University

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Poster #50

Computational Fire Dynamics Study of Flame Spread Between Closely Spaced Solid Fuels in Microgravity

Zoe Kao, Mechanical and Aerospace Engineering; Prof. Ya-Ting Liao, Department of Mechanical and Aerospace Engineering, Case Western Reserve University

In spacecraft, equipment and materials are often closely spaced, and fires can be difficult to detect, control, and extinguish in microgravity. Therefore, understanding how flame spread occurs between nearby solid fuels is important for improving fire safety in confined space environments. Flame spread between closely spaced solid fuel samples is affected by the competing effects of heat transfer, flow acceleration, and oxygen transport. This study uses an in-house computational fire dynamics code with a two-sample geometry to examine flame spread from a primary ignited sample to a nearby secondary sample. The objective is to determine how separation distance H affects flow behavior, oxygen transport, secondary-sample heating, and flame interaction at a fixed imposed airflow speed of U_∞=6 cm/s. Three separation distances, H=1.5, 2.0, and 2.5 cm, were compared at an equivalent flame-spread stage. Streamwise velocity, oxygen mass fraction, gas temperature, secondary-surface temperature, and reaction rate near the secondary surface were analyzed. Preliminary results show that smaller gaps increase thermal coupling between the samples, producing higher gas temperatures, stronger secondary-surface heating, and greater reaction near the secondary surface. However, the smaller gaps also showed stronger oxygen depletion downstream of the flame base. In contrast, the H=2.5 cm case remained better ventilated but showed weaker secondary-sample heating and negligible reaction near the secondary surface. These results suggest that reduced spacing enhances flame interaction, while larger spacing improves oxygen transport but weakens heat feedback to the secondary sample.

Faculty Project Mentor: Prof. Ya-Ting Liao, Department of Mechanical and Aerospace Engineering, Case Western Reserve University

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Poster #51

Development of a Reversible PDMS-Acrylic Package for Mechanically Adaptive Microfluidic Neural Probes

Allison Ludwig, Electrical Engineering; Melinda Lake-Speers, Department of Mechanical and Aerospace Engineering, Case Western Reserve University; Allison Hess-Dunning, Department of Electrical, Computer, and Systems Engineering, Case Western Reserve University

Brain-computer interfaces (BCIs) restore sensory input and motor function in individuals through intracortical microelectrodes that record neural activity. Mechanically adaptive neural probes with integrated microfluidic channels have been developed to locally deliver anti-inflammatory therapeutics to improve long-term electrode performance. Current methods of connecting microfluidic neural probes to a fluid reservoir rely on irreversible epoxy, preventing probe removal for inspection or repackaging and making it difficult to distinguish packaging failures from probe failures.

This work adapts reversible compressive bonding concepts previously used in microfluidics to develop a low-cost packaging method for mechanically adaptive neural probes. The proposed package uses a PDMS-acrylic sandwich structure, where compliant PDMS forms the seal and rigid acrylic layers provide mechanical support through controlled compression. Acrylic was selected in place of glass, which is used more commonly in microfluidics, to enable rapid, inexpensive fabrication using laser cutting while maintaining a simple and accessible assembly process.

Preliminary proof-of-concept testing successfully delivered dyed deionized water through the probe microfluidic channel using the reversible package without visible probe deformation. The package can also be disassembled, allowing probes to be inspected, repackaged, and retested prior to permanent assembly. This capability may reduce unnecessary device loss by distinguishing packaging failures from probe defects prior to irreversible packaging for *in vivo* studies. The results indicate that a reversible packaging strategy for mechanically adaptive microfluidic neural probes is feasible.

Future work will evaluate long-term seal reliability and determine whether repeated assembly and extended compression affect probe integrity and microfluidic performance, enabling longitudinal studies of microfluidic probe degradation. By enabling repeated inspection and validation of individual probes, this packaging strategy provides a valuable tool for developing more reliable microfluidic neural interfaces that support long-term brain-computer interface performance.

Faculty Project Mentor: Dr. Allison Hess-Dunning, Department of Electrical, Computer, and Systems Engineering, Case Western Reserve University

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Poster #52

Non-pneumatic Dynamic Compression Device Promoting Lymphatic Drainage

Saanvi Gutta, Biomedical Engineering and Electrical Engineering; Dr. Yusuf Dikici, Dept. of Mechanical and Aerospace Engineering, Case Western Reserve University, Dept. of Mechanical Engineering, Bartin University; Dr. Gary Blackburn, Dept. of Biomedical Engineering, Case Western Reserve University; Dr. Karem Harth, Harrington Heart and Vascular Institute, University Hospitals; Dr. Irfan Ullah, Harrington Heart and Vascular Institute, University Hospitals; Dr. Ozan Akkus, Dept. of Mechanical and Aerospace Engineering, Dept. of Biomedical Engineering, Case Western Reserve University

Lymphedema is a chronic, progressive condition characterized by impaired lymphatic drainage due to cancer treatment, infection, injury, genetics, or venous disorders. It leads to extreme swelling of the limbs, fat accumulation, inflammation, and tissue fibrosis, which cause patients debilitating pain, restricted mobility, and stress. The standard treatment for lymphedema utilizes compression devices, such as the nonpneumatic Dayspring device by Koya Medical. However, Dayspring is limited by poor anatomical fitting, which creates pressure dead zones and uneven pressure profiles. Furthermore, the pressure amplitudes imparted by these systems are not well-defined. To address these gaps in technology, we developed D-Flate as a sensor-embedded, non-pneumatic compression device that integrates a closed-loop feedback control system to overcome limitations of existing compression devices for lymphedema management. This research involves developing a benchtop testing set-up to support the equivalence of D-Flate to the predicate Dayspring device for a Food and Drug Administration (FDA) equivalence-based 510(k) application. To accomplish this, we worked on programming, configuring, and calibrating a flexible pressure sensing strip (PSS) for benchtop testing. The PSS was designed and built with optimized wire management to map pressure distributions across the treatment regions on a silicone leg model. Force-sensitive resistor (FSR) sensors were conditioned with test weights and calibrated by relating pressure measurements from Kikuhime bladder pressure sensors to sensor resistance readings. Actuation pressure, pressure consistency across segments, and baseline pressure will be analyzed for both devices using the PSS. It is expected that D-Flate and Dayspring will have equivalent pressure levels, but D-Flate will outperform Dayspring in eliminating dead spaces and achieving uniform pressure profiles.

Faculty Project Mentor: Dr. Ozan Akkus, Department of Mechanical and Aerospace Engineering, Case Western Reserve University

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Poster #53

Understanding Role of Potentially Beneficial Fungal Species in Mediating Water Mold (Phytophthora cinnamomi) Pathology of Rhododendron

Afshan Ara, Biology ; Neyssa Encarnacion, Chemical Biology ; Saliha Ahmad, Biology ; Abisola Folorunso, Biology ; Jean H. Burns, Biology

Plant disease is dangerous for diversity of whole ecosystems, environmental health, food security and economic activity/trade. Historically, food supply and entire species have been lost to diseases that primarily cause damage across individuals rather quickly. This research study aims to address the role of two different fungi, *Trichoderma* and ericoid mycorrhizal fungi, which are commonly found in plant microbial networks, on mediating symptoms of *Phytophthora cinnamomi*, a water mold that inflicts damage to plants by causing rotting of root systems. Evaluating the possible beneficial effects of fungal applications can provide useful information for developing natural solutions for water molds and other pathogens inflicting damage to plants, especially crops. The methodology consists of planting seven different species of Rhododendron for a total of 840 planted pots, incubating cultures of the fungi and pathogen, creating blocks so that there remain controls and plants receiving the pathogen with either *Trichoderma* or ericoid mycorrhizal fungi treatment, and applying fungal treatment to the soil community once cultures are established. Controls will receive uninoculated agar. The pathogen, cultured in the laboratory, will be added to specific pots to reflect absent and present conditions after four weeks of soil microbial treatment establishment. Leaves will be assessed for damage, root to shoot ratio, survival, and total biomass will be recorded and analyzed using mixed linear models in R to understand response to treatment. Due to prior work with *Trichoderma* suggesting it serves as a protector against disease progression, and its ability to grow and establish much faster than ericoid mycorrhizal fungi, it is expected to be a better treatment for rhododendron undergoing damage and stress from *Phytophthora cinnamomi*. Finding that these treatments significantly reduce damage from common and widespread pathogens will set the groundwork for introducing more effective biocontrol agents both logistically and environmentally, than those currently used to fight root rot pathogens in rhododendron.

Faculty Project Mentor: Dr. Jean H. Burns, Department of Biochemistry, Case Western Reserve University

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Poster #54

Ontology-Based Linked Data Modeling and Analysis of Global Fertilizer Trade

Yongyi Mei; Laura S. Bruckman; Erika I. Barcelos, Department of Materials Science and Engineering, Case Western Reserve University

Fertilizer trade data provide valuable insight into global agricultural supply chains while serving as a practical foundation for semantic data modeling. However, traditional datasets do not explicitly represent relationships between concepts, and therefore limit how effectively computers can interpret and understand the data. This research investigates how linked data and ontology-based modeling can be used to structure and interpret geospatial datasets in a machine-readable and interoperable form. A fertilizer import and export dataset was used as a case study to demonstrate how raw trade records can be transformed into a formal linked data representation while also being analyzed in R using the tidyverse to examine dataset structure and summarize fertilizer trade patterns. The dataset was transformed into ontology diagrams, where individual variables were modeled as structured concepts connected through defined relationships. These diagrams were then converted into Turtle (.ttl) files using Cemento, a tool that converts ontology diagrams into Resource Description Framework (RDF) representations (such as Turtle) that can be interpreted and queried by computers through a command-line workflow. Core trade variables were represented as linked concepts organized through standard ontology relationships that define labels, definitions, and class structure. This semantic framework improves machine interpretation of the data, supports interoperability and reuse across systems, and enables geospatial integration of trade information, providing a foundation for analyzing spatial patterns in global fertilizer flows.

Faculty Project Mentor: Erika Barcelos, Department of Materials Science and Engineering, Case Western Reserve University

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Poster #55

Evaluating Multi-Strain Enrichment for Bacteriophage Isolation from Gardnerella and Prevotella

Kaylee Nguyen, Nutritional Biochemistry and Metabolism and Dance; Melissa Shinfuku, Department of Pathology, Case Western Reserve University; Gina Lewin, Department of Pathology, Case Western Reserve University

The vaginal microbiome, the community of microorganisms in the vagina, plays a critical role in maintaining women's health. A healthy vaginal microbiome is typically characterized by the dominance of *Lactobacillus* species, and bacterial vaginosis (BV) can occur when this dominance shifts and is replaced by an overgrowth of anaerobic bacteria, such as *Gardnerella* and *Prevotella*. BV is the most common form of vaginal dysbiosis among women of reproductive age and is associated with an increased risk of sexually transmitted infections and high recurrence rates, with more than half of cases recurring within one year. Bacteriophages, which are viruses that infect specific bacteria, are often found in natural sources such as wastewater. Because conventional antibiotic treatments frequently fail to prevent BV recurrence, bacteriophages represent a promising targeted therapeutic alternative. In this project, we aim to better characterize bacteriophage against *Gardnerella* and *Prevotella*. First, because many bacteriophages have narrow host ranges and can only infect few specific bacterial strains, we are investigating whether enriching environmental samples with multiple *Gardnerella* and *Prevotella* strains yields more phages than enrichment with a single strain. We hypothesize that providing a greater diversity of potential hosts will increase the number of distinct phages that can infect, replicate, and be isolated. We are performing phage enrichments using wastewater with either individual or multiple bacterial strains. Following enrichment, we are using spot tests and plaque assays to isolate bacteriophages. Second, we are computationally characterizing virus-mediated antimicrobial resistance within vaginal metagenomes. Together, this study will expand our understanding of the vaginal microbiome while contributing to the development of targeted phage-based therapies as a potential alternative to traditional antibiotics for the treatment of recurrent BV.

Faculty Project Mentor: Gina Lewin, Department of Pathology, Case Western Reserve University

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Poster #56

Data Curation for Molecular Discovery and Property Prediction

Michael Parker, Isabella Giammattei, Meredith Francis, Quynh D. Tran, Laura Bruckman, Roger H. French, Materials Science and Engineering, Case Western Reserve University

Energetic materials—including 6-Oxo-2,5,7-trinitro-2,5,7,9-tetraazabicyclo[4.3.0]nonane-8-one, pentanitrobenzene, 5-picrylamino-1,2,3,4-tetrazole, potassium 5-aminotetrazolate, and polyvinyl nitrate—are compounds that demonstrate high reactivity due to their ability to store and rapidly release chemical energy. In these systems, functional groups such as nitro and other electron-withdrawing groups (EWGs) regulate molecular behavior by withdrawing electron density through inductive and resonance effects. These EWGs can induce particular bonds in the molecule to be more polarized and thus weaker, destabilizing the parent molecule. The products generated are generally favorable (H_2O, CO_2, etc.) in comparison to their initial products, establishing a large thermodynamic driving force for energy release, hence the name energetic materials. Graph Neural Networks (GNNs), a class of deep learning models, are developed to predict molecular properties of interest for energetic materials. This work focuses on the curation of an energetic materials dataset from the Energetic Materials Encyclopedia by Thomas Klapotke. The data is critical for successful training and accurate predictions with GNNs.

Faculty Project Mentor: Quynh D. Tran, Materials Science and Engineering, Case Western Reserve University

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Poster #57

Developing an Alloxazine Derivative as Prospective Imaging-Guided Photodynamic Therapy Agent

Izabella Isaza, Chemical Biology; Rubej Khan, Chemistry; Nitza V. Falcón-Cruz, Chemistry; Karitza Díaz González, Chemistry; and Carlos E. Crespo-Hernández, Department of Chemistry, Case Western Reserve University.

Alloxazine, a flavin-derived chromophore naturally present in biological systems, has recently emerged as a promising heavy-atom-free photosensitizer. Recent work in the Crespo group demonstrated that sugar-conjugated alloxazine derivatives bearing methoxy substituents exhibited long-lived triplet states, near-unity singlet-oxygen quantum yields, sufficient fluorescence for cancer cell imaging and phototoxicity (Khan, R., et al. *Photochem. Photobiol.*, **2026**, *102*, 589-604). The investigation established alloxazines as multifunctional agents for image-guided photodynamic therapy (PDT). Building on this foundation, this study explores the thiophene group as an alternative strategy to enhance the imaging capability of the alloxazine while maintaining therapeutic efficacy. A thiophene group was attached to a sugar-protected alloxazine via a palladium-catalyzed cross-coupling reaction to generate a thiophene-alloxazine (THP-Alloxazine) conjugate. The product was purified by silica gel chromatography and was characterized by ^{1}H NMR spectroscopy. Photophysical investigations revealed absorption and emission maxima at 406 nm and 510 nm, respectively. Additionally, a fluorescence quantum yield of 0.51 ± 0.02 was determined in acetonitrile, which is 4.5-fold higher than the fluorescence quantum yield previously measured for the methoxy-substituted alloxazine derivative. This result demonstrates that the thiophene incorporation enhances the fluorescent properties of the alloxazine scaffold while extending its conjugation. These properties are beneficial for bioimaging and therapeutic applications. Ongoing studies are focused on performing theoretical calculations and cell biology experiments to further understand its electronic properties and evaluate its potential as a bioimaging and phototherapeutic agent.

Faculty Project Mentor: Dr. Carlos E. Crespo-Hernández, Department of Chemistry, Case Western Reserve University

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Poster #58

Evaluating the Glomerular Basement Membrane Structural Integrity in Timp3 Mutant Kidneys

Saanvi Kumar, Neuroscience; R. Allen Schweickart, Department of Heart, Blood, and Kidney Research, Cleveland Clinic Research, Cleveland Clinic; Oliver Wessely, Department of Heart, Blood, and Kidney Research, Cleveland Clinic Research, Cleveland Clinic.

Sorsby fundus dystrophy (SFD) is a rare genetic eye disorder that causes the breakdown of the macula. This breakdown can lead to macular degeneration and loss of vision, as well as night blindness. SFD is caused by a mutation in the *Tissue Inhibitor of Metalloproteinase-3* (*TIMP3*) gene. TIMP3 is a protein that normally inhibits the enzyme matrix metalloproteinases (MMPs). However *TIMP3* mutations cause abnormal aggregates of TIMP3, creating drusen deposits between the basement membrane of the retinal pigment epithelium (RPE) and the inner layer of the Bruch's membrane. Interestingly, parallels exist in other basement membrane disorders such as Alport Syndrome. Alport Syndrome is a rare genetic condition that occurs due to a mutation that affects type IV Collagen, an essential structural protein of the basement membrane in ear, eye, and kidney. These mutations result in sensory deficits including hearing loss, thinning of the macula and other ocular abnormalities. In the kidney, Alport Syndrome leads to structural defects in the glomerular basement membrane (GBM) of the kidney, which severely impede the filtration process resulting in hematuria, proteinuria, and hypertension. Based on these similarities between Bruch's membrane and the GBM, we hypothesize that *TIMP3* mutations cause structural defects in the GBM. We aim to determine if in addition to the ocular mutations in TIMP3 have an unexpected consequence on renal filtration structure, mirroring the multi-organ effect of Alport syndrome. To this end, we investigated mice, which carry an engineered Timp3 variant homologous to one of the most common human Sorsby variants. To assess GBM morphology, kidney tissues were harvested from the *Timp3* mutant mice and wildtype controls and analyzed by Hematoxylin and eosin (H&E), Periodic Acid Schiff (PAS) and trichrome staining. In addition, to examine structural integrity, we then used immunofluorescence for Laminin subunit alpha-1 (Lama1) and Podocalyxin to visualize the potentially damaged or thickened GBM.

Faculty Project Mentor: Dr. Oliver Wessely, Department of Heart, Blood, and Kidney Research, Cleveland Clinic Research, Cleveland Clinic

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Poster #59

Special Delivery: Locating and Characterizing Virus-like Particles Created by a Fluorescent HIV-1 Gag-PABPC1 fusion

Penelope Cloonan, Biochemistry; Alexa Schnell, Dept. of Biochemistry, Case Western Reserve University; Dr. Joseph Luna, Dept. of Biochemistry, Case Western Reserve University.

Gag is a protein that is involved in the creation, budding, and release of infectious particles in HIV-1 infection. Independent Gag expression creates virus-like particles (VLPs)—protein-based hollow shells lacking infectious material. Poly(A)-binding protein cytoplasmic 1 (PABPC1) has many functions involving mRNA regulation, including managing export and stability. This project works off a larger goal of the Luna Lab to use VLPs to package RNA as a means of non-invasively studying the transcriptome. We aim to determine if Gag will produce VLPs, if these VLPs can package RNA with the help of PABPC1 and where Gag is localizing in these cells. For this experiment, three constructs were created. The first plasmid contains Gag with a V5 tag and truncated PABPC1. The second construct contains Gag with a V5 tag and mKate2, a red fluorescent protein (RFP). The third construct contains Gag with a V5 tag, mKate2 and truncated PABPC1. Constructs will be transfected into U2OS and HEK293 cells. The cells and supernatant of each condition will be collected, and using western blots as a readout, determine if VLPs are produced. We expect that Gag will be present in the cell and supernatant for all conditions. Further testing with qPCR will reveal if RNA is packaged in the VLPs. We expect that constructs one and three will be able to package RNA, while 2 cannot. Using immunofluorescence, we will image the cells to determine where Gag is localizing. We expect to see all constructs localize around the cell membrane. These studies fit into the Luna Lab's ongoing work developing a non-invasive transcriptome reporter using HIV-1 Gag.

Faculty Project Mentor: Dr. Joseph Luna, Department of Biochemistry, Case Western Reserve University

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Poster #60

Ontology Framework for Standardizing X-ray Diffraction Metadata

Jiani Xu, Willoughby South High School; **Noah Lee,** John Hay High School

Synchrotron science produces massive volumes of data that must be curated so that both humans and computers can find, access, understand, and reuse it. Ontologies represent scientific knowledge in a structured way, defining concepts and their relationships to support FAIR (Findable, Accessible, Interoperable, and Reusable) data principles. This work focused on expanding and improving the X-ray diffraction (XRD) branch of a materials science ontology, with the goal of increasing its completeness, consistency, and long-term usability.

To support this goal, definitions were developed for several hundred XRD terms, and a Python-based workflow was implemented to automatically link each definition to its corresponding ontology term. However, the ontology contains concepts from multiple areas of materials science beyond XRD. So this workflow also enabled verification that definitions were correctly associated with their respective concepts and improved the efficiency of ontology expansion.

While this work specifically focused on X-ray diffraction, it contributes to a broader effort to develop a machine-readable scientific knowledge base. By improving the ontology, scientific data management can be enhanced, interoperability between research groups can be increased, and future AI-driven applications and computational tools can be supported. This work demonstrates how integrating materials science with computational methods can help establish the foundation for modern scientific research.

Faculty Project Mentors: Jonah Bachman, Ozan Dernek, Roger French, Department of Material Science and Engineering, Case Western Reserve University

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Poster #61

Impedimetric Microfluidic Flow Rate Sensor for Validation of Intracortical Neural Probe Drug Delivery

Nico Bartoe, Biomedical Engineering; Dr. Melinda Lake-Speers, Dept. of Mechanical and Aerospace Engineering, Case Western Reserve University; Dr. Allison Hess-Dunning, Dept. of Electrical, Computer, and Systems Engineering, Case Western Reserve University, Louis Stokes Cleveland VA Medical Center

Implanted intracortical probes offer a way to bypass the blood-brain barrier in order to facilitate localized drug delivery and measure electrical activity within brain tissue. Drug delivery is especially important in allowing these probes to be able to combat neural inflammation caused by probe implantation. Drug delivery flow rates are often controlled by pressure-driven systems such as osmotic pumps. However in practical use implanted microfluidic probes are a black box, offering no way to know if any sort of probe failure *in vivo* occurs until it is removed from the subject. If we don't know how much drug is being delivered, we cannot interpret its pharmacological effects on a subject accurately, leaving efficacy and safety concerns.

This project aims to validate flow rate in real time through the design and evaluation of an in-channel microscale impedimetric flow rate sensor. In a microfluidic channel, an electrical double-layer is formed when an electrolyte flows within it and changes shape/thickness based on flow rate. To evaluate the flow sensor, we apply an AC voltage across two parallel electrodes within the microfluidic channel using PBS as a sample electrolyte, measuring impedance across the channel at flow rates of 0 uL/hr to 300 uL/hr in steps of 50 uL/hr. We found that the magnitude of impedance decreases by approximately 90 ohms per uL/hr increase.

In our future work, the system will be further miniaturized for use in our 50 micron wide intracortical probe flow channels, which is expected to increase sensitivity to flow rates lower than 10 uL/hr. This project introduces a potential method for real-time validation of intracortical microfluidic probe integrity and flow rate sensing, opening the door for integration into active drug delivery systems that can be tailored to individual user needs.

Faculty Project Mentor: Dr. Allison Hess-Dunning, Department of Electrical, Computer, and Systems Engineering, Case Western Reserve University and VA Northeast Ohio Healthcare System

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Poster #62

Automated Detection of Stair Negotiation Errors Using Machine Learning–Based Video Analysis

Alyssa Schellhouse, Biomedical Engineering; Aarika Sheehan, Louis Stokes Cleveland Department of Veterans Affairs Medical Center; Dr. Hamid Charkhkar, Department of Biomedical Engineering, Case Western Reserve University

Lower limb loss can compromise mobility during complex tasks such as stair negotiation or navigating uneven terrain, where inaccurate foot placement may contribute to unsafe or inefficient movement strategies. Quantifying these errors can provide an objective measure of stair negotiation performance and may be particularly valuable when evaluating assistive and rehabilitation technologies. As part of a long-term study evaluating the effects of a sensory neuroprosthesis that restores sensation from the prosthetic foot, participants complete repeated stair ascent and descent trials on a four-step instrumented staircase (Bertec Inc.). Four cameras capture each trial, and stair negotiation errors, including heel scrapes, toe overshoots, and other unsafe foot placement events, are identified from video recordings. Currently, error identification requires time intensive manual review of video footage, limiting the efficiency and scalability of this analysis. In this project, we developed a machine learning–based video analysis pipeline to automate the detection of stair negotiation errors. This consists of a custom-trained YOLO11s-seg model to segment the participant's shoes within each video frame. A subsequent Python-based detection algorithm then identifies stair boundaries and performs various calculations with the resulting shoe and stair coordinate regions to quantify foot placement and flag potential errors. To validate the pipeline, recorded trials are also manually annotated for predefined stair negotiation errors and compared with automated detections. This project will deliver a validated automated pipeline that will accurately detect stair negotiation errors. This approach is intended to reduce manual video review and enable scalable, objective quantification of stair negotiation performance across studies evaluating prosthetic, sensory restoration, and rehabilitation interventions.

Faculty Project Mentor: Dr. Hamid Charkhkar, Department of Biomedical Engineering, Case Western Reserve University

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Poster #63

Uncertainty Quantification via an Efficient CUR-Based Gaussian Process Regression Framework for Predicting β-Phase Volume Fraction of Ti-6Al-4V Alloy

Armagan Koyuturk, Hudson High School; Ayorinde E. Olatunde, Materials Data Science for Stockpile Stewardship: Center of Excellence, Case Western Reserve University, Department of Mathematics, Applied Mathematics and Statistics, Case Western Reserve University; Ozan Dernek, Materials Data Science for Stockpile Stewardship: Center of Excellence, Case Western Reserve University; Roger H. French, Materials Data Science for Stockpile Stewardship: Center of Excellence, Case Western Reserve University, Department of Materials Science and Engineering, Case Western Reserve University, Department of Computer and Data Sciences, Case Western Reserve University; Anirban Mondal, Materials Data Science for Stockpile Stewardship: Center of Excellence, Case Western Reserve University, Department of Mathematics, Applied Mathematics and Statistics, Case Western Reserve University.

Predicting the β-phase volume fraction from synchrotron X-ray diffraction patterns of a Ti-6Al-4V alloy often requires analyzing large, high-dimensional datasets, which is computationally expensive. To reduce this computational burden, we used CUR matrix decomposition, a dimensionality reduction technique that approximates the original dataset by selecting a small subset of its columns and rows, and a link matrix that preserves its structural information. This approach reduces the dataset's feature space, enabling more efficient analysis while retaining features relevant to accurate β-phase volume fraction estimation.
A Gaussian Process (GP) regression model is then used to model the relationship between the reduced diffraction data and the β-phase volume fraction. The GP model provides a way to quantify the uncertainty in the predictions. This provides an efficient framework for β-phase volume fraction prediction with uncertainty quantification and may be extended to other materials characterization problems involving diffraction data.

Faculty Project Mentor: Ayorinde E. Olatunde, Materials Science and engineering, Case School of Engineering

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Poster #64

Verification of Chemical Data for Energetic Materials in a Reference Database

Yusef Rudolph; Isabella Giammattei; Meredith Francis; Quynh D. Tran; Laura Bruckman; Roger H. French; Materials Science and Engineering, Case Western Reserve University

The goal of this project is to verify the chemical data for compounds in a JSON database by comparing each entry with published scientific literature. This includes checking chemical names, molecular formulas, molecular structures, and reported physical and energetic properties to ensure the data is accurate, complete, and consistent. A verified database provides reliable reference data for future research.

Energetic materials include a wide range of compounds with applications in propellants, explosives, pyrotechnics, and gas-generating systems. Examples examined in this project include 3-amino-5-nitro-1,2,4-triazole (ANTA), 3-amino-6-nitro-1,2,4,5-tetrazine-2,4-dioxide, Azido-acetic-acid-2-[2′-(2″-azido-acetoxy)-ethoxy]-ethylester, Azido-acetic-acid-3-(2′-azido-acetoxy)-2-(2′-azido-acetoxymethyl)-2-nitro-propylester, and Azido-acetic-acid-3-(2′-azido-acetoxy)-2,2-bis-(2′-azido-acetoxymethyl)-propylester. These compounds represent different classes of energetic materials and demonstrate how molecular structure influences energetic behavior.

Many energetic compounds contain functional groups such as azido (-N_3), nitro (-NO_2), and N-oxide groups, along with nitrogen-rich ring systems. These features store large amounts of chemical energy and influence properties such as density, thermal stability, oxygen balance, and sensitivity. Understanding these relationships helps explain why some compounds are more energetic or more stable than others.

The verified database will support future research, including computational and machine learning models that predict the properties of new energetic materials. Improving the quality of the reference data leads to more accurate predictions and supports the development of next-generation energetic compounds.

Faculty Project Mentor: Quynh Tran, Materials Science and Engineering, Case Western Reserve University

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Poster #65

Designing an Intelligent Power Module for Control of Micromotor used in Brain Targeted Low-Flow Rate Drug Delivery

Austin Schneidler, Electrical Engineering; Haowei Ma, Mechanical Engineering; Dr. Melinda Lake-Speers, Dept. of Mechanical and Aerospace Engineering, Case Western Reserve University; Dr. Allison Hess-Dunning, Dept. of Electrical, Computer, and Systems Engineering, Case Western Reserve University, Advanced Platform Technology Center, Louis Stokes Cleveland VA Medical Center

Intracortical microfluidic drug delivery bypasses the blood-brain barrier, permits targeted doses of various therapies, and allows for activating and sustaining delivery across indefinite durations. Ultra-low flow rates are required to avoid exacerbating the neuroinflammatory response and to achieve consistent dosing. To leverage flexibility in drug selection and delivery profile without requiring surgical implantation, a wearable motorized peristaltic pump system is under development to mechanically transfer liquid from a drug reservoir to the desired region of the brain. For compatibility with testing in rodents, the system necessitates lightweight, micro-sized control electronics.

We designed an intelligent power module (IPM) to rotate a small motor at reduced speeds to produce a consistent and ultra-low flow rate of 0.1-0.2μL/h. The designed IPM utilizes pulse-width modulation (PWM) to efficiently actuate the motor while maintaining low power for extended battery life. To power the circuit, a zinc-air size 10 battery was selected as it offers superior energy density while maintaining minimal size and weight. Furthermore, the microcontroller unit (MCU) will run on Bluetooth low-energy connectivity, which enables wireless control of the motorized pump. The selected MCU is equipped with sufficient ports to monitor the voltage output of the battery, which can be used to monitor battery life and determine when a replacement is needed. To ensure consistency in MCU performance, a linear boost converter was incorporated into the circuit to account for battery stability and degradation. Future iterations of the IPM will incorporate a 4-layer printed circuit board (PCB) design to effectively minimize the size of the circuit while ensuring stable bluetooth connectivity. Developing miniaturized control electronics for a wearable pump will facilitate programmable neural drug delivery that is optimized to the needs of the individual.

Faculty Project Mentor: Dr. Allison Hess-Dunning, Dept. of Electrical, Computer, and Systems Engineering, Case Western Reserve University, Advanced Platform Technology Center, Louis Stokes Cleveland VA Medical Center

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Poster #66

Validation and Standardization of JSON Datasets for Energetic Compounds Using the Energetic Materials Encyclopedia

AbdulBaasit Tadese; Isabella Giammattei; Meredith Francis; Quynh D. Tran, Materials Science and Engineering, Case Western Reserve University; Laura Bruckman; Roger H. French, Materials Science and Engineering, Case Western Reserve University.

Energetic Compounds: This study examines the chemical structures and functional groups of several nitrate-containing compounds, including Ethriol trinitrate, ethylenediamine dinitrate, ethylene dinitramine, ethylene glycol dinitrate, and ethyl picrate. Energetic materials are widely used in explosives, propellants, and pyrotechnics, making accurate chemical information essential for research, safety, and engineering applications. To accomplish this, the JSON files for each compound were compared with the corresponding entries in the *Energetic Materials Encyclopedia* to verify chemical names, molecular formulas, and structural information. The data were then cleaned and standardized before identifying and comparing the functional groups present in each compound. These structural differences influence the compound's chemical properties, stability, and reactivity of energetic materials, which may affect the performance. Understanding these relationships provides a more reliable dataset for future analysis and demonstrates the importance of accurate structural information when studying energetic compounds.

Faculty Project Mentor: Quynh D. Tran, Materials Science and Engineering, Case Western Reserve University

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Poster #67

Cereblon Deficiency Impairs Mitochondrial Homeostasis and Generates Neurodegenerative Molecular Signatures

Sophia Han, Neuroscience; **Julia Duong**, Neuroscience, Yale University

According to the National Institutes of Health (NIH), dementia-related diseases affect more than 6 million Americans each year. Recent research into these neurodegenerative disorders demonstrates that the protein cereblon (CRBN) plays an essential role in mitochondrial homeostasis. Cereblon participates with the DNA binding protein 1 (DBBP1)-Cullin-4A E3 ubiquitin ligase complex to regulate neurodevelopment by targeting proteins for ubiquitin-related degradation. Here, we analyzed cell-specific sequencing data from Alzheimer's disease patients and observed decreased CRBN levels within hippocampal neurons. To further investigate CRBN's role in neurodegeneration, we sought to examine the impact of CRBN on mitochondrial redox regulation, as mitochondrial dysfunction is a hallmark of neurodegenerative disorders. Utilizing cereblon-deficient ($Crbn^{KO}$) and overexpressing ($Crbn^{OE}$) HT-22 mouse hippocampal neurons, we performed Seahorse XF analysis, mitochondrial assays, and proteomic mapping to measure mitochondrial respiratory capacity, oxidative stress, membrane potential,and mitochondrial proteome integrity. $Crbn^{OE}$ cells showed increased basal and maximal oxygen consumption rate (OCR) when tested on the Seahorse assay, while $Crbn^{KO}$ cells displayed worse performance. When measuring mitochondrial membrane potential using the JC-1 assay, we determined that $Crbn^{OE}$ improved the membrane potential, while $Crbn^{KO}$ reversed this effect. Finally, our proteomic analysis revealed that $Crbn^{KO}$ cells displayed greater alteration in the mitochondrial proteome than $Crbn^{OE}$ cells. Our results indicate that CRBN deficiency has deleterious effects on brain health, while CRBN overexpression elevates neuroprotective measures of mitochondrial function. This highlights cereblon-mediated mechanisms as a novel target for the treatment of neurodegenerative diseases.

Project Mentors: Salvatore Caradonna, Department of Psychiatry, University Hospitals; Faculty Sponsor: Dr. Andrew Pieper, Department of Psychiatry, University Hospitals

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Poster #68

Dark IV analysis of thermally cycled PV samples

Braelyn Marshall; Peter Burdick, Isabella Giammattei, Laura Bruckman; Department of Materials Science and Engineering, Case Western Reserve University

Materials aging occurs as the components within photovoltaic (PV) solar cells gradually degrade due to prolonged exposure to environmental conditions and continuous operation. Over time, factors such as thermal stress from repeated heating and cooling cycles, humidity, and mechanical stresses (such as strong winds, hail or impacts from weather) reduce panel efficiency, however the specific mechanisms responsible for degradation are not always well understood. This project investigates how solar cells respond to accelerated aging by comparing their electrical performance before and after thermal cycling. Samples will undergo thermal cycling to simulate years of repeated heating and cooling experienced during day and night outdoor temperature cycles over the years. Dark IV analysis, a technique that measures a solar cell's electrical characteristics in the absence of light, was performed before and after treatment to identify changes in electrical behavior associated with aging. By analyzing electrical properties such as series resistance, shunt resistance, and diode characteristics, the study aims to determine how thermal cycling affects internal resistance, structural defects, or short-circuit pathways. The results are expected to provide insight into the mechanisms of material degradation and support the development of more durable, longer-lasting PV cells.

Faculty Project Mentor: Laura Bruckman, Materials Science Department, Case Western Reserve University.

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Poster #69

Lactobacillus iners Microbe-Microbe Interactions and Inter-Strain Variation May Play a Role in HIV Susceptibility

Paulina Rullán Torres, Industrial Microbiology, University of Puerto Rico Mayagüez Campus; Alyssa R. Hamm, Center for Global Health, Case Western Reserve University; Dr. Gina R. Lewin, Center for Global Health, Case Western Reserve University

Human immunodeficiency virus (HIV) infects millions of people worldwide every year, with new HIV infections disproportionately affecting women. The state of the vaginal microbiome, optimal or otherwise, can play a key role in determining how susceptible an individual is to being infected with HIV. While *Lactobacillus* dominance is indicative of optimal conditions, *Lactobacillus iners* dominance has been associated with both optimal and non-optimal phenotypes, including HIV acquisition, preterm birth, and bacterial vaginosis (BV). We hypothesize that this variability can be explained by interactions between *L. iners* and other bacteria present in the vagina. First, to experimentally observe the interaction between *L. iners* and other vaginal bacteria, we designed co-culture experiments to evaluate if the commensal *Lactobacillus crispatus* or BV-associated microbes like *Gardnerella vaginalis* have an impact on *L. iners* growth rate. Based on our hypothesis that *L. iners* behavior is impacted by the vaginal microbiome, we expect *G. vaginalis* to increase *L. iners* growth rate while *L. crispatus* decreases *L. iners* growth rate. To further our analysis, we sought to understand whether *L. iners* exhibits inter-strain genetic variation that may mediate microbe-microbe interactions. We approached this question by constructing a phylogeny and pangenome using 24 bacterial isolates. We found that there is considerable inter-strain diversity in gene content, including in secretion systems and bacteriocin immunity. Together, these concepts could point to explanations for the variability in phenotypes associated with *L. iners* dominance as well as provide insight as to how *L. iners* could be interacting with other microbes in the vaginal microbiome to affect susceptibility to HIV.

Faculty Project Mentor: Dr. Gina R. Lewin, Department of Pathology, Case Western Reserve University

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Poster #70

Clustering of Counter-Rotating Particles in Dense Suspensions During Discontinuous Shear Thickening and Jamming

Siddharth Sah; Antonio Maia, School of Engineering; Muzaffar Rafique, Department of Macromolecular Science and Engineering; Abhinendra Singh, Department of Macromolecular Science and Engineering

Discontinuous Shear-Thickening (DST) in dense suspensions is a phenomenon in which viscosity increases abruptly with shear rate due to the interplay between interparticle interactions occurring at the so-called jamming transition. Simulations of dense suspensions under shear reveal clusters of counter-rotating particles, which we define based on particles rotating against the direction of shear. However, *why these clusters form and their exact impact on the behavior* have not been investigated. Here, we test various clustering techniques primarily to assess which analysis and algorithm are best suited to this context.
We tested various clustering techniques in the Python package scikit-learn, including their methodologies for identifying clusters and their common applications in our simulations. We further investigated the correspondence between clusters identified by Python and those identified by visual inspection.
We envision this process as a key step toward refining methods for analyzing clusters of counter-rotating particles, advancing our understanding of discontinuous shear thickening (DST) and jamming. Improved insight into DST is important because dense suspensions are widely used in materials such as cements, slurries, and paints. A deeper understanding could optimize their transport and processing while enabling technologies that require an elegant blend of energy dissipation and rigidity. Applications span civil engineering, including earthquake-resistant materials, and soft robotics, where adaptable yet robust structures are essential, fostering innovation across multiple scientific and engineering disciplines.

Faculty Project Mentors: Antonio Maia, School of Engineering; Muzaffar Rafique, Department of Macromolecular Science and Engineering; Abhinendra Singh, Department of Macromolecular Science and Engineering

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Poster #71

Modular Microfluidic Device Designed for Localized Analysis of Organ-on-a-Chip

Madeleine Lukang, Mechanical Engineering; Dr. Allison Hess-Dunning, Dept. of Electrical, Computer, and Systems Engineering, Case Western Reserve University, Louis Stokes Cleveland VA Medical Center; Dr. Melinda Lake-Speers, Dept. of Mechanical and Aerospace Engineering, Case Western Reserve University

Organ-on-a-chip (OoC) devices combine microfluidics and cell cultures to simulate the structure and function of organs in the human body, including enabling physiological fluid flow that is not possible on conventional cell culture well plates. OoCs could play a critical role in the advancement of drug discovery during the pre-clinical trial stages, providing more direct data on the effects on human cells in comparison to animal models. Current limiting factors of OoCs to broader deployment include scalability and ease of use. Many OoCs are designed as single-organ systems which mimic a specific organ's functions and behaviors (i.e. lungs, kidneys, etc.). The major caveat of these designs is the failure to model multi-organ systems which provide deeper insight to the interconnected processes of the body. To study these, a more standardized model is needed to allow for easy integration of multiple organ modules. This study presents the development of a modular microfluidic device that enables the connection and interchanging of multiple organ-on-a-chip modules. Within the scope of the project, we demonstrate leakproof tube-free connections up to 5 mL/min from a syringe pump between single chamber wells as proof-of-concept using a benchtop 3D printer. CAD software was used to design and model the modular wells and their connectors. Minimum feature sizes and optimal angles were determined for successful channel printing. Dimensional analysis investigated the standardization of 3D printing the design, measuring the ranges of alignment peg height (0.175-0.440mm) and tee height deviation (0.057-0.324mm).

Future realizations of the chip would incorporate single cell and co-cultures for downstream biology studies including testing long-term cell culture viability and integrating actuators and electrodes for cell perturbation and sensing. Importantly, the modularity enables localized sampling that could support localized genomic and proteomic sampling for spatially dependent analysis of molecular profiles in and across organ modules.

Faculty Project Mentor: Dr. Melinda Lake-Speers, Department of Mechanical and Aerospace Engineering, Case Western Reserve University.

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Poster #72

HIV Tat Site-specific Mutations Reveal Mechanisms of 7SK snRNP Remodeling and Viral Transactivation

Rania Rodríguez-Quiles, Department of Industrial Microbiology, University of Puerto Rico, Mayagüez Campus, PR; Amie Donner, Department of Molecular Biology & Microbiology, Case Western Reserve University School of Medicine; Uri Mbonye, Department of Molecular Biology & Microbiology, Case Western Reserve University School of Medicine, Rustbelt Center for AIDS Research, Case Western Reserve University

During its replicative life cycle, HIV establishes transcriptionally latent reservoirs in lymphoid tissues and circulating blood, primarily in the memory subset of $CD4^+$ T lymphocytes, which retain the ability to reactivate, forming a spreading infection if antiretroviral treatment is interrupted. Thus, viral latency remains the major challenge to finding a cure for HIV infection. Emergence of HIV from latency requires transactivation of epigenetically silenced proviruses by the viral Tat protein in complex with the host transcription elongation factor P-TEFb. In actively dividing cells, P-TEFb activity is controlled by sequestration into 7SK snRNP. Among latency-reversal agents (LRAs) that can reverse epigenetic repression at the HIV promoter as well as stimulate P-TEFb by releasing the enzyme from 7SK snRNP, Tat is considered ideal because it elicits minimal off-target adverse cellular effects. This research study employed a mutagenesis approach to investigate the mechanism by which Tat remodels 7SK snRNP to mobilize the recruitment of P-TEFb to proviral HIV. Jurkat T cells latently infected with a single-round HIV reporter virus were used to generate cellular models stably expressing FLAG epitope-tagged forms of wildtype Tat or a panel of point mutants known to disrupt RNA binding (R52A, K50Q) or interaction with P-TEFb (C22G). Affinity tag-based immunoprecipitation was carried out to comparatively examine the extent of Tat's incorporation into 7SK snRNP (Tat:7SK) and ability of Tat to dissociate P-TEFb from 7SK snRNP. Tat:7SK assembly was also examined by high resolution microscopy following combined immunofluorescence and RNA FISH. Of the three mutants examined, R52A Tat retained 20% of wildtype transactivation activity and bound P-TEFb albeit to a much lesser extent, without associating with 7SK snRNP. Our findings reveal an alternate, but less efficient, mechanism by which Tat can liberate P-TEFb from 7SK snRNP without the need to interact with the 7SK RNA scaffold.

Faculty Project Mentor: Prof. Uri Mbonye, Department of Molecular Biology & Microbiology, Case Western Reserve University School of Medicine, Cleveland, OH, Rustbelt Center for AIDS Research, Case Western Reserve University

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Poster #73

Effect of Choline as a Broad Neuroprotectant in Neonatal Cerebellar Development

Kangana Modi, Biology & Medical Anthropology; Mrinaj Janampalli, Department of Pediatrics, Case Western Reserve University; Ameneh Lamsehchi, Department of Pediatrics, Case Western Reserve University; Cynthia Bearer, Division of Neonatology, University Hospitals Rainbow Babies and Children's Hospital

Neonatal hyperbilirubinemia can cause cerebellar injury and decreased motor functions. Our previous studies have demonstrated that choline supplementation in the offspring of choline-deficient mothers improves cerebellar development and motor functions in models of bilirubin-induced neurotoxicity. It remains unclear whether choline can still act as a broad neuroprotectant in offspring when choline intake is sufficient in the expecting mothers. This study investigates whether postnatal choline supplementation attenuates bilirubin-induced cerebellar dysfunction in neonatal Gunn rats born to choline-sufficient mothers. Gunn rats, a well-established model of neonatal hyperbilirubinemia who carry a mutation in the gene encoding for uridine diphosphate glucuronyltransferase (j), were assigned to eight experimental groups based on genotype of Nj or jj, choline or saline supplementation, and saline or sulfadimethoxine (SDMX) treatment. Choline or saline was administered daily via subcutaneous injections from postnatal day (P)1 to P21. On P5, pups received an intraperitoneal injection of either saline or SDMX to increase the free bilirubin which passes through the blood brain barrier. Cerebellar function was evaluated using negative geotaxis on P10 and rotarod performance on P28-30. Following the behavioral testing on P30, the cerebellums were dissected and weighed. While data collection is ongoing, we hypothesize that choline supplementation will decrease the bilirubin-induced cerebellar dysfunction, resulting in improved behavioral performance and increased cerebellar weight compared to the untreated hyperbilirubinemic controls. If confirmed, the findings would support choline acting as a broad neuroprotectant, its benefits extending to all pregnancies, choline-deficient and sufficient.

Faculty Project Mentor: Dr. Cynthia Bearer, Division of Neonatology, University Hospitals Rainbow Babies and Children's Hospital

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Poster #74

Running a Mechanical Parameter Scan of a Hydrogel Two-Photon Polymerization Resin using Tensile Expansion Microscopy

Benjamin Mellick, Engineering Physics

Two-Photon Polymerization (2PP) is an additive manufacturing method that allows for the construction of geometries on the micrometer and nanometer scale. Hydrogel based resins are becoming increasingly popular in biological applications of 2PP. In this area, understanding the mechanical properties of the hydrogel resin prints is very important for cell growth and analysis. Unfortunately, mechanically testing objects this small is difficult and cumbersome by traditional methods. To circumvent this problem, we will use Tensile Expansion Microscopy (TExM) to perform parameter scans of hydrogel resin prints embedded in a larger hydrogel with known properties. By varying the 2PP print parameters of laser power and scanning speed, several iterations of a consistent design can be printed in a grid. This grid is then embedded in a hydrogel with known parameters. During expansion, the larger hydrogel will be unable to pull prints that are more stiff than the hydrogel is. Through observation of the prints pre and post expansion, we can understand what 2PP print parameters yield the same mechanical properties as the hydrogel. This method will allow facilities that may not have the equipment to test the mechanical properties of these 2PP 3D prints to search for what print parameters match the properties they need for their research.

Faculty Project Mentor: Dr. Lydia Kisley, Ambrose Swasey Associate Professor, Departments of Physics & Chemistry, Case Western Reserve University

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Poster #75

Responsiveness and Mechanisms of TCR and IL-15 Stimulation by CD57+ CD8 T cells in PWH and PWoH

Vikhyath Jonnalagadda, Department of Biochemistry; Katelyn O'Hare, Division of Infectious Diseases and HIV Medicine; and Michael L. Freeman, Division of Infectious Diseases and HIV Medicine

People with HIV (PWH) have an elevated risk of developing cardiovascular disease (CVD), and CD8 T cells expressing the immunosenescence marker CD57 have been linked to this higher CVD risk. Using cells from PWH, we previously showed that interleukin-15 (IL-15) maintains CD57+ T cell viability and proliferation, whereas T cell receptor (TCR) engagement drives activation-induced cell death, but we did not examine these pathways in cells of people without HIV (PWoH). Here, we evaluated proliferation, activation, and signaling in human peripheral blood mononuclear cells (PBMCs) from PWH and PWoH. PBMCs were stimulated with plate-bound anti-CD3 plus soluble anti-CD28 (TCR stimulation) or with IL-15, then analyzed by flow cytometry. The mTOR inhibitor rapamycin and the PI3K inhibitor LY294002 were used to assess the roles of mTOR and PI3K, respectively, and STAT5 inhibitor was used to assess the STAT5 signaling pathway. After 7 days, TCR and IL-15 elicited similar proliferation of CD57+ CD8 T cells in both PWH and PWoH, and blocking with either rapamycin or LY294002 led to a significant decrease in proliferation under IL-15 stimulation. After 2 days, TCR and IL-15 lead to similar expression of the activation marker CD69 on CD57+ CD8 T cells in both PWH and PWoH. Both inhibitors significantly reduced CD69 expression only after IL-15 stimulation, with LY294002 producing a stronger inhibition than rapamycin. After 45 minutes, STAT5 inhibition in both stimulations led to a decrease in phosphorylated (p)S6 in cells of both PWH and PWoH, showing that phosphorylation was downstream of STAT5 signaling. Our findings demonstrate the responsiveness of CD57+ CD8 T cells under antigen specific and antigen nonspecific stimulations, while also characterizing the role of the PI3K-AKT-mTOR pathway under each stimulation in PWH and PWoH. These results may have implications for the immunopathogenesis and treatment of CVD in PWH and PWoH.

Faculty Project Mentor: Michael L. Freeman, Division of Infectious Diseases and HIV Medicine

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Poster #76

Investigating the Functional Role of Bifidobacterium in the Vaginal Microbiome Using a Metatranscriptomic Database

Camila Acosta Matos, Systems Biology; Alyssa Hamm, Center for Global Health and Diseases, CWRU; Dr. Gina Lewin, Center for Global Health and Diseases, CWRU

The vaginal microbiome is a dynamic microbial ecosystem that plays a critical role in reproductive health. Typically, it is dominated by *Lactobacillus* species, whereas shifts toward more diverse, anaerobe-rich communities are associated with bacterial vaginosis (BV) and adverse reproductive health outcomes. *Bifidobacterium* is widely recognized for its beneficial role in the gut; however, it is also detected at lower abundances in the vagina and frequently observed in BV-associated communities. Despite its presence in vaginal microbial ecosystems, the functional activity of Bifidobacterium and its contribution to vaginal health remain poorly understood. To address this gap, we constructed a database of publicly available vaginal metatranscriptomes by integrating four studies comprising 368 samples from pregnant, preterm birth-affected, nonpregnant asymptomatic, and BV-diagnosed individuals. Raw sequencing data were retrieved from public repositories and processed using a standardized computational pipeline. Metatranscriptomic reads were mapped to the Human Vaginal Non-Redundant Gene Catalog (VIRGO2) to characterize microbial gene expression. To validate this approach, we generated mock metatranscriptomes from reference genomes of *Bifidobacterium* and other vaginal-associated species to evaluate VIRGO2 mapping accuracy. Validation demonstrated over 95% species-level accuracy for *B. bifidum* and *B. breve*, and 95% genus-level accuracy for *B. longum*. *Bifidobacterium* transcripts were detected in 362 of 368 samples. We observed expression of genes encoding L-lactate dehydrogenase, suggesting potential involvement of *Bifidobacterium* in lactic acid production and vaginal pH regulation. We also identified transcripts associated with quorum sensing pathways which may serve to investigate potential roles in microbial signaling and community dynamics. This framework will be applied to characterize *Bifidobacterium* transcriptional activity and identify differentially expressed genes between healthy and BV-associated vaginal microbiomes. Together, this database and analytical framework provide a foundation for investigating the functional role of *Bifidobacterium* in the vaginal microbiome and advancing understanding of microbial activity associated with reproductive health.

Faculty Project Mentor: Dr. Gina Lewin, Center for Global Health and Diseases, CWRU

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Poster #77

Hypothermic Oxygenated Perfusion Preserves Mitochondrial Function and Tissue architecture in Deceased Donor Uterus Grafts

Abhinav Kandula, Biology; Keyue Sun, MD, Department of Inflammation and Immunity, Cleveland Clinic Research Institute; Andrea Schlegel, MD, MBA, Transplantation Center, Digestive Disease and Surgery Institute, Cleveland Clinic

Uterus transplantation (UTx) is currently the only established treatment for absolute uterine factor infertility, but near total reliance on living donors limits how many patients can be treated. Expanding to deceased donors, including donation after circulatory death (DCD), is constrained by ischemic injury and by the lack of a reliable, real-time way to assess graft viability before transplant. Hypothermic oxygenated perfusion (HOPE) has reduced ischemia reperfusion injury in liver, kidney, and heart transplantation [1–3], but its application to the uterus remains relatively unstudied.

We performed the first application of hypothermic oxygenated perfusion (HOPE) to six human deceased-donor uteri (three donation after brain death [DBD], three donation after circulatory death [DCD]), each perfused for 8 hours and compared against a paired tissue sample preserved by static cold storage (SCS). Mitochondrial injury (flavin mononucleotide [FMN], NADH), cellular energy status (ATP), tissue architecture (hematoxylin and eosin staining), and inflammatory/fibrotic changes (Galectin-3 immunostaining) were assessed.

HOPE-preserved grafts showed lower FMN and NADH release than SCS stored tissue, consistent with reduced mitochondrial Complex I/II injury, and higher tissue ATP, consistent with better preserved oxidative metabolism. H&E staining showed better maintained cellular structure in HOPE preserved tissue compared with SCS controls.

These findings suggest that HOPE better preserves mitochondrial function and tissue structure in the uterus than static cold storage, supporting HOPE based preservation as a strategy to improve graft viability and expand the deceased-donor pool for uterus transplantation.

Faculty Project Mentor: Keyue Sun, MD, Department of Inflammation and Immunity, Cleveland Clinic Research Institute

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Poster #78

Characterizing High Dose Differences for tSNIP in Chronic Pain Rat Models: High-Resolution Gait Analysis Using CatWalk

Rithika Karthikeyan, Biology; Aaron Skubal, Dept. of Biomedical Engineering, Case Western Reserve University; Dr. Michael Moffitt, Dept. of Biomedical Engineering, Case Western Reserve University; Dr. Michael Jenkins, Dept. of Biomedical Engineering, Case Western Reserve University

Chronic pain affects more than 50 million Americans each year, presenting a major challenge in pain management. Current treatments rely heavily on prescription opioids and other pharmacologic therapies, which can provide effective short-term pain relief. However, they are associated with tolerance, addiction, dependence, and systemic side effects that may limit their long-term use. Although non-pharmacologic interventions such as spinal cord stimulation are available, they are only indicated for select pain types and may lose efficacy over time.
These limitations highlight the need for safe, non-addictive therapies that provide localized pain relief while preserving normal motor function. Transient Selective Neural Inhibition via Photobiomodulation (tSNIP) is a non-pharmacologic therapy that selectively inhibits pain-transmitting peripheral nerve fibers using light, which provides localized analgesia while avoiding many of the other drawbacks associated with other therapies. Although previous studies have demonstrated that tSNIP reduces hypersensitivities in a rodent neuropathic pain model, its effects on voluntary locomotion and functional gait have not yet been characterized. Establishing whether analgesic effects translate into improved functional mobility is an important step in evaluating the therapeutic potential of tSNIP.
The goal of this study is to evaluate changes in gait dynamics following tSNIP treatment in a rat model of neuropathic pain using the CatWalk XT automated gait analysis system. Four experimental groups consisting of sham-operated and spared nerve injury (SNI) rats with or without tSNIP treatment at multiple wavelengths will undergo baseline and longitudinal gait assessments. Quantitative measures including stride length, paw print area, weight-bearing distribution, interlimb symmetry, and walking speed will be analyzed to determine whether tSNIP selectively modulates nociceptive signaling without impairing normal motor function. By establishing the locomotive outcomes associated with tSNIP treatment, this study will provide evidence regarding the safety of this therapy and support its continued development as a non-addictive, targeted treatment for chronic pain.

Faculty Project Mentors: Dr. Michael Moffitt, Dept. of Biomedical Engineering, Case Western Reserve University; Dr. Michael Jenkins, Dept. of Biomedical Engineering, Case Western Reserve University

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Poster #79

Immunofluorescence Analysis of Zbtb16 Expression in the Mouse Brain Following Mild Traumatic Brain Injury

Karis Mao, Department of Chemical Engineering, Case Western Reserve University; **Gabriel Rubanenko**, Department of Biomedical Engineering, The Ohio State University; Hui Liu, and Andrew A. Pieper, Department of Psychiatry; Institute for Transformative Molecular Medicine, School of Medicine, Case Western Reserve University; Harrington Discovery Institute, University Hospitals Cleveland; Louis Stokes Cleveland VA Medical Center

Traumatic brain injury (TBI) is a major health challenge in the United States, impacting more than 64 million individuals nationally. Mild TBI (mTBI) comprises approximately 85% of all TBI cases. Despite its high incidence, the diagnosis and prognosis of mTBI remain challenging because current clinical assessments still rely predominantly on subjectively assessed symptoms. Since few molecular or imaging biomarkers are available to assess severity or predict long-term outcomes, identifying biomarkers of mTBI are of great interest. Recent studies show that detection of change in chromatin accessibility provides a powerful tool to identify potential novel biomarkers and therapeutic targets. Using spatial Assay for Transposase-Accessible Chromatin (ATAC)-sequencing, we have now identified significant decline in gene accessibility of Zinc finger and BTB domain-containing protein 16 (*Zbtb16*), a transcription factor involved in regulation of cell cycle progression and cognitive development, in the mouse brain 24 hours post-mTBI compared with sham controls. Given that gene accessibility and transcriptional/translation activity are tightly coordinated, we then hypothesized that acute mTBI would induce changes in Zbtb16 protein expression.
Immunofluorescent (IF) staining was carried out using a rabbit-anti-mouse Zbtb16 monoclonal antibody to assess Zbtb16 protein expression in mouse brain sections from 24-hour post-mTBI and sham groups. QuPath was used for image quantification.
IF images showed strong nuclear signals in the cortical and hippocampal regions of both TBI and sham brain sections. Both the mean intensity and positive Zbtb16 stain area percentage were higher in TBI brains than shams.
Given that our IF staining data revealed increased Zbtb16 protein expression in the mouse brain 24 hours post-mTBI, the decreased gene accessibility of *Zbtb16* might be a negative feedback regulation compensating for increased protein expression.

Faculty Project Mentors: Dr. Hui Liu, Department of Psychiatry, Case Western Reserve University; Dr. Andrew A. Pieper, Department of Psychiatry, Case Western Reserve University

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Poster #80

Expression of PADI2 by M1-like Macrophages in People With HIV

Naomi L. Núñez Altagracia, Biology; Katelyn O'Hare, Immunology; Michael L. Freeman, Division of Infectious Diseases and HIV Medicine, School of Medicine, Case Western Reserve University

Antiretroviral therapy (ART) suppresses viral replication and extends the lifespans of persons with HIV (PWH). However, PWH on ART are still at elevated risk of developing non-AIDS related comorbidities, including cardiovascular disease (CVD), compared to persons without HIV (PWoH). Citrullination, a non-reversible modification of proteins in which arginine is converted to citrulline, might contribute to CVD in PWH on ART by generating altered self-peptides in the vasculature that could be recognized by vascular-homing T cells to worsen plaque inflammation. Citrullination occurs by the action of peptidylarginine deiminase (PADI) enzymes. Whether PWH have altered PADI enzyme expression is unknown. We hypothesize that macrophages from PWH express elevated levels of PADI enzymes than do macrophages of PWoH, which in turn produce more citrullinated proteins that can activate T cells, worsening CVD. To test this hypothesis, we differentiated monocyte-derived macrophages (MDMs) from PWoH (n=5) and PWH (n=5) into M1-like (GM-CSF) and M2-like (M-CSF) phenotypes. On day 5 of differentiation, macrophages were stimulated with inflammatory and atherosclerotic signals including baseline (no stimulus), IFN-γ, TNF, IL-6, CpG, and oxLDL for 24 hours. Following stimulation, cells were harvested and RNA was extracted. Quantitative PCR analysis was performed to measure PADI2 and PADI4 gene expression, with ubiquitin C (UBC) as a reference gene for normalization across samples. Our preliminary results show that PADI2 was detected more consistently than PADI4 among MDMs, and that M1-like MDMs express more PADI2 after stimulation than do M2-like MDMs. Furthermore, M1-like MDMs of PWH express higher levels of PADI2 enzymes at baseline (with no stimulation) compared to M1-like MDMs of PWoH. These initial findings suggest that M1-like macrophages may be a contributor to the increased CVD of PWH by generating more citrullinated proteins than macrophages of PWoH, even in the absence of strong inflammatory signals.

Faculty Project Mentor: Michael Freeman, Division of Infectious Diseases and HIV Medicine, School of Medicine, Case Western Reserve University

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Poster #81

Evaluating the Effects of 3' Untranslated Region Mutations on Gene Expression of the Neurofibromatosis Type I (NF1) Gene

Matthew Chen, Biology; Vedhan Sarvesh, Biology; Grace Glasser, Genetics and Genome Sciences; Annabelle Elsner Pacheco, Genetics and Genome Sciences

Neurofibromatosis Type I (NF1) is a disease that affects 1 in 2,500 people. NF1 affects multiple organ systems, causing skin discoloration, cognitive disabilities, and skeletal deformities. NF1 is caused by null mutations to the *NF1* gene that encodes neurofibromin, a critical regulator of RAS pathways. These mutations disrupt neurofibromin expression or activity. The 3' untranslated region (UTR) is an important regulatory region of mRNA that follows the protein-coding region and contains binding sites for RNA-binding proteins and microRNAs. Mutations in this region could disrupt interactions between the mRNA and those molecules, which can reduce *NF1* expression, causing NF1. Using a database containing known patient genomes (ClinVar), various mutations in NF1 patients' *NF1* gene have been identified, of which 71 are in the 3' UTR. We predict that patient-derived 3' UTR mutations will reduce *NF1* expression. To study the effect of eight of these mutations on gene expression, we utilized a dual-luciferase reporter. In this reporter, the NF1 3' UTR was inserted downstream a luciferase open reading frame. This allows luciferase activity to be measured to determine the effect of each mutation on gene expression. The mutations were introduced via site-directed mutagenesis to this reporter. These mutant reporters were then transfected into 3 cell lines: human bronchial epithelial cells, glioblastoma and neuroblastoma cells. After transfection, luciferase activity is measured. The experiments show that five out of the eight mutations cause reduced luciferase activity. A mutation 2,540 nucleotides away from the stop codon reduces luciferase activity by at least 25 percent across all three cell lines (n=4). Ultimately, evaluating the effect of the patient-derived mutations on luciferase activity will identify which 3' UTR variants might reduce *NF*1 expression. In the future, we plan to introduce these mutations into the *NF1* endogenous locus to confirm these findings.

Faculty Project Mentor: Dr. Hua Lou, Dept. of Genetics and Genome Sciences, Case Western Reserve University

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Poster #82

Identification of Proteomic Changes in the Brain That Coincide with Early Depression Preceding Cognitive Impairment in the TgF344-AD Rat Model of Alzheimer's Disease

Riya Kulkarni, Neuroscience; Dr. Andrew Pieper, Department of Psychiatry, Case Western Reserve University

Alzheimer's disease (AD) is a progressive neurodegenerative brain disorder characterized by pathological accumulation of extracellular amyloid plaques, intracellular neurofibrillary tangles, neuronal cell loss, and neuroinflammation. An early feature of AD is new onset depression before the emergence of cognitive symptoms, and we have previously shown that this aspect of AD is recapitulated in the Tg4344AD rat model. The basis for depression in early AD is not understood and is thought to be distinct from other forms of major depressive illness occurring outside of AD. To gain insight into the underlying mechanisms of this phenomenon, we performed label-free proteomic analysis of the male TgF344AD rat brain at 15 months of age, when animals displayed depression-like behavior with normal cognition. This revealed several altered proteomic signatures in this model that were also normalized by neuroprotective daily treatment with (-)-P7C3-S243 from 9 to 15 months of age, which effectively prevented depression-like behavior. Synaptic plasticity, which is disrupted in AD progression, also showed several altered signatures uniquely in male TgF344AD rats. We additionally observed that glyceraldehyde 3-phosphate dehydrogenase (GAPDH) was differentially expressed in male and female TgF344AD rat brain and thus not suitable as a loading control for western blot analysis, highlighting the need for whole blot densitometry in this model. GAPDH was upregulated to different degrees in males and females and has been shown in the field to be involved in aggregation of amyloid-beta and tau proteins. Through western blot analysis, we also observed that G protein subunit alpha Q (GNAQ), which plays a central role in synaptic plasticity, was selectively decreased in female TgF344AD rats and returned to wild-type levels after daily treatment with (-)-P7C3-S243. Additionally, the synaptic protein amphiphysin showed a decrease during AD progression and was normalized by P7C3-S243 treatment. Collectively, we have identified sex and disease specific changes in protein expression that coincide with the emergence of early depression before cognitive impairment in the TgF344AD rat model of AD, potentially providing insight into the etiology of this condition.

Faculty Project Mentor: Dr. Andrew Pieper, Department of Psychiatry, Case Western Reserve University

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Poster #83

Ethanol Selection for Gut Microbes Containing 7α-HSDH and 7β-HSDH as a Potential Mechanism for Attenuated Cholestatic Liver Injury in the Humanized Bile Acid Cyp2c70-/- Mouse Model

Maya Tang, Nutritional Biochemistry and Metabolism; Allison Paschack, Department of Microbial Sciences in Health; Dr. J. Mark Brown, Department of Microbial Sciences in Health

Bile acids (BAs) are central to intestinal fat absorption and signaling. Cyp2c70 is a mouse-specific enzyme that converts human BAs into mouse-specific muricholic acids (MCAs). MCAs are more hydrophilic and cytoprotective than the human BA precursor, chenodeoxycholic acid (CDCA), which can cause cholestatic liver injury. *Cyp2c70*$^{-/-}$ mice lack the enzyme that catalyzes the conversion of CDCA into MCA, leaving them with a more "human-like" BA pool, which leaves *Cyp2c70*$^{-/-}$ mice prone to female-dominant progressive hepatobiliary injury and portal fibrosis. Preliminary data show that 10 days of 5% ethanol (EtOH) exposure resolves liver fibrosis in *Cyp2c70*$^{-/-}$ mice. We also found increased levels of ursodeoxycholic acid (UDCA) in the liver of EtOH treated *Cyp2c70*$^{-/-}$ mice. UDCA is a gut microbe derived hydrophilic secondary BA with therapeutic properties. UDCA is one of the only FDA approved medications for certain types of cholestatic liver disease. We hypothesize that EtOH helps resolve liver injury in *Cyp2c70*$^{-/-}$ mice by selecting for gut microbes that synthesize UDCA. UDCA is synthesized by a two-step microbial enzyme dependent reaction in the intestine. First, 7α-hydroxysteroid dehydrogenase (7α-HSDH) catalyzes the conversion of CDCA into the secondary bile acid intermediate, 7-oxolithocholic acid (7k-LCA). Subsequently, 7β-hydroxysteroid dehydrogenase (7β-HSDH) catalyzes the conversion of 7k-LCA into UDCA. To test whether these enzymes are enriched in the EtOH fed *Cyp2c70*-/- mice, DNA was extracted from the cecum of EtOH fed *Cyp2c70*$^{-/-}$ mice and corresponding controls. Polymerase chain reaction (PCR) and gel electrophoresis were performed to identify the presence of bacterial genes encoding 7α-HSDH and 7β-HSDH. We expect that the 7α-HSDH and 7β-HSDH microbial enzymes will be present in the EtOH fed *Cyp2c70*$^{-/-}$ mice, shifting the BA pool towards increased levels of UDCA. This supports increased levels of 7α-HSDH and 7β-HSDH as a potential mechanism for improvements in cholestatic liver injury in the *Cyp2c70*$^{-/-}$ mouse model.

Faculty Project Mentor: Dr. J. Mark Brown, Department of Microbial Sciences in Health, Cleveland Clinic Lerner Research Institute

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Poster #84

Assessment of Binding of a Small Molecule Inhibitor to MYO18A In Vitro

Lauren Ludwig, Nutritional Biochemistry and Metabolism; Dr. Seth Field, Case Comprehensive Cancer Center, Institute for Transformative Molecular Medicine, and Division of Endocrinology, School of Medicine, Case Western Reserve University

Myosin 18A (MYO18A) is an unconventional myosin that functions within the GOLPH3/MYO18A signaling pathway, which regulates Golgi organization, intracellular trafficking, and cell signaling. Increasing evidence suggests that MYO18A contributes to cancer progression. The Field lab has developed a small molecule inhibitor of MYO18A, M137. Characterization of the interaction between M137 and MYO18A will enable structure-guided medicinal chemistry to optimize the compound. M137 was identified in a phenotypic screen that mimics the phenotype of MYO18A loss. We have developed a derivative of M137 incorporating diazirine and alkyne moieties, enabling UV-induced covalent photo-crosslinking and click-chemistry-based M137 detection. In cultured mammalian cells, this reagent directly labels MYO18A. It also labels GFP-MYO18A following affinity purification from mammalian cells. In both cases, binding depends on the presence of the C-terminal region of MYO18A.
We seek to develop an assay using bacterially expressed MYO18A protein to enable more complete characterization of M137-diazirine-alkyne binding. We have developed bacterial expression constructs for the N-term, middle, and C-term regions of MYO18A, each with an N-terminal His-SUMO tag. During this project we are developing optimized protocols to express the proteins, assess binding of M137-diazirine-alkyne in crude lysates, and purify the MYO18A proteins to assess binding to purified proteins. Clarified *Escherichia coli* lysates expressing His-SUMO-tagged MYO18A N-terminal, middle, and C-terminal constructs are incubated with either DMSO or a diazirine-alkyne derivative of M137 and exposed to ultraviolet light to covalently capture protein-ligand interactions. Proteins are separated by SDS-PAGE, transferred to PVDF membranes, and subjected to copper-catalyzed azide-alkyne click chemistry using biotin-picolyl azide. Probe-labeled proteins are detected by streptavidin-HRP chemiluminescence and subsequently validated by Western blotting with anti-His and anti-MYO18A antibodies. Once optimized, this assay will provide a biochemical platform for comparing M137 binding across individual MYO18A domains and will support future studies of MYO18A mechanisms and its potential as a therapeutic target.

Faculty Project Mentor: Dr. Seth Field, Case Comprehensive Cancer Center, Institute for Transformative Molecular Medicine, and Division of Endocrinology, School of Medicine, Case Western Reserve University

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Poster #85

A transcriptomic approach to identify potential mechanisms driving psychiatric comorbidity in virologically suppressed people living with HIV.

Julianys Tirado-Alicea, Biology, University of Puerto Rico, Rio Piedras Campus, PR; Banumathi Tamilselvan, Case Western Reserve University School of Medicine; Brian Richardson, Case Western Reserve University School of Medicine; Nathaniel Craun, Case Western Reserve University School of Medicine; Diana Hume-Rivera, Case Western Reserve University School of Medicine; Michael Rubsamen, Tulane University School of Medicine; Zoe Rodes, Case Western Reserve University School of Medicine; Brian Richardson, Case Western Reserve University School of Medicine; Amanda Burger, MetroHealth Medical Center; Mark Cameron, Case Western Reserve University School of Medicine; Ann Avery, MetroHealth Medical Center; Corrilynn Hileman, MetroHealth Medical Center; Cheryl Cameron, Case Western Reserve University School of Medicine

HIV is a chronic viral infection that compromises the immune system by infecting and progressively damaging CD4 T cells, which are essential for coordinating adaptive immune responses. The standard treatment for HIV is antiretroviral therapy (ART), a combination of medications that suppress viral replication, promote immune restoration, and reduce the risk of disease progression. Unfortunately, chronic immune activation and inflammation persist in people living with HIV (PWH) who are receiving ART. Major depressive disorder (MDD) and generalized anxiety disorder (GAD) occur at disproportionately high rates in this population and may negatively affect quality of life, treatment adherence, and long-term clinical outcomes. This study aims to identify biological signatures associated with mood disorders in people living with HIV and determine if these signatures change over time in those participants that improve. Participants from a clinical cohort at MetroHealth Medical Center were assessed using a structured psychiatric evaluation, CAT-MH scores, and clinical psychologist review. They were then classified into four groups: PWH without MDD or GAD, PWH with MDD, PWH with GAD, and PWH with both MDD and GAD. To evaluate molecular differences, whole blood was collected in PAX gene tubes and later processed for RNA sequencing. Gene expression data was analyzed in R using quality control, normalization, differential gene expression contrasts, and pathway enrichment approaches to identify altered biological processes across groups. We identified multiple neurotransmitter and metabolic pathways that were differentially enriched in the PWH with mood disorders compared to those without. Furthermore, we saw differential regulation of a number of these pathways in PWH with mood disorders who went on to improve at later time points. These findings may support future biomarker discovery and inform therapeutic strategies for treatment-resistant psychiatric symptoms in this population.

Faculty Project Mentor: Dr. Cheryl Cameron, Department of Nutrition, Case Western Reserve University School of Medicine

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Poster #86

Cobalt Substitution of Murine BCO2 for Structural Trapping of Zeaxanthin

Abdul Nawaz; Mahip Kalra; Johannes von Lintig

Carotenoids are essential dietary pigments that contribute to vision and protection against oxidative stress in the retina of the human eyes. Two carotenoids, lutein and zeaxanthin, accumulate in the macula, particularly within the fovea, where they filter high-energy blue light and protect against oxidative damage. Their accumulation is regulated by β-carotene oxygenase-2 (BCO2), a non-heme iron enzyme that converts carotenoids to apocarotenoids. Despite the importance of this reaction for retinal homeostasis, it remains unclear how carotenoids interact with BCO2 and orient within the substrate binding tunnel to approach the catalytic metal center. Structural characterization of these interactions is challenging because native Fe(II)-containing BCO2 may cleave the substrate after binding, preventing formation of a stable enzyme–substrate complex.

This project was designed to generate a structurally intact form of murine BCO2 that retains substrate-binding ability but lacks catalytic activity. Previous studies of related carotenoid cleavage oxygenases demonstrated that cobalt can replace iron within the conserved four-histidine metal-binding site. These cobalt-substituted enzymes remained structurally similar to their native iron-containing forms but were catalytically inactive, allowing bound substrates to be stabilized for structural investigation. Based on this strategy, murine BCO2 was expressed under metal-controlled conditions to determine whether cobalt substitution could produce an inactive enzyme suitable for substrate trapping.

The central objective was to obtain Cobalt-substituted BCO2 with bound zeaxanthin to determine the structure of the BCO2–substrate complex by cryo-electron microscopy. Comparison with conventionally expressed, metal-depleted, and Co-containing BCO2 provides a method for distinguishing effects on protein expression, folding, solubility, and catalytic competence. Preliminary expression results support the feasibility of producing BCO2 under cobalt-supplemented conditions. Establishing a stable Co-BCO2–zeaxanthin complex would enable the determination of the orientation of the substrate within the substrate tunnel. These structural insights could clarify the molecular basis of BCO2 substrate recognition and region-selectivity of carotenoid cleavage.

This work was supported in part by grants from the National Institutes of Health, including RO1EY020551 (J.v.L.) and RO1EY028121 (J.v.L.).

Faculty Project Mentor: Johannes von Lintig, Department of Pharmacology, Case Western Reserve University

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Poster #87

Evaluation of Two-Point Strength-Duration Fitting Methods for Efficient FES Activation Prediction

Pranati Bulusu, Biomedical Engineering

Functional electrical stimulation (FES) restores movement to paralyzed muscles but requires characterizing the relationship between stimulation parameters and muscle activation for each individual. Muscle force is modulated by pulse amplitude (PA) and pulse width (PW), which follow a strength-duration relationship at a given activation level. Conventional characterization samples only a few recruitment curves (RCs), because full mapping of the PW-amplitude space is time-intensive. A two-point strength-duration fit offers an efficient approach by reconstructing these relationships from only two RCs . This method has been validated for two RCs bordering the stimulation space, but has not been tested for a wide range of possible RCs. Five datasets were obtained from a participant with cervical spinal cord injury using implanted cuff electrodes with 15 contacts around peripheral nerves. For each contact, EMG responses were recorded across a 20×20 grid of PWs (10–200 μs) and amplitudes (0.1-2.0 mA). Signals were rectified, normalized, and used to construct recruitment curves. Strength-duration curves were fitted with the Weiss equation using thresholds at five activation levels (0.1, 0.3, 0.5, 0.7, 0.9). Two-point fits estimated PWs required for target activations across PAs. Predicted PWs were applied to the RCs, and resulting EMG activation was compared with measured values using mean absolute error. Predictions were classified as interpolation or extrapolation. Interpolated predictions produced the lowest error and variability, while below-range extrapolations performed similarly. Above-range extrapolations showed the greatest error, exceeding that of multi-point fits. Error was highest at low PAs, decreasing and stabilizing between 1.0-2.0 mA, with slightly lower error at higher activation thresholds in this range. Predictions from PW-modulated RCs were more accurate than with PA modulation. Overall, two recruitment curves can accurately predict muscle activation using PW modulation and interpolation or below-range extrapolation at 1.0-2.0 mA.
Faculty Project Mentor: Dr. Abidemi Ajiboye, Department of Biomedical Engineering, Case Western Reserve University

PhD Student Mentor: Ben Alexander, Department of Biomedical Engineering, Case Western Reserve University

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Poster #88

Zwitterionic Copolymer Membrane Characterization for Rare Earth Element Separation

Caleb Green, Chemical & Biomolecular Engineering; Md Sarwar Kamal, Chemical & Biomolecular Engineering; Oscar Heft, Chemical & Biomolecular Engineering; Christine Duval, Chemical and Biomolecular Engineering.

Rare Earth Elements (REEs) are critical to a variety of applications including clean energy, medicine, and fluorescent materials. However, the United States accounts for only a small fraction of global REE mining and refinement. Current processes like solvent extraction for recycling or extracting REEs domestically, including from nuclear wastewater, are expensive and have a negative environmental impact. Nanofiltration membranes could provide a more environmentally sustainable, cost-effective option for REE purification. Specifically, we are interested in the effect of incorporating zwitterionic groups into dense hydrogel membranes in order to increase selectivity of REEs. Inspired by the effect of adding phosphate groups in solvent extraction, we hypothesize adding phosphorylcholine groups to membrane polymer networks will allow selectivity between similar ions, leading to a level of separation that previously limited membrane technology as a competitive process.

The membranes I tested were created by crosslinking 2-Methacryloyloxyethyl phosphorylcholine (zwitterion) and Poly[ethylene glycol] dimethacrylate (crosslinker) in DI water, using Lithium phenyl (2,4,6-trimethylbenzoyl) phosphinate as a photoinitiator under UV light. I am characterizing the membrane's sorption by soaking membrane coupons in varying salt concentrations until they reach equilibrium, then desorbing those membranes into DI water to measure the sorbed ion concentration using ICP-OES. Additionally, I am characterizing the membrane's apparent permeability with an H-cell where a membrane coupon is placed between a salt solution and water, and samples are drawn at regular intervals to be measured using ICP-OES. Characterizing these membranes will allow us to better understand the transport mechanisms that may lead to selectivity between ions in order to recover and concentrate valuable REEs.

Faculty Project Mentor: Christine Duval, Department of Chemical and Biomolecular Engineering, Case Western Reserve University

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Poster #89

Fentanyl Modulation of CARD8 Inflammasome-induced Pyroptosis in Primary Human CD4+ T Cells

Leiniz López, Biology, University of Puerto Rico, Aguadilla; So Eun Kang, Beachwood High School; Jackson Schumacher, Shaker High School; Kenneth Golovan, Immunology Training Program doctoral candidate, Case Western Reserve University; Alan D. Levine, PhD, Department of Molecular Biology and Microbiology, Case Western Reserve University.

Therapeutic and illicit opioid use are common among people with HIV, yet little is known about how opioids modulate innate immune pathways in infected cells. CARD8 is an inflammasome sensor that detects HIV-1 protease activity and triggers pyroptotic cell death in CD4+ T cells. However, the relationship between opioid receptor signaling and CARD8-mediated immune responses remains unexplored.

We established a primary human CD4+ T-cell model of CARD8 inflammasome activation. Negatively selected CD4+ human T cells were treated with Val-boroPro (VbP), a DPP8/9 inhibitor known to activate the CARD8 inflammasome, and cell lysates were collected at multiple time points for immunoblotting. CARD8 activation was assessed by monitoring downstream markers of pyroptosis, including CARD8 autoproteolysis, caspase-1 and GSDMD cleavage, and reduction in intracellular GAPDH levels through the Gasdermin pore. As expected, VbP treatment induced GSDMD cleavage and GAPDH release within 6 h, with maximal levels at 24 h, consistent with activation of pyroptotic pathways.

To address the possible modulation of HIV-initiated pyroptosis by opioid use, CD4+ T cells were treated with 400 nM fentanyl for 48 h and then stimulated with VbP to activate pyroptosis. At 6 h, we observed an increase in the expression of both full-length and cleaved/active CARD8 C-terminus and the active N-terminal fragment of GSDMD in the fentanyl-treated cells compared with untreated cells. The effects of fentanyl on caspase-1 activation and intracellular GAPDH levels will be reported in the poster.

These findings indicate that opioid exposure increases the rate and degree of CARD8 inflammasome-induced pyroptosis, providing a molecular mechanism for the known deleterious effects of opioid use on HIV pathogenesis. Future goals include defining the opioid receptor signaling pathways that regulate this response, the universality of this effect via alternate opioid receptors, and intracellular events that propagate opioid-induced pyroptosis in HIV-infected cells.

Faculty Project Mentor: Alan D. Levine, PhD, Department of Molecular Biology and Microbiology, Case Western Reserve University.

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Poster #90

Understanding Diffusion Through Cellulose Nanocomposite Materials Toward Neural Probe-Based Drug Delivery Applications

Alex Rak, Dept. of Biochemistry; Mali Ya Mungu Ocoko, Dept. of Biomedical Engineering; Dr. Allison Hess-Dunning, Dept. of Electrical, Computer, and Systems Engineering, Case Western Reserve University , Louis Stokes Cleveland VA Medical Center; Dr. Melinda Lake-Speers, Dept. of Mechanical and Aerospace Engineering

Intracortical neural probes being developed for use in patients with chronic brain or nervous system conditions include functions such as measuring and sending electrical signals as well as drug delivery to reduce inflammation. Here, we use mechanically adaptive cellulose nanocomposites (CNs), which more closely match brain compliance after insertion compared to standard silicon or glass probes. Versatile properties such as biocompatibility, mechanical compliance, and easy chemical modification make CNs ideal for the highly sensitive environment of the brain. Robust diffusion and flow characteristics in CNs must be investigated to ensure mechanically adaptive CN neural probes used in humans can maintain consistent behaviour during treatment. Here, we demonstrate a 3D-printed diffusion chamber to characterize diffusion through a CN membrane. Diffusion chambers were designed in CAD and printed on a benchtop 3D printer. CN membranes were installed in a 2-sided diffusion chamber where both sides were separated by a CN membrane in the middle filled with liquid solutions. A marker dye was added on one side to track diffusion across membranes over several days. A spectrophotometer was used to create a calibration curve and quantify flow. Qualitative diffusion has been observed in membranes for three weeks. Quantitative measurement using solutions of deionized water, phosphate-buffered saline, and artificial cerebrospinal fluid is ongoing.

Faculty Project Mentors: Melinda Lake-Speers, Department of Mechanical Engineering, Case Western Reserve University; Allison Hess-Dunning, Department of Electrical Engineering, Case Western Reserve University, Louis Stokes Cleveland VA Medical Center

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Poster #91

Functional Profiling of Diiron Lipid Oxidases as Mediators of Small-Molecule Cytotoxicity in Ewing Sarcoma

Aditya Anthati, Department of Biochemistry; Elijah Hayes, Department of Pharmacology, Case Western Reserve School of Medicine

Ewing sarcoma, an aggressive pediatric malignancy driven by EWSR1-ETS fusion oncoproteins, remains without FDA-approved targeted therapies. Prior work in the Adams lab identified fatty acid desaturase 2 (FADS2), a mammalian di-iron oxidase, as a mediator of small-molecule cytotoxicity, catalytically converting a class of compounds. FADS2-dependent cytotoxins (FDCs), into electrophilic species that drive oxidative cell death. FADS2 is markedly overexpressed in Ewing sarcoma relative to non-diseased tissue, and CRISPR-mediated knockout attenuates FDC sensitivity, confirming an on-target dependency. This raised the question of whether electrophilic bioactivation is unique to FADS2 or a broader property of the twelve-member di-iron oxidase family. To address this, we are screening activity-based probes derived from the mechanism-based inhibitor CP-24,879 against family members for covalent engagement, alongside overexpression assays testing paralog-specific sensitization to FDCs. Preliminary data indicate that these probes engage the majority of family members and that overexpression of several paralogs, including DEGS1, TMEM189, and FADS3, sensitizes cells to FDCs, with some exceeding FADS2's own sensitivity. Screening is ongoing to define which paralogs are functionally required for this cytotoxicity alongside a synthetic rescue strategy identifying candidate inhibitors of these historically intractable enzymes. This work aims to establish bioactivation-dependent cytotoxicity as a generalizable tool for probing di-iron oxidase function and to nominate additional therapeutic targets in Ewing sarcoma.

Faculty Project Mentor: Dr. Drew Adams, Department of Genetics and Genome Sciences, Case Western Reserve School of Medicine

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Poster #92

MultiCas12a-KRAB Multiplex Gene Perturbation in Prostate Cancer Cells

Sriharsha Jaladhi, Biochemistry, Dr. Frank Xie, Department of Infection Biology, Cleveland Clinic Lerner Research Institute, Atikur Rahman, Department of Pharmacology, School of Medicine, Case Western Reserve University

Silencing multiple genes simultaneously is a powerful approach for studying complex gene regulatory networks and discovering novel genetic interactions. However, most established CRISPR interference (CRISPRi) platforms utilizing dCas9 are limited in their multiplexing capacity because each target requires an individual guide RNA construct. The Cas12a system offers a compelling alternative by naturally processing CRISPR arrays, enabling simultaneous targeting of multiple genes from a single transcript with substantially less engineering overhead. Despite this advantage, conventional dead Cas12a (dCas12a) exhibits insufficient DNA-binding stability at low guide RNA levels, limiting its effectiveness in pooled functional genomics applications. To address this limitation, we utilized an engineered multiCas12a-KRAB CRISPRi platform containing previously developed stabilizing mutations that improve DNA occupancy and enable efficient multiplex gene repression. To validate this platform in a prostate cancer model, we generated a stable CWR-R1 cell line expressing the multiCas12a-KRAB fusion protein through lentiviral delivery. Following antibiotic selection and flow cytometric sorting, we established a highly pure (96.13%) BFP-positive population, confirming stable integration and sustained expression of the CRISPRi machinery. We then introduced a single lentiviral multiplex CRISPR array (gCH134) designed to simultaneously target four genes—CD55, B2M, KIT, and CD81. Flow cytometry was subsequently used to enrich the infected live-cell population, yielding nearly 65% GFP-positive cells. Analysis of protein expression demonstrated coordinated downregulation of all four target genes following delivery of the single multiplexed CRISPR array. These findings validate the functionality of the multiCas12a-KRAB platform in prostate cancer cells and demonstrate efficient simultaneous repression of multiple genes from a single CRISPR array. This work establishes multiCas12a-KRAB as a scalable platform for multiplex CRISPRi in prostate cancer cells and provides a foundation for future functional genomics studies investigating complex gene regulatory networks.

Faculty Project Mentor: Dr. Frank Xie, Department of Infection Biology, Cleveland Clinic Lerner Research Institute

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Poster #93

Metabolic Licensing of HIV Latency Reversal in Primary Memory CD4+ T Cells

Amrinpreet Sidhu, Nutritional Biochemistry & Metabolism, Business Management

HIV-1 persists indefinitely in resting memory CD4+ T cells despite suppressive antiretroviral therapy, and "shock-and-kill" strategies to eliminate this latent reservoir have shown limited success because the molecular requirements for latency reversal remain undefined. Productive HIV-1 transcription depends on the elongation factor P-TEFb (CDK9/Cyclin T1), whose induction in resting T cells requires mTORC1 activity; pharmacological mTOR inhibition blocks HIV reactivation, establishing mTORC1 as a licensing step rather than a permissive bystander. Canonical models of mTORC1 activation, derived from transformed cell lines, hold that the kinase is cytosolic at rest and translocates to the lysosome only after nutrient and growth-factor cues are sensed via the Sestrin-GATOR-Rag axis. Using immunofluorescence and deconvolution microscopy, we quantified colocalization (Pearson's coefficient) of mTOR and its activator Rheb with the lysosomal marker LAMP1 in primary human CD4+ T cells across a panel of nutrient and activation states. In freshly isolated, unstimulated memory CD4+ T cells, fixed immediately after isolation before culture, mTOR and Rheb were already strongly colocalized with LAMP1 (Pearson's r ~ 0.7-0.8), forming tight, continuous rings at the lysosomal membrane, contradicting the expectation that mTORC1 sits idle in the cytosol at rest. This baseline positioning proved dynamic: reinforced by nutrient-replete culture, partially eroded by amino-acid restriction, and disrupted by prolonged stimulation, as mTOR shifted from a peripheral ring into dense cytoplasmic clusters and LAMP1 signal thinned. Parallel imaging of naive CD4+ T cells showed a distinct pattern: LAMP1 stayed scattered rather than ring-shaped even at baseline, and mTOR never reached the tight ring seen in fresh memory cells, though both subsets converged on a similarly collapsed state after prolonged stimulation. These findings identify amino-acid-dependent lysosomal positioning of mTORC1 as a candidate metabolic checkpoint gating HIV-1 latency reversal, motivating ongoing work testing whether a Sestrin GDI-motif peptide that disrupts this checkpoint blunts latency-reversing-agent-induced HIV reactivation.

Faculty Project Mentor: Dr. Uri Mbonye, Dept. of Molecular Biology & Microbiology, Case Western Reserve University School of Medicine

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Poster #94

Molecular Analysis of 45 Clinically Relevant GABAa Receptor α1-Subunit Mutations

Milton Lin, Biophysics and Music; Dr. Megan Wang, Department of Physiology and Biophysics, Case Western Reserve University School of Medicine

GABAa receptors are pentameric ligand-gated chloride channels mediating inhibitory neurotransmission in the central nervous system (CNS). Pathogenic mutations in the GABAAR subunits are clinically associated with epilepsy and other neurodevelopmental phenotypes. Here, we quantified the cytosolic and surface levels of 45 alpha1 missense variants in transfected human embryonic kidney (HEK293T) cells. The 45 variants span both the binding ECD and all four transmembrane domains. In addition to defining variant-specific trafficking defects under variant-only transfection conditions, we found that a subset of alpha1 variants altered WT receptor abundance in co-expression experiments, consistent with dominant-negative effects on GABAa receptor biogenesis and surface trafficking. To accurately distinguish between alleles during these co-transfections, we utilized a mass-shifted, CFP-tagged WT alpha1 subunit, allowing for the simultaneous visualization of both WT and variant species via immunoblotting. All variants, both in isolation and in co-expressed cells, were further characterized by the quantification of beta2, and gamma2 subunits, the canonical synaptic GABAa receptor assembly. By correlating the expression profiles of all co-assembled subunits, we mapped distinct molecular pathomechanisms, differentiating variants that result in pure haploinsufficiency from those that actively trap WT and auxiliary subunits in the endoplasmic reticulum. Together, these analyses distinguish effects on total expression, intracellular retention, surface delivery, and WT suppression, providing a more complete view of how alpha1 variation disrupts receptor biology.

Faculty Project Mentors: Dr. Megan Wang, Dept. of Physiology and Biophysics, Case Western Reserve University School of Medicine; Dr. Tingwei Mu, Dept. of Physiology and Biophysics, Case Western Reserve University School of Medicine

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Poster #95

Repurposing Metformin to Target O-GlcNAcylation-Dependent NF-κB Signaling in Acute Myeloid Leukemia

Shreya Ghati, Biochemistry; Sophia Gavalas, Case Western Reserve University School of Medicine; and Parameswaran Ramakrishnan, Departments of Pathology and Biochemistry, Case Western Reserve University School of Medicine.

Acute myeloid leukemia (AML) is the most common acute leukemia in adults and is associated with poor prognosis due to therapeutic resistance and disease relapse. O-GlcNAcylation, a nutrient-sensitive post-translational protein modification, is elevated in AML and has been suggested to promote leukemic cell survival by regulating the transcription factor NF-κB. Metformin, a widely prescribed antidiabetic drug, has emerged as a potential anticancer agent and has been shown to reduce global O-GlcNAcylation in non-hematologic cancers. However, the ability of Metformin to inhibit progression of hematologic cancers such as AML remains unknown. This ongoing study aims to determine whether Metformin induces AML cell death by inhibiting NF-κB-dependent pro-survival/anti-apoptotic activity via modulation of O-GlcNAcylation. We will use various AML cell lines and patient samples to study the effect of metformin on survival, proliferation and death of AML cells. Successful completion of this work and future studies will provide insight into metabolically regulated pathways that contribute to leukemia progression and therapeutic resistance. This study will reveal the scope of repurposing of metformin as an inexpensive adjunct therapy for AML.

Faculty Project Mentor: Dr. Parameswaran Ramakrishnan, Departments of Pathology and Biochemistry, Case Western Reserve University School of Medicine.

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Poster #96

Characterizing the il11b-stat3 Signaling Axis in the Zebrafish Retina After Acute Injury

Misha Panchal, Biochemistry and Medical Anthropology; Gregory Konar, Department of Ophthalmic Research, Cole Eye Institute, Cleveland Clinic Research; Brian Perkins, Department of Ophthalmic Research, Cole Eye Institute, Cleveland Clinic Research

Human degenerative retinal diseases result in permanent vision loss because lost rod and cone photoreceptors cannot regenerate. In contrast, zebrafish regenerate retinal neurons in response to damage, making them an ideal model to study the mechanisms of retinal regeneration. In zebrafish, retinal injury causes an inflammatory response, leading to Müller glia (MG) reprogramming into progenitor cells, which then proliferate and differentiate to replace lost neurons. Following acute retinal injury, the NF-κB signaling pathway is activated to mediate the inflammatory response, acting as a negative regulator of MG proliferation. The exact molecular mechanism underlying this response remains unclear. The transcription factor *ascl1a* is a master regulator of MG proliferation. Work from our lab identified NF-κB binding sites within the promoter of *ascl1a*, suggesting that NF-κB regulates *ascl1a* expression. Inhibition of NF-κB by the inhibitor NAI (NF-kB Activation Inhibitor) following acute retinal injury results in decreased *ascl1a* expression; however, the number of proliferating MG was increased compared to untreated controls. This paradox suggests that an alternative signaling pathway may compensate for the decrease in *ascl1a* expression. Our goal was to determine whether the *il11b-stat3* signaling axis promotes the MG proliferative response following acute retinal injury and NF-κB inhibition. We used both genetic ablation and acute light damage paradigms to induce photoreceptor damage in the presence of NAI. Retinas were collected at 72 hours post injury (hpi) for molecular and histological analyses. Quantitative PCR measured the expression of *il11b*, *stat3*, *pcna*, and *ascl1a,* while immunohistochemical staining for PCNA and MG markers assessed proliferation and Stat3 signaling. Preliminary qPCR analyses indicate *il11b* and *stat3* expression increased following retinal injury, with NAI treatment further increasing expression compared with injury alone. Ongoing immunohistochemical staining, imaging, and quantitative analyses will determine the role of the *il11b-stat3* signaling axis in MG proliferation following acute injury.

Faculty Project Mentors: Brian Perkins, Department of Ophthalmic Research, Cole Eye Institute, Cleveland Clinic Research; Gregory Konar, Department of Ophthalmic Research, Cole Eye Institute, Cleveland Clinic Research

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Poster #97

Semantic Data Management (SDM) Framework for the Degradation and Reliability Assessment of Multilayer Ceramic Capacitors (MLCCs)

Jacob Lample, Department of Electrical, Computer and Systems Engineering; Rishabh Kundu, Department of Materials Science and Engineering; Roger French, Department of Materials Science and Engineering and Department of Computer Science; Alp Sehirlioglu, Department of Materials Science and Engineering

MLCCs are integral to a wide array of electronic circuits, serving critical functions in virtually every signal-processing operation. Their widespread usage is reflected financially, as the industry generated ~ USD 27 billion globally in 2025 with a projected CAGR of 15%[1]. MLCC reliability is especially crucial due to the diverse and often critical nature of their applications. Simultaneously, technological demands push for the continued minimization of the devices, further increasing the need for a comprehensive reliability analysis. Currently, the most widespread method to assess lifetime is through an aggregate Mean Time To Failure (MTTF) analysis[2]. In this method, a failure leakage current is specified and groups of MLCCs are subjected to Highly Accelerated Lifetime Testing (HALT) experiments. When an MLCC reaches the cutoff leakage current value it is averaged with other failures, producing the estimated lifetime of the population. While useful, MTTF struggles to generate highly accurate predictions and does not appropriately elucidate the reliability and lifetime of individual capacitors in operation. Alternatively, we present a semantic data management framework supporting a data-driven, epidemiological approach to MLCC reliability assessment. All data associated with the project is collected and organized through a series of ontologies, unified within the Materials Data Science Ontology (MDS-Onto). MLCC metadata, experimentally generated data, equipment data, etc., are all collected within this ontological framework, ensuring that as many variables as possible are being considered. This leads to a knowledge graph, which will join with a graph database such as GraphDB for semantic querying and analysis. Through the application of machine learning models, we would like to ultimately achieve reasoning ensued learning. This cycle will be repeated, with the goal of creating new connections between different variables and potential degradation modes. This integrated pipeline enables semantically rich, data-driven insights that maximize information extraction across studies, timelines, and projects.

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Faculty Project Mentor: Roger H. French, Department of Materials Science and Engineering and Department of Computer Science

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Poster #98

Characterization of Microglia in QPRT Knockout and Overexpression Mice Models

Thomas Rodman Biochemistry; Dr. Chinyere Iweka, Department of Pharmacology, Case Western Reserve University School of Medicine; Brent Eastman, Department of Pharmacology, Case Western Reserve University School of Medicine

Stroke is a life-threatening medical emergency characterized by disruption in blood flow to the brain typically due to neurovascular blockage (ischemic stroke) . This claims the lives of millions of people annually, while leaving those who survive with permanent impairments . Current therapies work to restore blood flow as quickly as possible, but new research is looking to understand some of the metabolic changes due to stroke after blood flow is restored. We have shown increased quinolinic acid (QA) levels, a known neurotoxin and precursor to NAD+, along with decreased NAD+ levels in blood monocytes . This led us to hypothesize that QPRT, the rate limiting enzyme in the *de novo* NAD+ biosynthesis path, was altered post-stroke and responsible for these changes. To further investigate the role of the QPRT under normal physiological conditions, we have crossed Cd11b-cre mice with both QPRT floxed mice and a QPRT overexpressed mouse model to create a myeloid specific cell-line knockout and overexpression of QPRT, respectively. I then dissected young mice from these groups and a control aged 8-12 weeks and collected brains for immunohistochemistry. Currently, I am in the process of staining coronal sections focused on the hippocampus and cerebral cortex for colocalization of IBA1 and CD68, hallmark microglial markers. After staining, I plan to quantify microglia, the resident immune cells of the brain, as well as characterize their morphology, differentiating between non-active amoeboid and active branched morphologies. I hypothesize that QPRT knockout mice will show increased microglial quantity with less activity. On the other hand, I predict that the QPRT overexpression mice will exhibit decreased microglial quantities, however with more activity.

Faculty Project Mentor: Dr. Chinyere Iweka, Department of Pharmacology, Case Western Reserve University School of Medicine

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Poster #99

Designing a Wireless Instrumented Walker to Measure Upper-Extremity Forces During SCI Walking

Grace Kim, Biomedical Engineering; Isabella McCollum, Advanced Platform Technology Center Motion Study Laboratory, Louis Stokes Cleveland VA Medical Center; Dr. Nathaniel Makowski, Department of Physical Medicine and Rehabilitation, Case Western Reserve University and MetroHealth Medical Center

Spinal Cord Injury (SCI) impairs motor and sensory function below the level of injury, impacting ambulation and often requiring assistive devices such as a walker for stability and support. Neuromuscular electrical stimulation (NMES) systems restore function by activating paralyzed muscles to enhance walking, with the aim of allowing individuals with SCI to move toward a more neurotypical gait, limiting compensatory actions, and reducing upper-extremity exertion. To evaluate the performance of these NMES walking systems and measure the compensatory upper-extremity forces a user exerts, an instrumented walker is required. The lab's current walker relies on a non-traditional frame with multiple wired connections, which adds bulk, limits walking distance, and complicates setup. This project focuses on redesigning the instrumented walker to wirelessly measure upper-extremity forces exerted during assisted walking, while preserving synchronized recording with the lab's existing motion-capture and real-time control environment. The design adapts a standard-frame walker to use a pair of AMTI six-axis force and torque load cells with built-in handles, each paired with a MicroStrain V-Link-200 wireless strain node that transmits force data without additional cabling. Since analysis requires only the three orthogonal forces, the moment channels are excluded and the three force bridges are routed to each node's differential inputs, using one node per handle. A wireless gateway then relays both nodes into the lab's existing data-acquisition chain, where force data is recorded in synchronization with motion capture. Synchronized sampling keeps the two handles aligned to within ±50 μs, and the gateway is selected to preserve alignment with the main recording system. The project is currently in the design and component-selection stage with the goal of a validated wireless force-sensing walker that adds force measurement without increasing the cabling burden and supports more natural gait studies for individuals with SCI.

Faculty Project Mentor: Dr. Nathaniel Makowski, Department of Physical Medicine and Rehabilitation, Case Western Reserve University and MetroHealth Medical Center

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Poster #100

Pre-Implantation Cytokine Profiling of Deceased Donor Organs: Associations With Graft Survival and Post-Transplant Hospital Course

Dubem Akunyili, Chemical Biology; **Sofia Kohl**, Chemical Biology

Organ transplantation is a life-saving treatment for patients with end-stage organ failure, but predicting how well a transplanted organ will function after surgery remains a major challenge. One factor that may influence outcomes is the inflammatory environment of the donor organ at the time of procurement. Understanding the disruptions in the inflammatory environment of an organ donor who has undergone brain-death, can lead to vast improvements in organ procurement and recipient outcomes. Cytokines are signaling proteins that regulate immune responses that accumulate in donor tissue. Levels of cytokines in donor plasma reflect the organ's biological condition before it is ever placed into a recipient. This study investigates whether pre-implantation cytokine levels in deceased donor organs are associated with post-transplant graft survival and hospital length of stay. Using a prospective dataset of over 40 deceased donor transplants performed between October 2023 and March 2024, seventeen biomarkers were measured from donor organ samples. These included pro-inflammatory cytokines such as IL-15, IL-17A, IFN-γ, and TNF-α; anti-inflammatory mediators IL-4 and IL-10; regulatory growth factors TGF-β1, TGF-β2, and TGF-β3; and additional markers including thromboxane, cell-free hemoglobin (CFH), and S-nitrosylated Hemoglobin (SNO-Hb). Pearson correlation coefficients were calculated between each biomarker and post-operative length of stay, and graft and patient survival were tracked at follow-up. Of the 18 cases, 15 grafts were functioning at follow-up, with 2 graft failures and 1 treated acute rejection episode. IL-15 showed the strongest positive correlation with LOS (r = +0.63), followed by IL-17A (r = +0.49), suggesting that a more pro-inflammatory donor organ is associated with a longer and more complicated post-operative course. TGF-

Faculty Project Mentor: James Reynolds, Department of Anesthesiology, Case Western Reserve University

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Poster #101

Measuring Acetylated Tau Plasma Levels in Collegiate Athletes after Mild Traumatic Brain Injury

Talia Proweller, Nursing; Zea Bud, Department of Psychiatry, Frances Payne Bolton School of Nursing; Yeojung Koh, Department of Psychiatry, Case Western Reserve University; Edwin Vázquez-Rosa, Department of Psychiatry, Case Western Reserve University; Tanishka Mhaskar, Department of Psychiatry, Case Western Reserve University; Kalyani Chaubey, Department of Psychiatry, Case Western Reserve University; Sarah Barker, Department of Psychiatry, Case Western Reserve University; Emiko Miller, Department of Psychiatry, Case Western Reserve University; Paul Harris, University Hospitals Clinical Research Center; Coral Clinton-Perez, Department of Psychiatry, Case Western Reserve University; Stephnie Bohon, University Hospitals Clinical Research Center; Dia Nath, Department of Neuropsychology and Neurology, University Hospitals Cleveland Medical Center, Zachary Hoffman, Lake Erie College Athletics and Sports Medicine; James Garfield, Case Western Reserve University Athletics and Sports Medicine; Christopher Tangen, Helen and Appel Alzheimer Disease Research Institute, Brain and Mind Research Institute, Weill Cornell Medicine; Brent Leiby, Helen and Appel Alzheimer Disease Research Institute, Brain and Mind Research Institute, Weill Cornell Medicine; Alan Wallace, Helen and Appel Alzheimer Disease Research Institute, Brain and Mind Research Institute, Weill Cornell Medicine; Rahul Mikkilineni, University Hospitals Clinical Research Center; Li Gan, Weill Cornell Graduate School of Medical Sciences, Weill Cornell Medicine; Christopher Bailey, Department of Neuropsychology and Neurology, University Hospitals Cleveland Medical Center; and Andrew A. Pieper, Harrington Discovery Institute, Center for Brain Health Medicines, University Hospitals Cleveland Medical Center, Department of Psychiatry, Case Western Reserve University.

Traumatic brain injury (TBI) is a major public health concern and a leading cause of disability among athletes and young adults, with sports-related concussions representing a common form of mild TBI (mTBI) in collegiate athletics. Repetitive head injuries and sports-related concussions are associated with neuroaxonal injury and may contribute to long-term neurological dysfunction. Current blood biomarkers are primarily useful for acute clinical decision-making, but they have limited utility for assessing mild TBI or long-term neurological outcomes. Acetylated tau (ac-tau) has emerged as a promising biomarker and may better reflect persistent neuroaxonal injury. By comparing ac-tau with established blood biomarkers in collegiate athletes over a competitive season, we aim to evaluate its potential as a biomarker of long-term neurological injury.

Faculty Project Mentor: Zea Bud, Psychiatry, Frances Payne Bolton School of Nursing; PI: Andrew Pieper, Psychiatry, Case Western Reserve University

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Poster #102

Wild-type IDH1 Inhibition Induces BRCAness In Pancreatic Cancer

Parsa Rezvani, Nutritional Biochemistry and Metabolism; Mehrdad Zarei University Hospitals; Sami O. Abul-Khoudoud University Hospitals-Surgery; Alexander W. Loftus University Hospitals-Surgery; Priyashree Sunita Case Western Reserve University-Biochemistry; Faith Nakazzi Case Western Reserve University-Biochemistry; Semmer A. Ali, Biology; Sakineh Rezaei Case Western Reserve University-Biochemistry; Hallie J. Graor, University Hospitals-Surgery; Luke D. Rothermal, University Hospitals-Surgery; Jordan Winter, University Hospitals, Case Western Reserve University-Surgery and Biochemistry

Pancreatic Ductal Adenocarcinoma (PDAC) cancer is one of the deadliest cancers, with an approximate survival rate of around 13% within 5 years. Current treatment options have proven to have limited therapeutic efficacy. The clinical benefit of poly(ADP-ribose) polymerase (PARP) inhibitors in pancreatic ductal adenocarcinoma (PDAC) is largely restricted to the small subset of tumors with homologous recombination deficiency (HRD). Consequently, most patients with homologous recombination-proficient (HRP) disease lack effective targeted treatment options. Pharmacologic induction of a functional HRD (BRCAness) phenotype represents an attractive strategy to expand the therapeutic utility of PARP inhibition. In this study, we investigated whether inhibition of wild-type isocitrate dehydrogenase 1 (wtIDH1) induces BRCAness and enhances PARP inhibitor sensitivity in HRP PDAC. Human pancreatic ductal adenocarcinoma (PDAC) cell lines (MiaPaCa-2 and Panc-1) were used to evaluate the effects of pharmacologic and genetic inhibition of wtIDH1 on homologous recombination (HR) repair. Changes in BRCA1/2 expression were assessed by qRT-PCR and Western blotting. DNA repair capacity was evaluated using HR and non-homologous end joining (NHEJ) reporter assays. The therapeutic efficacy of wtIDH1 inhibition alone and in combination with PARP inhibition was examined using cell viability, apoptosis, and DNA damage assays. Antitumor activity was further evaluated in human PDAC xenograft models and an orthotopic KPC mouse model. Pharmacologic and genetic inhibition of wtIDH1 reduced BRCA1 and BRCA2 expression and impaired homologous recombination repair while having minimal effects on non-homologous end joining. wtIDH1 inhibition induced a BRCAness phenotype and sensitized PDAC cells to PARP inhibition, resulting in reduced cell viability, increased DNA damage, and enhanced apoptosis. Combination therapy significantly suppressed tumor growth and prolonged survival in human PDAC xenograft and orthotopic KPC mouse models. Induction of BRCAness through wtIDH1 inhibition represents a novel therapeutic strategy for pancreatic ductal adenocarcinoma. By sensitizing homologous recombination-proficient tumors to PARP inhibition, this approach has the potential to expand the clinical benefit of PARP inhibitors to a broader population of patients with PDAC.

Faculty Project Mentor: Mehrdad Zarei, Surgery, University Hospitals

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Poster #103

Investigating the Reproductive Timelines of Beluga Whales

Josiah Shulman Shaker Heights High School; Prof. Lisa Cooper, Northeast Ohio Medical University

As in other mammals, beluga whale (*Delphinapterus leucas*) reproduction relies on the release of an egg from the ovary, a process known as ovulation. As this egg is released, the cells surrounding the oocyte persist as a yellow body known as the corpus luteum. The corpus luteum is a crucial collection of granulosa and theca cells derived from the remnants of the ruptured Graafian follicle. The function of the corpus luteum is for hormonal production, specifically progesterone and estrogen secretion, and will remain active in the ovary if fertilization occurs and throughout pregnancy. If the egg is not fertilized or following pregnancy, the corpus luteum will shrink into an inactive collagenous tissue called the corpus albicans, and may remain a scar in the ovary for the rest of the whale's life. These mechanisms of hormonal control and gametic ovulation are shared throughout much of the mammalian class. For our methods, we stained beluga ovaries with Lugol's iodine, a solution that responds to glycogen-rich areas of the organ, and utilized a Micro-CT scanner to visualize and further identify the corpora within the ovary. By examining the number, size, and appearance of these corpora in beluga ovaries, we can build upon our knowledge of when belugas reach sexual maturity, how often they reproduce, and eventually our understanding of the significance of menopause in the species. Unlike almost all other animal species–but similar to humans–belugas and a handful of other whale species live for many decades after menopause. Learning more about this process is crucial in our understanding of the life cycles of belugas and will prove beneficial as we continue to grasp the importance of post-reproductive life in many cetaceans.

Faculty Project Mentor: Prof. Lisa Cooper, Northeast Ohio Medical University

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Thank you!

Congratulations to all of our presenters!

We greatly appreciate the faculty mentors, volunteers, staff, and guests for making Summer Intersections a success.

We hope to see you at our next Intersections Poster Symposium!