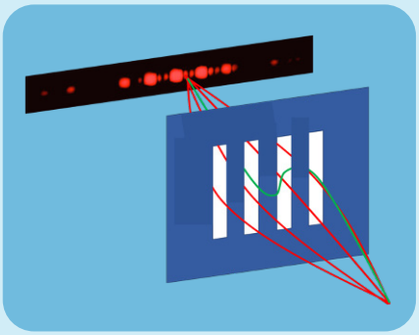
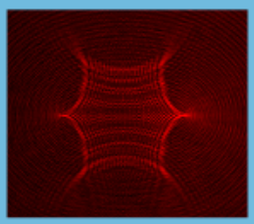
COLGATE UNIVERSITY





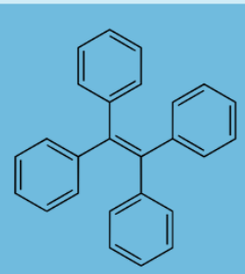
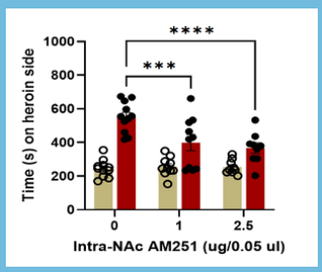
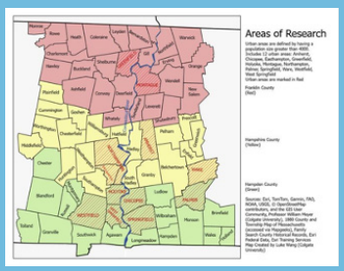
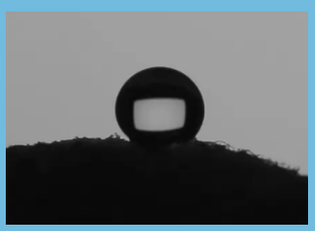
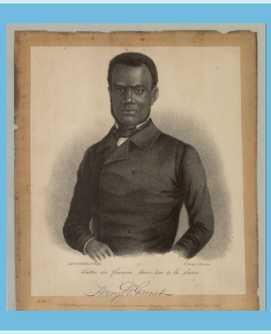


Figure 1: Structure of tetraphenylethylene









SUMMER UNDERGRADUATE RESEARCH DIRECTORY

VOLUME 32 | 2025

Colgate University Summer Undergraduate Research Directory

Volume 32
2025

Courtesy of the Office of Undergraduate Research
Center for Learning, Teaching, and Research
Colgate University
13 Oak Drive
Hamilton, NY 13346

Cover photos: Each of these images was taken from student abstracts found in this 2025 Directory.
A special thanks to Mona Dunn for creating the front cover and for compiling the research directory.

List of Participants

DIVISION OF ARTS AND HUMANITIES (AHUM)

Department of Art

Research Fellow: Julia Bihari 2027 (History)
Faculty Mentor: Elizabeth Marlowe
Title of Project: *Art, Museums and Repatriation: An Attempt to Assess Public Opinion*
Funding Source: J. Curtiss Taylor ’54 Endowed Student Research Fund

Research Fellow: Addisyn Donfris 2026 (Art History)
Faculty Mentor: Elizabeth Marlowe
Title of Project: *Art, Museums and Repatriation: An Attempt to Assess Public Opinion*
Funding Source: Division of Arts and Humanities

Research Fellow: Abigail Pierce 2026 (Peace and Conflict Studies)
Faculty Mentor: Lakshmi Luthra
Title of Project: *Illuminated in Heat*
Funding Source: Division of Arts and Humanities

Research Fellow: Elizabeth Wall 2027 (Classical Studies)
Faculty Mentor: Elizabeth Marlowe
Title of Project: *Art, Museums and Repatriation: An Attempt to Assess Public Opinion*
Funding Source: Division of Arts and Humanities

Department of Classics

Research Fellow: JP Conrad 2025 (Political Science)
Faculty Mentor: Daniel Tober
Title of Project: *The Education of Alexander the Great*
Funding Source: The Kraynak Institute for the Study of Freedom and Western Traditions (James Madison Fellow)

Research Fellow: MG King 2027 (Classics)
Faculty Mentor: Geoffrey Benson
Title of Project: *“Quis nominis umbram horreat?”: The Ghastly Power of Shades in Lucan’s Pharsalia*
Funding Source: The Kraynak Institute for the Study of Freedom and Western Traditions (James Madison Fellow)

Research Fellow: Coleman Wohlken 2026 (Classics; Philosophy)
Faculty Mentor: Daniel Tober
Title of Project: *Remembering War: Thucydides and Modern memorials*
Funding Source: Lampert Institute for Civic and Global Affairs

Department of East Asian Languages and Literatures

Research Fellow: Katarina Fechner 2026 (Chinese)
Faculty Mentor: Jing Wang
Title of Project: *The Needham Revolution of Integration*
Funding Source: Division of Arts and Humanities

Research Fellow: Jiongchen Li 2027 (Philosophy)
Faculty Mentor: Jing Wang
Title of Project: *Joseph Needham's Early Scientific Work and Its Role in Shaping a Global History of Science*
Funding Source: Division of Arts and Humanities

Department of English

Research Fellow: Karla Joseph 2027 (English)
Faculty Mentors: Jennifer Brice; CJ Hauser
Title of Project: *Creative Writing Fellowship*
Funding Source: Division of Arts and Humanities

Research Fellow: Chloe Liversidge 2027 (English)
Faculty Mentor: Ariel Martino
Title of Project: *Research Assistant for Book Manuscript Preparation*
Funding Source: Division of Arts and Humanities

Research Fellow: Dani Palmer 2026 (English; Peace and Conflict Studies)
Faculty Mentor: Ariel Martino
Title of Project: *Research Assistant for Book Manuscript Preparation*
Funding Source: Division of Arts and Humanities

Research Fellow: Lilly Post 2028 (Undeclared)
Faculty Mentors: Jennifer Brice; CJ Hauser
Title of Project: *Creative Writing Fellowship*
Funding Source: Division of Arts and Humanities

Research Fellow: Elizabeth Rainey 2026 (English)
Faculty Mentors: Jennifer Brice; CJ Hauser
Title of Project: *Creative Writing Fellowship*
Funding Source: Division of Arts and Humanities

Research Fellow: Everett Shinn 2027 (English)
Faculty Mentors: Jennifer Brice; CJ Hauser
Title of Project: *Creative Writing Fellowship*
Funding Source: Division of Arts and Humanities

Research Fellow: Maxwell Walker 2026 (English)
Faculty Mentors: Jennifer Brice; CJ Hauser
Title of Project: *Creative Writing Fellowship*
Funding Source: Division of Arts and Humanities

Department of Philosophy

Research Fellow: Amy Meng 2026 (Psychological Science; Philosophy)
Faculty Mentor: David Dudrick
Title of Project: *A Comparative Study of Reformed, Pentecostal, and Catholic Theologies*
Funding Source: The Kraynak Institute for the Study of Freedom and Western Traditions (James Madison Fellow)

Department of Religion

Research Fellow: Topher Durette 2026 (History; Native American Studies)
Faculty Mentor: Chris Vecsey
Title of Project: *Black Hills, Lakota World: Summer Research on the Lakota Sioux Relationship to the Black Hills Before and After U.S. Colonization*
Funding Source: Division of University Studies

Research Fellow: Maya Khadem 2026 (Applied Math)
Faculty Mentor: Megan Abbas
Title of Project: *The Bahai Alternative to Soft Power Diplomacy*
Funding Source: Lampert Institute for Civic and Global Affairs

Research Fellow: Cecilia Purkiss 2027 (Religion; Environmental Studies)
Faculty Mentor: Megan Abbas
Title of Project: *Religion and U.S. Foreign Policy in Cold War Indonesia*
Funding Source: J. Curtiss Taylor ’54 Endowed Student Research Fund

Research Fellow: Kira Sullivan 2028 (Undeclared)
Faculty Mentor: Megan Abbas
Title of Project: *Religion and U.S. Foreign Policy in Cold War Indonesia*
Funding Source: Division of Arts and Humanities

Research Fellow: Natalie Yale 2026 (Religion)
Faculty Mentor: Megan Abbas
Title of Project: *Rehabilitating Rastafari: Religion and the State in the Jamaican 1960s*
Funding Source: Division of Arts and Humanities

DIVISION OF NATURAL SCIENCES AND MATHEMATICS (NASC)

Department of Biology

Research Fellow: Bob Aboh 2028 (Undeclared)
Faculty Mentor: Engda Hagos
Title of Project: *Investigating the role of Krüppel-like Factor 4 in Ferroptosis*
Funding Source: Division of Natural Sciences and Mathematics

Research Fellow: Hana Ahmed 2027 (Molecular Biology)
Faculty Mentor: Engda Hagos
Title of Project: *Investigating the Role of Klf4 in Epigenetics*
Funding Source: Michael J. Wolk ’60 Heart Foundation

Research Fellow: Obsidian Ammons 2026 (Biochemistry; Molecular Biology)
Faculty Mentor: Geoff Holm
Title of Project: *The Relationship Between Host Cell Metabolism and Reovirus Infection*
Funding Source: Division of Natural Sciences and Mathematics

Research Fellow: Caroline Brooks 2026 (Biology)
Faculty Mentor: Jen Greenwich
Title of Project: *Investigating the Dimerization of DcpA in the Regulation of Biofilms in Agrobacterium tumefaciens*
Funding Source: Division of Natural Sciences and Mathematics

Research Fellow: Corinne Campbell 2026 (Biology)
Faculty Mentor: Jason Meyers
Title of Project: *Fueling Regeneration - The Critical Role of Glycolysis in Zebrafish Sensory Organ Recovery*
Funding Source: Mind, Brain, and Behavior Summer Grant

Research Fellow: Cinthia Destinville 2026 (Biology)
Faculty Mentor: Ken Belanger
Title of Project: *The Cave Microbiome: Exploring the Microbial Organisms in Titan Cave*
Funding Source: Michael J. Wolk ’60 Heart Foundation

Research Fellow: Grace Fraser 2026 (Molecular Biology)
Faculty Mentor: Geoff Holm
Title of Project: *The Relationship Between Host Cell Metabolism and Reovirus Infection*
Funding Source: Michael J. Wolk ’60 Heart Foundation

Research Fellow: Kevin Fuentes Gonzalez 2027 (Molecular Biology)
Faculty Mentor: Engda Hagos
Title of Project: *Investigating the Role of KLF4 in Epigenetic Modification*
Funding Source: Division of Natural Sciences and Mathematics

Research Fellow: Wyatt Hall 2026 (Biology)
Faculty Mentor: Tim McCay
Title of Project: *Long-term Macro-invertebrate Response to Watershed Liming in the Adirondacks*
Funding Source: Division of Natural Sciences and Mathematics

Research Fellow: Jenna Hayson 2026 (Molecular Biology)
Faculty Mentor: Engda Hagos
Title of Project: *Investigating the Role of Klf4 in Epigenetics*
Funding Source: Michael J. Wolk ’60 Heart Foundation

Research Fellow: Ja’Zhana Henderson 2028 (Philosophy)
Faculty Mentor: Jason Meyers
Title of Project: *Not All Support Is Equal: Functional Compartmentalization of Supporting Cells in Zebrafish Hair Cell Regeneration*
Funding Source: Division of Natural Sciences and Mathematics

Research Fellow: Carlyn Johnson 2026 (Biology)
Faculty Mentor: Catherine Cardelús
Title of Project: *Canopy Latrines and Nutrient Cycling in Costa Rica and Perú*
Funding Source: Division of Natural Sciences and Mathematics

Research Fellow: Melissa Kennedy 2028 (Undeclared)
Faculty Mentor: Catherine Cardelús
Title of Project: *Canopy Latrines and Nutrient Cycling in Costa Rica and Perú*
Funding Source: Division of Natural Sciences and Mathematics

Research Fellow: Matt Leopold 2026 (Molecular Biology)
Faculty Mentor: Eddie Watkins
Title of Project: *Exploring the Influence of Polyploidy in Hybrid Wood Ferns*
Funding Source: Division of Natural Sciences and Mathematics

Research Fellow: Zach Lightfoot 2026 (Biology)
Faculty Mentor: Damhnait McHugh
Title of Project: *Geneic Analysis of a Soil Dwelling Species Introduced from France to Ireland: An Interdisciplinary Research Opportunity in Spain*
Funding Source: Division of Natural Sciences and Mathematics

Research Fellow: Benjamin Marks 2027 (Biology)
Faculty Mentor: Bineyam Taye
Title of Project: *Interaction between Helminths and protozoan infection and gut microbiome among School children*
Funding Source: Michael J. Wolk ’60 Heart Foundation

Research Fellow: Abigail McGuire 2026 (Biology; Native American Studies)
Faculty Mentor: Tim McCay
Title of Project: *Long-term Macro-invertebrate Response to Watershed Liming in the Adirondacks*
Funding Source: Division of Natural Sciences and Mathematics

Research Fellow: Daniel Oluoch 2028 (Undeclared)
Faculty Mentor: Tim McCay
Title of Project: *Invasive Earthworms, Acid Rain, and Soil Biodiversity*
Funding Source: Division of Natural Sciences and Mathematics

Research Fellow: Avery Pickering 2027 (Molecular Biology)
Faculty Mentor: Ken Belanger
Title of Project: *Analysis of Factors Influencing Composition of the Gut Microbiome*
Funding Source: Division of Natural Sciences and Mathematics

Research Fellow: Mary Thomas Powell 2026 (Environmental Studies; Biology)
Faculty Mentor: Catherine Cardelús
Title of Project: *Canopy Latrines and Nutrient Cycling in Costa Rica and Perú*
Funding Source: Division of Natural Sciences and Mathematics

Research Fellow: Jordan Quimby 2027 (Molecular Biology)
Faculty Mentor: Jason Meyers
Title of Project: *The End of the Line: Investigating Terminal Sensory Organ Regeneration in Zebrafish*
Funding Source: Michael J. Wolk ’60 Heart Foundation

Research Fellow: Elijah Ramirez 2026 (Biology)
Faculty Mentor: Eddie Watkins
Title of Project: *Comparative Ecophysiology of Sun and Shade Grown Individuals of E. hyemale and E. variegatum*
Funding Source: Division of Natural Sciences and Mathematics

Research Fellow: Jenavieve Sherwood 2026 (Spanish; Molecular Biology)
Faculty Mentor: Engda Hagos
Title of Project: *Investigating the Role of Krüppel-like Factor Four (KLF4) in Cancer Metabolism*
Funding Source: Michael J. Wolk ’60 Heart Foundation

Research Fellow: Jenavieve Sherwood 2026 (Spanish; Molecular Biology)
Faculty Mentor: Engda Hagos
Title of Project: *Investigating the Role of Klf4 in Epigenetics*
Funding Source: Michael J. Wolk ’60 Heart Foundation

Research Fellow: Shep Sorenson 2027 (Molecular Biology)
Faculty Mentor: Jen Greenwich
Title of Project: *Investigating the Interaction Between PruR and DcpA in Agrobacterium tumefaciens*
Funding Source: Division of Natural Sciences and Mathematics

Research Fellow: JD Suarez 2027 (Environmental Biology)
Faculty Mentor: Tim McCay
Title of Project: *Assessing and Mitigating the Impact of Invasive Earthworms on Small Vegetable and Nursery Farms: An Integrated Research and Education Approach*
Funding Source: Division of Natural Sciences and Mathematics

Research Fellow: Joy Tang 2026 (Biology; Sociology)
Faculty Mentor: Tim McCay
Title of Project: *Assessing and Mitigating the Impact of Invasive Earthworms on Small Vegetable and Nursery Farms: An Integrated Research and Education Approach*
Funding Source: Division of Natural Sciences and Mathematics

Research Fellow: Cal Tortolani 2026 (Environmental Studies)
Faculty Mentor: Priscilla Van Wynsberghe
Title of Project: *Environmentalism in the US and Australia: The Role of Constitutional Foundations, Free Enterprise, and Individual Freedom in Shaping and Implementing Environmental Policies*
Funding Source: The Kraynak Institute for the Study of Freedom and Western Traditions (James Madison Fellow)

Research Fellow: Pablo Vivas Rivera 2026 (Molecular Biology)
Faculty Mentor: Damhnait McHugh
Title of Project: *Building the genetic roadmap of Prosellodrilus amplisetosus, an invasive earthworm species in Ireland*
Funding Source: Division of Natural Sciences and Mathematics

Research Fellow: Jerry Zhang 2026 (Molecular Biology)
Faculty Mentor: Geoff Holm
Title of Project: *The Relationship Between Host Cell Metabolism and Reovirus Infection*
Funding Source: Division of Natural Sciences and Mathematics

Research Fellow: Angie Zhu 2026 (Applied Math)
Faculty Mentor: Bineyam Taye
Title of Project: *The impact of food insecurity on the gut microbiome of Ethiopian schoolchildren*
Funding Source: Michael J. Wolk ’60 Heart Foundation

Department of Chemistry

Research Fellow: Aryeh Andriola 2026 (Chemistry; Biology)
Faculty Mentor: Jason Keith
Title of Project: *Surface Plasmon Induced Reactivity*
Funding Source: Justus ’43 and Jayne Schlichting Student Research Fund

Research Fellow: Kim Gates 2026 (Chemistry)
Faculty Mentor: Gongfang Hu
Title of Project: *Mechanistic Study of Aldol Reaction of Aldehyde and Methyl Isocyanoacetate Using Bismuth–Palladium Bimetallic Complex*
Funding Source: Justus ’43 and Jayne Schlichting Student Research Fund

Research Fellow: Victoria Houser 2027 (Biochemistry)
Faculty Mentor: Anthony Chianese
Title of Project: *Screening Pincer Catalysts for Various Hydrogenation Reactions*
Funding Source: National Science Foundation Grant

Research Fellow: Vivian Jiang 2026 (Biochemistry)
Faculty Mentor: Stephanie Sanders
Title of Project: *Solution-Phase Aggregation-Induced Emission of Properties of a Tetraphenylethylene Derivative for Bioimaging*
Funding Source: Division of Natural Sciences and Mathematics

Research Fellow: Isabel Kats-Rodgers 2027 (Chemistry)
Faculty Mentor: Eric Muller
Title of Project: *2D Quantitative Model for Infrared Scattering Scanning Near-Field Optical Microscopy (IR s-SNOM)*
Funding Source: Justus ’43 and Jayne Schlichting Student Research Fund

Research Fellow: Jordan Lazaar 2026 (Chemistry)
Faculty Mentor: Rick Geier
Title of Project: *Development of a TLC Method for Monitoring Reactions Leading to Mixtures of Porphyrinoids, and Comparison to UV-vis and HPLC Methods*
Funding Source: John C. Cochran Endowed Fund for Undergraduate Research

Research Fellow: Jiayi Liu 2026 (Chemistry)
Faculty Mentor: Gongfang Hu
Title of Project: *Catalytic Aldol Reactions of Aldehyde and Methyl Isocyanoacetate Using Bismuth–Group 10 Metal Bimetallic Complexes*
Funding Source: Division of Natural Sciences and Mathematics

Research Fellow: Liam McCarthy 2026 (Biochemistry)
Faculty Mentor: Jacob Goldberg
Title of Project: *New Methods for Imaging Zinc(II) Ions in Biology*
Funding Source: Organic Syntheses PUI Summer Research Grant

Research Fellow: Jason Mrosla 2027 (Biochemistry)
Faculty Mentor: Jacob Goldberg
Title of Project: *New Methods for Imaging Zinc(II) Ions in Biology*
Funding Source: John C. Cochran Endowed Fund for Undergraduate Research

Research Fellow: Robert Ozerdem 2026 (Chemistry)
Faculty Mentor: Gongfang Hu
Title of Project: *Using DFT to Examine an Improved Aldol reaction*
Funding Source: Justus ’43 and Jayne Schlichting Student Research Fund

Research Fellow: Brian Pallares 2026 (Biochemistry)
Faculty Mentor: Jacob Goldberg
Title of Project: *New Methods for Imaging Zinc(II) Ions in Biology*
Funding Source: Division of Natural Sciences and Mathematics

Research Fellow: Olivia Pearre 2027 (Chemistry)
Faculty Mentor: Gongfang Hu
Title of Project: *Influence of Pnictogens (Bi, Sb, and P) in Catalyzing an Aldol Reaction*
Funding Source: Warren Anderson Fund

Research Fellow: Havya Peddineni 2026 (Chemistry)
Faculty Mentor: Stephanie Sanders
Title of Project: *Role of Concentration and Solvent on Aggregation-induced Emission of Tetraphenylethylene*
Funding Source: Miller-Cochran Fund

Research Fellow: Penelope Schenkel 2028 (Undeclared)
Faculty Mentor: Anthony Chianese
Title of Project: *Kinetics of Ruthenium-catalyzed Hydrodehalogenation Reactions*
Funding Source: National Science Foundation Grant

Research Fellow: Yaroslav Spytskyi 2028 (Chemistry)
Faculty Mentor: Anthony Chianese
Title of Project: *Ru-catalyzed Hydrodehalogenation*
Funding Source: Warren Anderson Fund

Research Fellow: Sabrina Srabani 2027 (Molecular Biology)
Faculty Mentor: Dimitar Shopov
Title of Project: *Synthesis and Characterization of Iridium Oxo Dimers for Water Oxidation Catalysis*
Funding Source: Division of Natural Sciences and Mathematics

Research Fellow: Sam Witonsky 2026 (Chemistry)
Faculty Mentor: Eric Muller
Title of Project: *Structure and Ordering of Self-Assembled Monolayers through Vibrational Spectroscopy*
Funding Source: Division of Natural Sciences and Mathematics

Research Fellow: David Ye 2027 (Chemistry)
Faculty Mentor: Anthony Chianese
Title of Project: *Identifying the Active Catalyst in Ru-PNN Complexes Catalyzed Ester Hydrogenation*
Funding Source: Justus ’43 and Jayne Schlichting Student Research Fund

Research Fellow: Figo Zhang 2026 (Chemistry; Biology)
Faculty Mentor: Rick Geier
Title of Project: *Synthesis of Tetrapentylporphyrin, and the Investigation of the Preparation of Tetrapentyl-N-Confused Porphyrin*
Funding Source: Justus ’43 and Jayne Schlichting Student Research Fund

Research Fellow: Grace Zhang 2027 (Biochemistry)
Faculty Mentor: Jenny Peeler
Title of Project: *Influence of lysine acetylation on bacterial stress response proteins*
Funding Source: Division of Natural Sciences and Mathematics

Research Fellow: Lezhi Zhang 2028 (Undeclared)
Faculty Mentor: Stephanie Sanders
Title of Project: *Photophysical Properties Across Phases: Aggregation-Induced Emission of Tetraphenylethylene in Acetonitrile-Water and Electronic Characteristics of Fluorophores in Thin Films*
Funding Source: Division of Natural Sciences and Mathematics

Research Fellow: Haiyu Zhu 2027 (Biochemistry)
Faculty Mentor: Jenny Peeler
Title of Project: *Influence of lysine acetylation on bacterial stress response proteins*
Funding Source: Justus ’43 and Jayne Schlichting Student Research Fund

Department of Computer Science

Research Fellow: Andres Carvajal Sanchez 2028 (Undeclared)
Faculty Mentors: Aaron Gember-Jacobson; Kate Valete (research assistant)
Title of Project: *Speech-to-Speech Translation Tools in Higher Education Classrooms*
Funding Source: Tom and Liz Brackett Endowed Fund for Diversity, Equity, and Inclusion in Computer Science

Research Fellow: Renzo Cruzado 2026 (Computer Science)
Faculty Mentor: Joel Sommers
Title of Project: *Mapping DNS Wildcards and Organizations*
Funding Source: National Science Foundation Grant

Research Fellow: Anika Gurjar 2028 (Undeclared)
Faculty Mentor: Elodie Fourquet
Title of Project: *An Exploration of Sentiment Analysis Methods to Study Student Perspectives on Artificial Intelligence*
Funding Source: Tom and Liz Brackett Endowed Fund for Diversity, Equity, and Inclusion in Computer Science

Research Fellow: Tobi Onabanjo 2028 (Undeclared)
Faculty Mentor: Elodie Fourquet
Title of Project: S*caffolding Diagrams*
Funding Source: Holden Endowment Fund

Research Fellow: Yabesi Witinya 2026 (Computer Science)
Faculty Mentor: Joel Sommers
Title of Project: *Geographic Footprints in the rDNS Records via N-ary Tree Structure*
Funding Source: National Science Foundation Grant

Department of Earth and Environmental Geosciences

Research Fellow: Rowan Barnes 2028 (Undeclared)
Faculty Mentor: Joe Levy
Title of Project: *HeliHabitable Drone Research in the Alvord Desert in Eastern Oregon*
Funding Source: NASA Grant

Research Fellow: Rylie Berwanger 2026 (Geology)
Faculty Mentor: Alison Koleszar
Title of Project: *Tracing Magma Mixing through Plagioclase Populations at Augustine Volcano, Alaska*
Funding Source: Doug Rankin ’53 Endowment-Geology Research

Research Fellow: Jeriah Garcia 2028 (Undeclared)
Faculty Mentors: Paul Harnik; Rebecca Metzler
Title of Project: *Examination of Bryozoan Feeding Rates in the Gulf of Mexico*
Funding Source: Sonya Lee-Chung ’85, P’21 Endowed Research Fund

Research Fellow: Emma José 2028 (Undeclared)
Faculty Mentors: Paul Harnik; Rebecca Metzler
Title of Project: *Examination of Bryozoan Feeding Rates in the Gulf of Mexico*
Funding Source: Norma Vergo Prize

Research Fellow: Aidan Kenefick 2026 (Geology)
Faculty Mentor: William Peck
Title of Project: *Timing of the Cheney Mountain Shear Zone, Adirondack Highlands, New York*
Funding Source: Doug Rankin ’53 Endowment-Appalachian Research

Research Fellow: Emma Lewis 2025 (Biology; French)
Faculty Mentors: Paul Harnik; Rebecca Metzler
Title of Project: *Microstructure and Genetic Differences of Nucula proxima across Coastal Regions of North America*
Funding Source: Picker Interdisciplinary Science Institute; Division of Natural Sciences and Mathematics

Research Fellow: Avery Mathews 2027 (Environmental Geology)
Faculty Mentors: Paul Harnik; Rebecca Metzler
Title of Project: *Impact of Ocean Warming on Seafloor Communities: Initiating a Conservation Paleobiology Study in the Gulf of Maine*
Funding Source: Doug Rankin ’53 Endowment-Geology Research

Research Fellow: Christopher Olivares 2028 (Undeclared)
Faculty Mentors: Paul Harnik; Rebecca Metzler
Title of Project: *Corbulid Biomineralization and Environmental Variation Within the Gulf of Mexico*
Funding Source: Bob Linsley/James McLelland Fund

Research Fellow: Meredith Shapiro 2028 (Undeclared)
Faculty Mentors: Paul Harnik; Rebecca Metzler
Title of Project: *Microstructure and Genetic Differences of Nucula proxima across Coastal Regions of North America*
Funding Source: Bob Linsley/James McLelland Fund

Research Fellow: Riley Taylor 2026 (Geology; Natural Sciences)
Faculty Mentor: Joe Levy
Title of Project: *HeliHabitable Drone Research in the Alvord Desert in Eastern Oregon*
Funding Source: NASA Grant

Research Fellow: Allison Wen 2028 (Undeclared)
Faculty Mentors: Paul Harnik; Rebecca Metzler
Title of Project: *Microstructure and Genetic Differences of Nucula proxima across Coastal Regions of North America*
Funding Source: Hackett-Rathmell 1968 Memorial Fund

Department of Mathematics

Research Fellow: Matthew Liu 2027 (Computer Science; Mathematics)
Faculty Mentor: Silvia Jimenez Bolaños
Title of Project: *Homogenization of Second-Order Elliptic PDEs*
Funding Source: Division of Natural Sciences and Mathematics

Research Fellow: Danny Molyneux 2026 (Applied Math)
Faculty Mentor: Will Cipolli
Title of Project: *Data Science Collaboratory Project*
Funding Source: Division of Natural Sciences and Mathematics

Research Fellow: Olivia Schlegel 2026 (Applied Math)
Faculty Mentor: Nick Moore
Title of Project: *Numerical sampling and simulation of rogue water waves*
Funding Source: Office of Naval Research Grant

Research Fellow: Jacqueline Tong 2027 (Applied Math)
Faculty Mentor: Shu Gu
Title of Project: *How doctors spend service times with patients with varying degree of severity: An approach using deep learning*
Funding Source: Division of Natural Sciences and Mathematics

Research Fellow: Max Warriner 2027 (Applied Math)
Faculty Mentor: Will Cipolli
Title of Project: *Data Science Collaboratory Project*
Funding Source: Division of Natural Sciences and Mathematics

Research Fellow: Yuchen Zhao 2026 (Economics; Applied Math)
Faculty Mentor: Nick Moore
Title of Project: *Numerical sampling and simulation of rogue water waves*
Funding Source: Division of Natural Sciences and Mathematics

Research Fellow: Chengtong Zhu 2027 (Mathematics)
Faculty Mentor: Zichen Ma
Title of Project: *Feature Selection Method for Credit Risk Assessment Using LASSO Regression and Mutual Information-Based Ranking: Improving Predictive Accuracy in Risk and Fraud Detection*
Funding Source: Division of Natural Sciences and Mathematics

Neuroscience Program

Research Fellow: Corinne Campbell 2026 (Biology)
Faculty Mentor: Jason Meyers
Title of Project: *Fueling Regeneration - The Critical Role of Glycolysis in Zebrafish Sensory Organ Recovery*
Funding Source: Mind, Brain, and Behavior Summer Grant

Research Fellow: Ja'Zhana Henderson 2028 (Philosophy)
Faculty Mentor: Jason Meyers
Title of Project: *Not All Support Is Equal: Functional Compartmentalization of Supporting Cells in Zebrafish Hair Cell Regeneration*
Funding Source: Division of Natural Sciences and Mathematics

Research Fellow: Joy Huang 2027 (Neuroscience)
Faculty Mentor: Bruce Hansen
Title of Project: *Building a novel brain-guided convolutional neural network augmented with large language models to study how knowledge influences perception*
Funding Source: Division of Natural Sciences and Mathematics

Research Fellow: Jordan Quimby 2027 (Molecular Biology)
Faculty Mentor: Jason Meyers
Title of Project: *The End of the Line: Investigating Terminal Sensory Organ Regeneration in Zebrafish*
Funding Source: Michael J. Wolk '60 Heart Foundation

Research Fellow: Evan Sheldon 2026 (Neuroscience; Classical Studies)
Faculty Mentor: Bruce Hansen
Title of Project: *Building a novel brain-guided convolutional neural network augmented with large language models to study how knowledge influences perception*
Funding Source: Division of Natural Sciences and Mathematics

Research Fellow: Cenjing Wang 2028 (Undeclared)
Faculty Mentor: Bruce Hansen
Title of Project: *Building a novel brain-guided convolutional neural network augmented with large language models to study how knowledge influences perception*
Funding Source: Division of Natural Sciences and Mathematics

Department of Physics and Astronomy

Research Fellow: Alec Aggazio-Bach 2026 (Astronomy/Physics)
Faculty Mentor: Thomas Balonek
Title of Project: *Processing Quasar Observations from the Zwicky Transient Facility and Colgate's Foggy Bottom Observatory*
Funding Source: Division of Natural Sciences and Mathematics

Research Fellow: Abdul Almaweri 2028 (Physics)
Faculty Mentor: Kiko Galvez
Title of Project: *Investigations of Novel Quantum Effects in Photon Interference*
Funding Source: Division of Natural Sciences and Mathematics

Research Fellow: Tori Broadnax 2027 (Philosophy)
Faculty Mentor: Cosmin Ilie
Title of Project: *Probing the nature of Dark Matter with the first stars and galaxies in the Universe*
Funding Source: Division of Natural Sciences and Mathematics

Research Fellow: Jahanvi Chamria 2028 (Undeclared)
Faculty Mentor: Ramesh Adhikari
Title of Project: *Peptide Nanowire Growth on Cellulose Sponges for Hydrophobic Surfaces and Oil–Water Separation*
Funding Source: Justus '43 and Jayne Schlichting Student Research Fund

Research Fellow: Anneliese Coleman 2027 (Russian and Eurasian Studies; Physics)
Faculty Mentor: Ramesh Adhikari
Title of Project: *Bio-based Materials for Electronic Devices and Functional Surfaces*
Funding Source: National Science Foundation Grant

Research Fellow: Henry Combs 2027 (Philosophy)
Faculty Mentor: Thomas Balonek
Title of Project: *Tracking the Short Term Changes in Brightness of Quasars*
Funding Source: Division of Natural Sciences and Mathematics

Research Fellow: Duncan Earl 2028 (Undeclared)
Faculty Mentor: Thomas Balonek
Title of Project: *Combining Colgate and All-Sky-Survey Observations to Study the Long-and-Short-Term Optical Variability of Quasars*
Funding Source: Division of Natural Sciences and Mathematics

Research Fellow: Matthew Fumo 2028 (Undeclared)
Faculty Mentor: Kiko Galvez
Title of Project: *Free Space Communications with Rotating Optical Beams*
Funding Source: Division of Natural Sciences and Mathematics

Research Fellow: Jeriah Garcia 2028 (Undeclared)
Faculty Mentors: Paul Harnik; Rebecca Metzler
Title of Project: *Examination of Bryozoan Feeding Rates in the Gulf of Mexico*
Funding Source: Sonya Lee-Chung ’85, P’21 Endowed Research Fund

Research Fellow: Gunnar Gasper 2028 (Undeclared)
Faculty Mentor: Cosmin Ilie
Title of Project: *Probing the nature of Dark Matter with the first stars and galaxies in the Universe*
Funding Source: Justus ’43 and Jayne Schlichting Student Research Fund

Research Fellow: John Griffith 2026 (Physics)
Faculty Mentor: Ken Segall
Title of Project: *Simulating and Testing a Superconducting Analog Multiplier*
Funding Source: Division of Natural Sciences and Mathematics

Research Fellow: Chris Gross 2026 (Physics)
Faculty Mentor: Jonathan Levine
Title of Project: *Characterizing Calibration Targets for the DIMPLE Experiment to the Moon*
Funding Source: Justus ’43 and Jayne Schlichting Student Research Fund

Research Fellow: Yufeng Gu 2027 (Physics)
Faculty Mentor: Kiko Galvez
Title of Project: *Laboratory Gravitational Lensing of Binary Stars*
Funding Source: National Science Foundation Grant

Research Fellow: Halle Hatten 2027 (Astronomy/Physics)
Faculty Mentor: Thomas Balonek
Title of Project: *Optical Variability of Quasars*
Funding Source: Division of Natural Sciences and Mathematics

Research Fellow: Emma José 2028 (Undeclared)
Faculty Mentors: Paul Harnik; Rebecca Metzler
Title of Project: *Examination of Bryozoan Feeding Rates in the Gulf of Mexico*
Funding Source: Norma Vergo Prize

Research Fellow: Daniel Kaper-Barcelata 2028 (Astronomy/Physics)
Faculty Mentor: Jonathan Levine
Title of Project: *DIMPLE Console Development Research Project*
Funding Source: Division of Natural Sciences and Mathematics

Research Fellow: Arshia Khadivizand 2027 (Physics)
Faculty Mentor: Rebecca Metzler
Title of Project: *Biominerals in a changing climate: unraveling structure, composition, and materials properties*
Funding Source: Justus ’43 and Jayne Schlichting Student Research Fund

Research Fellow: Emma Lewis 2025 (Biology; French)
Faculty Mentors: Paul Harnik; Rebecca Metzler
Title of Project: *Microstructure and Genetic Differences of Nucula proxima across Coastal Regions of North America*
Funding Source: Picker Interdisciplinary Science Institute; Division of Natural Sciences and Mathematics

Research Fellow: Jackson Lowell 2027 (Physics)
Faculty Mentor: Ramesh Adhikari
Title of Project: *Characterization of Electronic Properties of Peptide Nanowires*
Funding Source: Division of Natural Sciences and Mathematics

Research Fellow: Flynn McGrath 2026 (Physics)
Faculty Mentor: Ken Segall
Title of Project: *Investigation of a SQUID-based Analog Multiplier Chip*
Funding Source: Mind, Brain, and Behavior Scholars Award

Research Fellow: Xinjian Qiu 2027 (Physics; Studio Arts)
Faculty Mentor: Kiko Galvez
Title of Project: *Investigations of Novel Quantum Effects in Photon Interference*
Funding Source: Division of Natural Sciences and Mathematics

Research Fellow: Will Rye 2026 (Physics)
Faculty Mentor: Ken Segall
Title of Project: *Investigation of a SQUID-based Analog Multiplier Chip*
Funding Source: Justus ’43 and Jayne Schlichting Student Research Fund

Research Fellow: Rafael Sanchez Lazaro 2026 (Physics)
Faculty Mentor: Cosmin Ilie
Title of Project: *Determining the Geometry of the Dark Matter Halo at the Center of our Galaxy*
Funding Source: Justus ’43 and Jayne Schlichting Student Research Fund

Research Fellow: Andrew Savage 2026 (Computer Science; Physics)
Faculty Mentor: Ramesh Adhikari
Title of Project: *Characterization of Pristine Leaf Memristive Devices*
Funding Source: National Science Foundation Grant

Research Fellow: Kathryn Schluter 2026 (Biology)
Faculty Mentor: Rebecca Metzler
Title of Project: *Ocean Acidification and its Effect on Crab Microstructures*
Funding Source: Division of Natural Sciences and Mathematics

Research Fellow: Meredith Shapiro 2028 (Undeclared)
Faculty Mentors: Paul Harnik; Rebecca Metzler
Title of Project: *Microstructure and Genetic Differences of Nucula proxima across Coastal Regions of North America*
Funding Source: Bob Linsley/James McLelland Fund

Research Fellow: Andrew Tatela 2027 (Physics)
Faculty Mentor: Ramesh Adhikari
Title of Project: *Leaf-Based Electronic Components*
Funding Source: National Science Foundation Grant; Division of Natural Sciences and Mathematics

Research Fellow: Allison Wen 2028 (Undeclared)
Faculty Mentors: Paul Harnik; Rebecca Metzler
Title of Project: *Microstructure and Genetic Differences of Nucula proxima across Coastal Regions of North America*
Funding Source: Hackett-Rathmell 1968 Memorial Fund

Department of Psychological and Brain Sciences

Research Fellow: Jessie Cai 2026 (Psychological Science)
Faculty Mentor: Erin Cooley
Title of Project: *The Pain of Falling Behind: Contexts of Inequality May Shape Subjective Perceptions of Status, Emotions, and Health*
Funding Source: Division of Natural Sciences and Mathematics

Research Fellow: Ella Duchnowska 2026 (Neuroscience)
Faculty Mentor: Anzela Niraula
Title of Project: *Neuroimmune Response in Xenopus laevis to Bacterial Infection*
Funding Source: Division of Natural Sciences and Mathematics

Research Fellow: Anna Fleischer 2027 (German; Neuroscience)
Faculty Mentor: Ewa Galaj
Title of Project: *Neuroadaptations of CB1 receptor and its involvement in heroin conditioned place preference*
Funding Source: Mind, Brain, and Behavior Scholars Award

Research Fellow: Anna Fleischer 2027 (German; Neuroscience)
Faculty Mentor: Ewa Galaj
Title of Project: *The Role of the VTA → Insula Pathway in Drug Self-Administration in Rats*
Funding Source: Mind, Brain, and Behavior Scholars Award

Research Fellow: Maya Guha 2028 (Undeclared)
Faculty Mentor: Erin Cooley
Title of Project: *The Pain of Falling Behind: Contexts of Inequality May Shape Subjective Perceptions of Status, Emotions, and Health*
Funding Source: Division of Natural Sciences and Mathematics

Research Fellow: Joy Huang 2027 (Neuroscience)
Faculty Mentor: Bruce Hansen
Title of Project: *Building a novel brain-guided convolutional neural network augmented with large language models to study how knowledge influences perception*
Funding Source: Division of Natural Sciences and Mathematics

Research Fellow: Josephine Jenne 2027 (Psychological Science; English)
Faculty Mentor: Jennifer Tomlinson
Title of Project: *Sleep and Relationships in Adulthood*
Funding Source: Division of Natural Sciences and Mathematics

Research Fellow: Lillian Kibby 2026 (Psychological Science; Neuroscience)
Faculty Mentor: Erin Cooley
Title of Project: *The Pain of Falling Behind: Contexts of Inequality May Shape Subjective Perceptions of Status, Emotions, and Health*
Funding Source: Mind, Brain, and Behavior Scholars Award

Research Fellow: Yangqi Li 2028 (Undeclared)
Faculty Mentor: Lauren Philbrook
Title of Project: *The Role of Neighborhood and Family Contexts in Children's Sleep*
Funding Source: Division of Natural Sciences and Mathematics

Research Fellow: Delaney Lobell 2026 (Psychological Science)
Faculty Mentor: Lauren Philbrook
Title of Project: *The Role of Neighborhood and Family Contexts in Children's Sleep*
Funding Source: Division of Natural Sciences and Mathematics

Research Fellow: Kajol Luplunge 2028 (Undeclared)
Faculty Mentor: Wan-chun Liu
Title of Project: *Co-Song Gestures on Birds*
Funding Source: Division of Natural Sciences and Mathematics

Research Fellow: Charlotte Morris 2027 (Neuroscience)
Faculty Mentor: Ewa Galaj
Title of Project: *Neuroadaptations of CB1 receptor and its involvement in heroin conditioned place preference*
Funding Source: Division of Natural Sciences and Mathematics

Research Fellow: Charlotte Morris 2027 (Neuroscience)
Faculty Mentor: Ewa Galaj
Title of Project: *The Role of the VTA → Insula Pathway in Drug Self-Administration in Rats*
Funding Source: Division of Natural Sciences and Mathematics

Research Fellow: Ethan Ouyang 2027 (Neuroscience)
Faculty Mentor: Wan-chun Liu
Title of Project: *Developing Computational Models for Quantifying Co-Song Gestures in Zebra Finches*
Funding Source: Division of Natural Sciences and Mathematics

Research Fellow: Emy Pacheco Ramirez 2028 (Undeclared)
Faculty Mentor: Erin Cooley
Title of Project: *The Pain of Falling Behind: Contexts of Inequality May Shape Subjective Perceptions of Status, Emotions, and Health*
Funding Source: Division of Natural Sciences and Mathematics

Research Fellow: Juhyun Park 2028 (Undeclared)
Faculty Mentor: Wan-chun Liu
Title of Project: *Studying zebra finches' song-entangled gestures*
Funding Source: Division of Natural Sciences and Mathematics

Research Fellow: Oscar Quintanilla 2028 (Neuroscience)
Faculty Mentor: Anzela Niraula
Title of Project: *Microglia in Transition: Remodeling of Brain Circuits and Vasculature During Xenopus laevis Metamorphosis*
Funding Source: Division of Natural Sciences and Mathematics

Research Fellow: Carlie Rzeszotarski 2026 (Psychological Science; Sociology)
Faculty Mentor: Jennifer Tomlinson
Title of Project: *Sleep and Relationships in Adulthood*
Funding Source: Division of Natural Sciences and Mathematics

Research Fellow: Ashley Shanahan 2027 (Neuroscience)
Faculty Mentor: Anzela Niraula
Title of Project: *Exploring the microglia response to demyelination and remyelination in mice*
Funding Source: Division of Natural Sciences and Mathematics

Research Fellow: Evan Sheldon 2026 (Neuroscience; Classical Studies)
Faculty Mentor: Bruce Hansen
Title of Project: *Building a novel brain-guided convolutional neural network augmented with large language models to study how knowledge influences perception*
Funding Source: Division of Natural Sciences and Mathematics

Research Fellow: Holly Shortell 2027 (Neuroscience)
Faculty Mentor: Ewa Galaj
Title of Project: *Neuroadaptations of CB1 receptor and its involvement in heroin conditioned place preference*
Funding Source: National Institutes of Health Grant

Research Fellow: Holly Shortell 2027 (Neuroscience)
Faculty Mentor: Ewa Galaj
Title of Project: *The Role of the VTA → Insula Pathway in Drug Self-Administration in Rats*
Funding Source: National Institutes of Health Grant

Research Fellow: Emma Slupik 2026 (Neuroscience)
Faculty Mentor: Wan-chun Liu
Title of Project: *Defining Syllable Complexity in Zebra Finch Birds*
Funding Source: Division of Natural Sciences and Mathematics

Research Fellow: Maksim Tesovic 2027 (Neuroscience)
Faculty Mentor: Anzela Niraula
Title of Project: *Sickness at the Cellular Level: How Macrophages Mediate Brain-Body Communication in Response to Viral Immune Challenges in Mice*
Funding Source: Division of Natural Sciences and Mathematics

Research Fellow: Cenjing Wang 2028 (Undeclared)
Faculty Mentor: Bruce Hansen
Title of Project: *Building a novel brain-guided convolutional neural network augmented with large language models to study how knowledge influences perception*
Funding Source: Division of Natural Sciences and Mathematics

Research Fellow: Natalie Woodson 2026 (Psychological Science)
Faculty Mentor: Lauren Philbrook
Title of Project: *The Role of Neighborhood and Family Contexts in Children's Sleep*
Funding Source: Mind, Brain, and Behavior Summer Grant

Research Fellow: Coco Xie 2026 (Molecular Biology)
Faculty Mentor: Ewa Galaj
Title of Project: *Neuroadaptations of CB1 receptor and its involvement in heroin conditioned place preference*
Funding Source: Division of Natural Sciences and Mathematics

Research Fellow: Coco Xie 2026 (Molecular Biology)
Faculty Mentor: Ewa Galaj
Title of Project: *The Role of the VTA → Insula Pathway in Drug Self-Administration in Rats*
Funding Source: Division of Natural Sciences and Mathematics

DIVISION OF SOCIAL SCIENCES (SOSC)

Department of Economics

Research Fellow: Ernest Clottey 2026 (Computer Science; Economics)
Faculty Mentor: Yang Song
Title of Project: *Understanding Charter Schools State Laws: Patterns and Trends*
Funding Source: Division of Social Sciences

Research Fellow: Young Hu 2027 (Economics)
Faculty Mentor: Takao Kato
Title of Project: *The Effects of Working Hours on Career Advancement and Gender Disparities in Promotions*
Funding Source: Division of Social Sciences

Research Fellow: Abrielle Silva 2026 (Environmental Economics)
Faculty Mentor: Isla Globus-Harris
Title of Project: *National-Level Analysis of Single-Use Plastic Bag Regulations*
Funding Source: Walter Broughton ’63 Research Fund

Research Fellow: Alice Walton 2026 (Economics)
Faculty Mentor: Chad Sparber
Title of Project: *Economic Freedom and Labor Dynamics in Great Britain’s Industrial Revolution*
Funding Source: The Kraynak Institute for the Study of Freedom and Western Traditions (James Madison Fellow)

Research Fellow: Melly Zhuang 2026 (Mathematical Economics)
Faculty Mentor: Yang Song
Title of Project: *Analyzing Patterns in the U.S. Charter School Laws and Their Political Context*
Funding Source: Division of Social Sciences

Department of Educational Studies

Research Fellow: Aastha Ghimire 2027 (Psychological Science; Educational Studies)
Faculty Mentor: Meg Gardner
Title of Project: *STEM teaching and learning in place: Leveraging qualitative research to understand critical pedagogy and practices*
Funding Source: Division of Social Sciences

Research Fellow: Eloise Sampson 2026 (Studio Arts; Educational Studies)
Faculty Mentor: Meg Gardner
Title of Project: *Art in Place: Art within a place-based framework in science education*
Funding Source: Division of Social Sciences

Department of Geography

Research Fellow: Jack Mullen 2026 (Environmental Geography)
Faculty Mentors: Adam Burnett; Peter Klepeis
Title of Project: *Shared histories and contemporary influences of First-Nations people of Eastern North America and Western Australia*
Funding Source: Division of Social Sciences

Research Fellow: Nathaly Tlaseca Verde 2026 (Geography)
Faculty Mentor: William Meyer
Title of Project: *Urban and Rural Accident Risk in 1880s Massachusetts*
Funding Source: Division of Social Sciences

Research Fellow: Luke Wang 2027 (Environmental Geography; International Relations)
Faculty Mentor: William Meyer
Title of Project: *Urban and Rural Accident Risk in 1880s Massachusetts*
Funding Source: Division of Social Sciences

Research Fellow: Jannah Zabadi 2026 (Geography)
Faculty Mentors: Adam Burnett; Peter Klepeis
Title of Project: *Indigenous Australian Cultural Exchange*
Funding Source: Division of Social Sciences

Department of History

Research Fellow: Alec Stein 2027 (History)
Faculty Mentor: Graham Hodges
Title of Project: *Henry Highland Garnet Research/Underground Railroad*
Funding Source: Division of Social Sciences

Research Fellow: Brendan Werries 2027 (History)
Faculty Mentor: Graham Hodges
Title of Project: *Henry Highland Garnet Research/Underground Railroad*
Funding Source: Division of Social Sciences

Research Fellow: Logan Wilson 2026 (Middle Eastern and Islamic Studies; History)
Faculty Mentor: Noor-Aiman Khan
Title of Project: *Immigrants at Work: Uncovering Arab Americans Place in the Michigan Auto Industry and Labor Movement*
Funding Source: Division of Social Sciences

Department of International Relations

Research Fellow: Sarah Kinnard 2026 (Middle Eastern and Islamic Studies; Peace and Conflict Studies)
Faculty Mentor: Danielle Lupton
Title of Project: *Threat Construction During Crises: How Leaders Justify Coercion Abstract*
Funding Source: Division of Social Sciences

Research Fellow: London Pettibone 2027 (Political Science; English)
Faculty Mentor: Danielle Lupton
Title of Project: *Affective Polarization, Partisanship, and Democracy: The Rising Threat of Lone-Wolf Terrorism*
Funding Source: The Kraynak Institute for the Study of Freedom and Western Traditions (James Madison Fellow)

Research Fellow: Kathryn Shearer 2027 (Political Science)
Faculty Mentor: Danielle Lupton
Title of Project: *Threat Construction During Crises: How Leaders Justify Coercion*
Funding Source: Stickles Fund

Research Fellow: Catherine Whang 2026 (Political Science)
Faculty Mentor: Danielle Lupton
Title of Project: *Threat Construction During Crises: How Leaders Justify Coercion*
Funding Source: Stickles Fund

Department of Political Science

Research Fellow: Alexander Di Napoli 2026 (Political Science)
Faculty Mentor: Valerie Morkevičius
Title of Project: *Deterrence and Diplomacy: South Korea's Response to a Nuclear North and a Divided Indo-Pacific*
Funding Source: The Kraynak Institute for the Study of Freedom and Western Traditions (James Madison Fellow)

Research Fellow: Ben Haber 2025 (Political Science)
Faculty Mentor: Ed Fogarty
Title of Project: *Assessing the Military-Industrial Complex: Do Defense Contracts in Wartime Serve National Security or Business Interests*
Funding Source: The Kraynak Institute for the Study of Freedom and Western Traditions (James Madison Fellow)

Research Fellow: Emma Hanlon 2027 (Political Science)
Faculty Mentor: Annie Benn
Title of Project: *Rhetoric and Power: Exploring the Expansion of Executive Authority in the Bush and Trump Administrations*
Funding Source: The Kraynak Institute for the Study of Freedom and Western Traditions (James Madison Fellow)

Research Fellow: Chris Johnson 2026 (Political Science)
Faculty Mentor: Juan Ibarra Del Cueto
Funding Source: Lampert Institute for Civic and Global Affairs

Research Fellow: Sarah Kinnard 2026 (Middle Eastern and Islamic Studies; Peace and Conflict Studies)
Faculty Mentor: Danielle Lupton
Title of Project: *Threat Construction During Crises: How Leaders Justify Coercion Abstract*
Funding Source: Division of Social Sciences

Research Fellow: Jordan Maxham 2026 (Political Science)
Faculty Mentor: Dominika Koter
Title of Project: *Media Ecosystems and the Asymmetric Rise of the Populist Right in Europe*
Funding Source: The Kraynak Institute for the Study of Freedom and Western Traditions (James Madison Fellow)

Research Fellow: Emma McCartan 2026 (International Relations)
Faculty Mentor: Bruce Rutherford
Funding Source: Lampert Institute for Civic and Global Affairs

Research Fellow: Olivia Pascione 2026 (Psychological Science; Political Science)
Faculty Mentor: Fred Chernoff
Title of Project: *Freedom vs. Security: Reconciling Civil Liberties and Nuclear Strategies*
Funding Source: The Kraynak Institute for the Study of Freedom and Western Traditions (James Madison Fellow)

Research Fellow: London Pettibone 2027 (Political Science; English)
Faculty Mentor: Danielle Lupton
Title of Project: *Affective Polarization, Partisanship, and Democracy: The Rising Threat of Lone-Wolf Terrorism*
Funding Source: The Kraynak Institute for the Study of Freedom and Western Traditions (James Madison Fellow)

Research Fellow: Eli Senzel 2026 (English; Political Science)
Faculty Mentor: Annie Benn
Title of Project: *Congressional Oversight of the Bureaucracy*
Funding Source: Division of Social Sciences

Research Fellow: Kathryn Shearer 2027 (Political Science)
Faculty Mentor: Danielle Lupton
Title of Project: *Threat Construction During Crises: How Leaders Justify Coercion*
Funding Source: Stickles Fund

Research Fellow: Peyton Taylor 2027 (Political Science)
Faculty Mentor: Matt Luttig
Title of Project: *Reviving Trust in American Journalism through the Proper Use of Polling*
Funding Source: The Kraynak Institute for the Study of Freedom and Western Traditions (James Madison Fellow)

Research Fellow: Catherine Whang 2026 (Political Science)
Faculty Mentor: Danielle Lupton
Title of Project: *Threat Construction During Crises: How Leaders Justify Coercion*
Funding Source: Stickles Fund

Research Fellow: Luca Williams 2026 (Computer Science; Political Science)
Faculty Mentor: Annie Benn
Title of Project: *Regulations.gov Data Project*
Funding Source: Division of Social Sciences

Department of Sociology and Anthropology

Research Fellow: Georgia Banner 2026 (Anthropology; Psychological Science)
Faculty Mentor: Michelle Bigenho
Title of Project: *Creativity, Connection, and Embodiment in Shared Art Spaces*
Funding Source: Division of Social Sciences

Research Fellow: Evelyn Gao 2026 (Economics)
Faculty Mentor: Carolyn Hsu
Title of Project: *Lying Flat or Competing? Chinese Youth Attitudes in a Time of Economic Slowdown*
Funding Source: Division of Social Sciences

Research Fellow: Reem Numan 2027 (Music)
Faculty Mentor: Michelle Bigenho
Title of Project: *Blerd(ing) Out: Black Syncretism with Anime and other Japanese Pop Culture*
Funding Source: Walter Broughton ’63 Research Fund

DIVISION OF UNIVERSITY STUDIES (UNST)

Africana and Latin American Studies Program

Research Fellow: Georgia Banner 2026 (Anthropology; Psychological Science)
Faculty Mentor: Michelle Bigenho
Title of Project: *Creativity, Connection, and Embodiment in Shared Art Spaces*
Funding Source: Division of Social Sciences

Research Fellow: Reem Numan 2027 (Music)
Faculty Mentor: Michelle Bigenho
Title of Project: *Blerd(ing) Out: Black Syncretism with Anime and other Japanese Pop Culture*
Funding Source: Walter Broughton ’63 Research Fund

Research Fellow: Alec Stein 2027 (History)
Faculty Mentor: Graham Hodges
Title of Project: *Henry Highland Garnet Research/Underground Railroad*
Funding Source: Division of Social Sciences

Research Fellow: Brendan Werries 2027 (History)
Faculty Mentor: Graham Hodges
Title of Project: *Henry Highland Garnet Research/Underground Railroad*
Funding Source: Division of Social Sciences

Asian Studies Program

Research Fellow: Ernest Clottey 2026 (Computer Science; Economics)
Faculty Mentor: Yang Song
Title of Project: *Understanding Charter Schools State Laws: Patterns and Trends*
Funding Source: Division of Social Sciences

Research Fellow: Melly Zhuang 2026 (Mathematical Economics)
Faculty Mentor: Yang Song
Title of Project: *Analyzing Patterns in the U.S. Charter School Laws and Their Political Context*
Funding Source: Division of Social Sciences

Environmental Studies Program

Research Fellow: Wyatt Hall 2026 (Biology)
Faculty Mentor: Tim McCay
Title of Project: *Long-term Macro-invertebrate Response to Watershed Liming in the Adirondacks*
Funding Source: Division of Natural Sciences and Mathematics

Research Fellow: Carlyn Johnson 2026 (Biology)
Faculty Mentor: Catherine Cardelús
Title of Project: *Canopy Latrines and Nutrient Cycling in Costa Rica and Perú*
Funding Source: Division of Natural Sciences and Mathematics

Research Fellow: Melissa Kennedy 2028 (Undeclared)
Faculty Mentor: Catherine Cardelús
Title of Project: *Canopy Latrines and Nutrient Cycling in Costa Rica and Perú*
Funding Source: Division of Natural Sciences and Mathematics

Research Fellow: Abigail McGuire 2026 (Biology; Native American Studies)
Faculty Mentor: Tim McCay
Title of Project: *Long-term Macro-invertebrate Response to Watershed Liming in the Adirondacks*
Funding Source: Division of Natural Sciences and Mathematics

Research Fellow: Daniel Oluoch 2028 (Undeclared)
Faculty Mentor: Tim McCay
Title of Project: *Invasive Earthworms, Acid Rain, and Soil Biodiversity*
Funding Source: Division of Natural Sciences and Mathematics

Research Fellow: Mary Thomas Powell 2026 (Environmental Studies; Biology)
Faculty Mentor: Catherine Cardelús
Title of Project: *Canopy Latrines and Nutrient Cycling in Costa Rica and Perú*
Funding Source: Division of Natural Sciences and Mathematics

Research Fellow: Abrielle Silva 2026 (Environmental Economics)
Faculty Mentor: Isla Globus-Harris
Title of Project: *National-Level Analysis of Single-Use Plastic Bag Regulations*
Funding Source: Walter Broughton ’63 Research Fund

Research Fellow: JD Suarez 2027 (Environmental Biology)
Faculty Mentor: Tim McCay
Title of Project: *Assessing and Mitigating the Impact of Invasive Earthworms on Small Vegetable and Nursery Farms: An Integrated Research and Education Approach*
Funding Source: Division of Natural Sciences and Mathematics

Research Fellow: Joy Tang 2026 (Biology; Sociology)
Faculty Mentor: Tim McCay
Title of Project: *Assessing and Mitigating the Impact of Invasive Earthworms on Small Vegetable and Nursery Farms: An Integrated Research and Education Approach*
Funding Source: Division of Natural Sciences and Mathematics

Global Public and Environmental Health Program

Research Fellow: Benjamin Marks 2027 (Molecular Biology)
Faculty Mentor: Bineyam Taye
Title of Project: *Interaction between Helminths and protozoan infection and gut microbiome among School children*
Funding Source: Michael J. Wolk ’60 Heart Foundation

Research Fellow: Angie Zhu 2026 (Applied Math)
Faculty Mentor: Bineyam Taye
Title of Project: *The impact of food insecurity on the gut microbiome of Ethiopian schoolchildren*
Funding Source: Michael J. Wolk ’60 Heart Foundation

Museum Studies Program

Research Fellow: Julia Bihari 2027 (History)
Faculty Mentor: Elizabeth Marlowe
Title of Project: *Art, Museums and Repatriation: An Attempt to Assess Public Opinion*
Funding Source: J. Curtiss Taylor ’54 Endowed Student Research Fund

Research Fellow: Addisyn Donfris 2026 (Art History)
Faculty Mentor: Elizabeth Marlowe
Title of Project: *Art, Museums and Repatriation: An Attempt to Assess Public Opinion*
Funding Source: Division of Arts and Humanities

Research Fellow: Elizabeth Wall 2027 (Classical Studies)
Faculty Mentor: Elizabeth Marlowe
Title of Project: *Art, Museums and Repatriation: An Attempt to Assess Public Opinion*
Funding Source: Division of Arts and Humanities

Native American Studies Program

Research Fellow: Topher Durette 2026 (History; Native American Studies)
Faculty Mentor: Chris Vecsey
Title of Project: *Black Hills, Lakota World: Summer Research on the Lakota Sioux Relationship to the Black Hills Before and After U.S. Colonization*
Funding Source: Division of University Studies

Russian and Eurasian Studies Program

Research Fellow: Jebbie Bauer 2026 (Russian and Eurasian Studies; International Relations)
Faculty Mentor: Jessica Graybill
Title of Project: *Russia's Patronage of Global Authoritarianism*
Funding Source: The Kraynak Institute for the Study of Freedom and Western Traditions (James Madison Fellow)

Research Fellow: Sophie Karbstein 2026 (Russian and Eurasian Studies; Peace and Conflict Studies)
Faculty Mentor: Mieka Erley
Title of Project: *Radioactive Mutants and Toxic Sovereignty: (Post-)Soviet Strategies of Irradiated Subjectivity*
Funding Source: Division of University Studies

DEPARTMENT OF INFORMATION TECHNOLOGY SERVICES

Research Fellow: Ali Abdullah 2028 (Undeclared)
Faculty Mentor: Joe Eakin
Title of Project: *Summer 2025 at the Ho Tung Visualization Lab*
Funding Source: Division of Social Sciences

Research Fellow: Fausto de León 2027 (Computer Science)
Faculty Mentor: Joe Eakin
Title of Project: *Summer 2025 at the Ho Tung Visualization Lab*
Funding Source: Information Technology Services

Research Fellow: Will Grossman 2027 (Applied Math)
Faculty Mentor: Joe Eakin
Title of Project: *Summer 2025 at the Ho Tung Visualization Lab*
Funding Source: Information Technology Services

Research Fellow: Yibo (Kendall) Wang 2028 (Undeclared)
Faculty Mentor: Joe Eakin
Title of Project: *Summer 2025 at the Ho Tung Visualization Lab*
Funding Source: Division of Social Sciences

KRAYNAK INSTITUTE FOR THE STUDY OF FREEDOM AND WESTERN TRADITIONS

Research Fellow: Jebbie Bauer 2026 (Russian and Eurasian Studies; International Relations)
Faculty Mentor: Jessica Graybill
Title of Project: *Russia's Patronage of Global Authoritarianism*
Funding Source: The Kraynak Institute for the Study of Freedom and Western Traditions (James Madison Fellow)

Research Fellow: Sawyer Brown 2025 (International Relations)
Funding Source: International Security and Intelligence Programme

Research Fellow: JP Conrad 2025 (Political Science)
Faculty Mentor: Daniel Tober
Title of Project: *The Education of Alexander the Great*
Funding Source: The Kraynak Institute for the Study of Freedom and Western Traditions (James Madison Fellow)

Research Fellow: Alexander Di Napoli 2026 (Political Science)
Faculty Mentor: Valerie Morkevičius
Title of Project: *Deterrence and Diplomacy: South Korea's Response to a Nuclear North and a Divided Indo-Pacific*
Funding Source: The Kraynak Institute for the Study of Freedom and Western Traditions (James Madison Fellow)

Research Fellow: Ben Haber 2025 (Political Science)
Faculty Mentor: Ed Fogarty
Title of Project: *Assessing the Military-Industrial Complex: Do Defense Contracts in Wartime Serve National Security or Business Interests*
Funding Source: The Kraynak Institute for the Study of Freedom and Western Traditions (James Madison Fellow)

Research Fellow: Emma Hanlon 2027 (Political Science)
Faculty Mentor: Annie Benn
Title of Project: *Rhetoric and Power: Exploring the Expansion of Executive Authority in the Bush and Trump Administrations*
Funding Source: The Kraynak Institute for the Study of Freedom and Western Traditions (James Madison Fellow)

Research Fellow: William Keiser 2027 (Computer Science)
Funding Source: International Security and Intelligence Programme

Research Fellow: MG King 2027 (Classics)
Faculty Mentor: Geoffrey Benson
Title of Project: *"Quis nominis umbram horreat?": The Ghastly Power of Shades in Lucan's Pharsalia*
Funding Source: The Kraynak Institute for the Study of Freedom and Western Traditions (James Madison Fellow)

Research Fellow: Jordan Maxham 2026 (Political Science)
Faculty Mentor: Dominika Koter
Title of Project: *Media Ecosystems and the Asymmetric Rise of the Populist Right in Europe*
Funding Source: The Kraynak Institute for the Study of Freedom and Western Traditions (James Madison Fellow)

Research Fellow: Amy Meng 2026 (Psychological Science; Philosophy)
Faculty Mentor: David Dudrick
Title of Project: *A Comparative Study of Reformed, Pentecostal, and Catholic Theologies*
Funding Source: The Kraynak Institute for the Study of Freedom and Western Traditions (James Madison Fellow)

Research Fellow: Olivia Pascione 2026 (Psychological Science; Political Science)
Faculty Mentor: Fred Chernoff
Title of Project: *Freedom vs. Security: Reconciling Civil Liberties and Nuclear Strategies*
Funding Source: The Kraynak Institute for the Study of Freedom and Western Traditions (James Madison Fellow)

Research Fellow: London Pettibone 2027 (Political Science; English)
Faculty Mentor: Danielle Lupton
Title of Project: *Affective Polarization, Partisanship, and Democracy: The Rising Threat of Lone-Wolf Terrorism*
Funding Source: The Kraynak Institute for the Study of Freedom and Western Traditions (James Madison Fellow)

Research Fellow: Peyton Taylor 2027 (Political Science)
Faculty Mentor: Matt Luttig
Title of Project: *Reviving Trust in American Journalism through the Proper Use of Polling*
Funding Source: The Kraynak Institute for the Study of Freedom and Western Traditions (James Madison Fellow)

Research Fellow: Cal Tortolani 2026 (Environmental Studies)
Faculty Mentor: Priscilla Van Wynsberghe
Title of Project: *Environmentalism in the US and Australia: The Role of Constitutional Foundations, Free Enterprise, and Individual Freedom in Shaping and Implementing Environmental Policies*
Funding Source: The Kraynak Institute for the Study of Freedom and Western Traditions (James Madison Fellow)

Research Fellow: Alice Walton 2026 (Economics)
Faculty Mentor: Chad Sparber
Title of Project: *Economic Freedom and Labor Dynamics in Great Britain's Industrial Revolution*
Funding Source: The Kraynak Institute for the Study of Freedom and Western Traditions (James Madison Fellow)

LAMPERT INSTITUTE FOR CIVIC AND GLOBAL AFFAIRS

Research Fellow: Chris Johnson 2026 (Political Science)
Faculty Mentor: Juan Ibarra Del Cueto
Funding Source: Lampert Institute for Civic and Global Affairs

Research Fellow: Maya Khadem 2026 (Applied Math)
Faculty Mentor: Megan Abbas
Title of Project: *The Bahai Alternative to Soft Power Diplomacy*
Funding Source: Lampert Institute for Civic and Global Affairs

Research Fellow: Emma McCartan 2026 (International Relations)
Faculty Mentor: Bruce Rutherford
Funding Source: Lampert Institute for Civic and Global Affairs

Research Fellow: Coleman Wohlken 2026 Classics; Philosophy)
Faculty Mentor: Daniel Tober
Title of Project: *Remembering War: Thucydides and Modern memorials*
Funding Source: Lampert Institute for Civic and Global Affairs

UPSTATE INSTITUTE

Research Fellow: Julia Card 2027 (Geography)
Faculty Mentor: Julie Dudrick
Title of Project: *The Demand for and Feasibility of a Shared-Use Value-Added Processing Facility in Madison County*
Funding Source: Upstate Institute

Research Fellow: Jonathan Cheng 2027 (Japanese; Peace and Conflict Studies)
Faculty Mentor: Julie Dudrick
Title of Project: *Curriculum Design for Teaching Reading to Refugee Adults*
Funding Source: Upstate Institute

Research Fellow: Brigid Clive 2027 (English)
Faculty Mentor: Julie Dudrick
Title of Project: *One-Stop Shop: Consolidating Essential Services for Residents of Saranac Lake Central School District*
Funding Source: Upstate Institute

Research Fellow: Anna DiSorbo 2027 (Economics)
Faculty Mentor: Julie Dudrick
Title of Project: *Developing Forecasting Tools for Charitable Fund Resilience at the Adirondack Community Foundation*
Funding Source: Upstate Institute

Research Fellow: Emery Furgason 2027 (Political Science)
Faculty Mentor: Julie Dudrick
Title of Project: *Campaign Marketing and ALICE*
Funding Source: Upstate Institute

Research Fellow: Theo Hauptman 2027 (Biology)
Faculty Mentor: Julie Dudrick
Title of Project: *Uncovering the Roots: Understanding Invasives Species and their Impacts in the Adirondacks*
Funding Source: Upstate Institute

Research Fellow: Spencer Kidd 2026 (Political Science)
Faculty Mentor: Julie Dudrick
Title of Project: *Helping the Historical Society Go Digital*
Funding Source: Upstate Institute

Research Fellow: Jessica Lee 2027 (Environmental Studies; Biology)
Faculty Mentor: Julie Dudrick
Title of Project: *Thriving Together: Advancing Adirondack Pollinator Conservation Through Research, Restoration, and Community Engagement*
Funding Source: Upstate Institute

Research Fellow: Alec Lehtman 2027 (Environmental Studies)
Faculty Mentor: Julie Dudrick
Title of Project: *Laying the Groundwork for a Regional Economic Analysis: Small Business Trends and Gaps in the North Country*
Funding Source: Upstate Institute

Research Fellow: Lulu Manco-Stenz 2026 (Sociology; Environmental Studies)
Faculty Mentor: Julie Dudrick
Title of Project: *Researching the Role of Community Science in Pollinator Habitat Restoration at Rogers Environmental Education Center*
Funding Source: Upstate Institute

Research Fellow: Zemira Meade 2026 (Neuroscience; Africana and Latin American Studies)
Faculty Mentor: Julie Dudrick
Title of Project: *Giving a "Hand Up," not a "Handout": Helping Madison County Residents Achieve Self-Sufficiency*
Funding Source: Upstate Institute

Research Fellow: Zachary O'Donnell 2027 (Environmental Studies; Psychological Science)
Faculty Mentor: Julie Dudrick
Title of Project: *Potato Leafhopper Abundance in Central New York.*
Funding Source: Upstate Institute

Research Fellow: Eliza Potter 2026 (History)
Faculty Mentor: Julie Dudrick
Title of Project: *Peterboro, New York Earned Itself a Place on the Network to Freedom*
Funding Source: Upstate Institute

Research Fellow: Jack Schaeffer 2026 (Applied Math)
Faculty Mentor: Julie Dudrick
Title of Project: *Expanding the Story: Phase II of the Oneida Ltd. Oral History Project*
Funding Source: Upstate Institute

Research Fellow: Leigha Schultze 2026 (Environmental Studies; Political Science)
Faculty Mentor: Julie Dudrick
Title of Project: *Employing Community-Building Strategies to Enhance Regional Support Networks within the Adirondacks*
Funding Source: Upstate Institute

Research Fellow: Sophie Sujo 2027 (Environmental Studies)
Faculty Mentor: Julie Dudrick
Title of Project: *Direct Seeding Methodologies for Riparian Restoration in the Ausable Watershed: Innovating Native Plant Restoration with Low-Input, Climate-Adapted Methods*
Funding Source: Upstate Institute

Research Fellow: Sara Tabibian 2026 (Environmental Geography)
Faculty Mentor: Julie Dudrick
Title of Project: *How Do Transportation Barriers Impact Refugees' Resettlement and Employment Outcomes?*
Funding Source: Upstate Institute

Research Fellow: Naomi Valentine 2027 (Biology)
Faculty Mentor: Julie Dudrick
Title of Project: *Managing Fields for Grassland Birds in the Champlain Valley*
Funding Source: Upstate Institute

Research Fellow: Matheson Williams 2027 (Economics; Environmental Geography)
Faculty Mentor: Julie Dudrick
Title of Project: *Hamilton - A Climate Smart Community (CSC)*
Funding Source: Upstate Institute

Research Summaries

Research Fellows: **Ali Abdullah (2028)** **Concentration: Undeclared**
Fausto de León (2027) **Concentration: Computer Science**
Will Grossman (2027) **Concentration: Applied Math**
Yibo (Kendall) Wang (2028) **Concentration: Undeclared**
Faculty Mentor: **Joe Eakin** **Department: Learning and Applied Innovation**
Title of Project: **Summer 2025 at the Ho Tung Visualization Lab**
Funding Source: **Division of Social Sciences; Information Technology Services**
Project Summary:

Noh K'uh is a recently discovered Late Preclassic (400 BC - AD 250) Mayan site near the Usumacinta River region of Chiapas, Mexico. Containing an estimated 400 structures, with a peak construction phase between 395 and 1 BC, Noh K'uh was a moderately sized city with a population of about 20,000 at its height. The Maya paid particular attention to the relationship between buildings within their cities and the surrounding terrain, and many structure groups within the site at Noh K'uh follow an internal alignment. However, most Mayan sites are believed to have been aligned with significant astronomical events/axes, which is not obvious when analyzing the layout of Noh K'uh, making this site of particular interest.

This summer at the Ho Tung Visualization Lab, we initiated a project to recreate Noh K'uh in 3D,showing how this city may have looked at its peak. Using a variety of 3D modeling software including Blender and Unreal Engine, we sought to accurately depict the appearance and position of most of the site's major structures, guided by LIDAR data that reveals irregularities on the jungle floor. The project is still a work in progress and is nearing its final stages. As an educational resource, students and educators will be able to freely move about a fully modeled Preclassic site in 3D, getting a sense for how buildings would have looked and how they were positioned. As a research tool, since the individual building models are positioned accurately, our full model of Noh K'uh can potentially be used to determine a geospatial or astronomical reason for the site's abnormal alignment (e.g. did the sun appear to set on a nearby mountain during a solstice, which the city was aligned with?). The Visualization Lab's Digistar software will allow viewing the sky above Noh K'uh at specific dates in time, potentially revealing clues to its alignment.

Research Fellow: **Bob Aboh (2028)** **Concentration:** **Undeclared**
Faculty Mentor: **Engda Hagos** **Department:** **Biology**
Title of Project: **Investigating the role of Krüppel-like Factor 4 in Ferroptosis**
Funding Source: **Division of Natural Sciences and Mathematics**
Project Summary:

Krüppel-like factor 4 (KLF4) is a zinc finger transcription factor with tumor suppressive activity in colorectal cancer. In addition it is linked to genomic stability, as cells lacking KLF4 show higher apoptosis, DNA damage, aneuploidy, and chromosomal aberrations (Hagos et al., 2009). Further, KLF4 modulates reactive oxygen species (ROS) by regulating antioxidant genes, making it relevant to study ferroptosis, an iron-dependent cell death marked by lipid peroxide accumulation and membrane damage. GPX4 normally uses glutathione (GSH) to detoxify lipid hydroperoxides, but when inactivated, toxic peroxides build up. System xC^- imports cystine in exchange for glutamate; cystine (Cys_2) is then converted to cysteine, a building block for making GSH. Meanwhile, iron enters bound to transferrin, is reduced from Fe^{3+} to Fe^{2+} by STEAP3, and released via DMT1. Excess Fe^{2+} drives ROS generation, oxidizing membrane lipids and triggering ferroptosis (Jiang X et al.; Mou Y et al). This study is aimed to determine the role of KLF4 in regulating ferroptosis using mouse embryonic fibroblasts (MEFs).

To assess KLF4's role, wildtype cells (+/+) and cells lacking KLF4 (−/−) were treated with either DMSO, FIN56 (ferroptosis inducer), and FIN56 plus Liproxstatin-1 (ferroptosis inhibitor) for 24 hrs at 37°C and 5% CO_2. In addition to investigating which genotype is more sensitive to treatments, we used a trypan blue assay. We found that FIN56 reduced viability in both genotypes, while Liproxstatin-1 rescued it (Fig 1). Finally, after sample collection, western blot analysis was conducted to determine if there were varying expression levels of ferroptosis-related genes such as GPX4 between the KLF4 wildtype and null MEFs. Our western blotting data showed that under control conditions, GPX4 was higher in KLF4 −/− cells but dropped with FIN56, while KLF4 +/+ cells increased GPX4 after FIN56 and maintained it with Liproxstatin-1, indicating KLF4 helps stabilize GPX4 during ferroptotic stress (Fig 2).

Results

Trypan Blue Cell Viability Assay

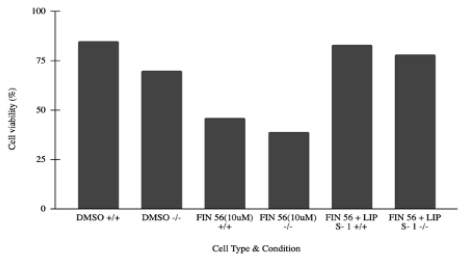


Fig 1. Effect of KLF4 and Liproxstatin-1 on Cell Survival After FIN56 Treatment. Trypan blue cell viability assay reveals that KLF4 wild-type cells are more resilient at baseline and during ferroptosis, but also show slightly more ROS-induced death with FIN56. Liproxstatin-1 rescues viability in both cases, confirming the role of KLF4 in sensitizing cells to ferroptosis via ROS accumulation and iron handling. Quantification was performed by counting total number of viable cells against total cell count.

Expression of GPX 4

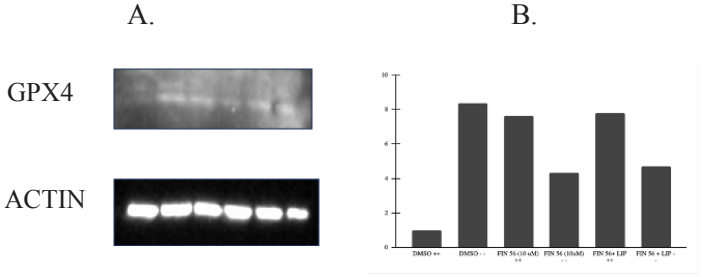


Fig 2. KLF 4 Regulates GPX4 Expression in Response to Ferroptotic Stress. (A) Western blotting showcasing expression levels of GPX4, and actin as a loading control, in protein samples extracted from MEF cells treated with DMSO, FIN 56, and LIP S-1. (B) Quantification of GPX4 expression values, normalized using actin.

Research Fellow: **Alec Aggazio-Bach (2026)** **Concentration:** **Astronomy/Physics**

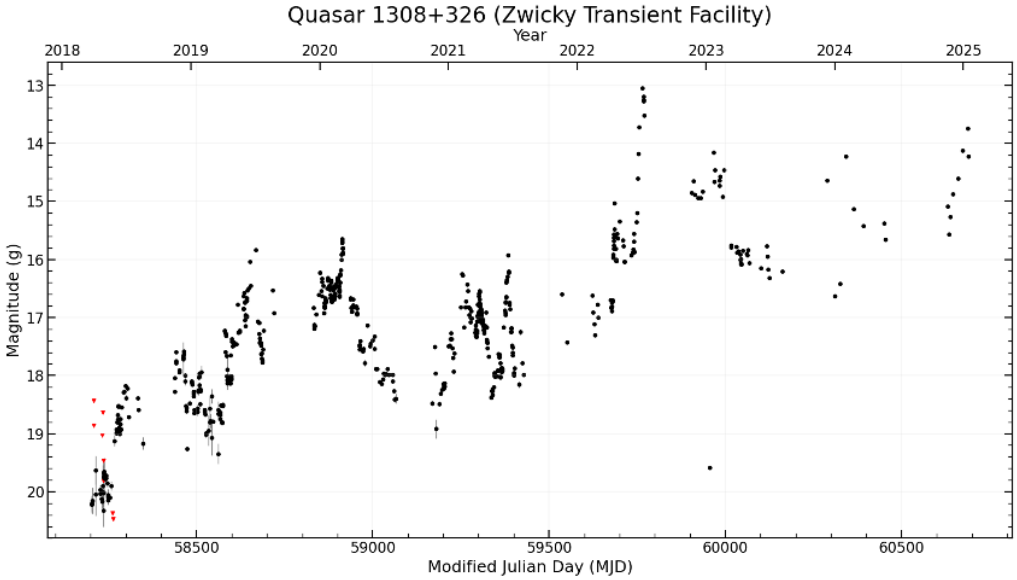
Faculty Mentor: **Thomas Balonek** **Department:** **Physics and Astronomy**

Title of Project: **Processing Quasar Observations from the Zwicky Transient Facility and Colgate's Foggy Bottom Observatory**

Funding Source: **Division of Natural Sciences and Mathematics**

Project Summary:

Most, if not all, of our team this summer are writing our own abstracts due to specialization. Our overall task was to gather and process observation data on quasars–highly luminous objects whose brightness changes over time–with the aim of graphing their brightness as a function of time, creating "lightcurve" graphs. While the other team members primarily worked on refining the data we all gathered at Foggy Bottom Observatory (FBO), my work was with writing and operating Python programs which would process spreadsheets of data into viewable graphs. This did involve data from FBO, but primarily focused on observations from the Zwicky Transient Facility, an optical observing group capable of imaging the entire northern sky every two days, whose data is publicly accessible. I have created a pipeline through which any researcher can download raw data from the ZTF site and process it into a lightcurve graph within a matter of minutes. Here is one such graph, using the most plentiful data from their green filter:



I also worked on additional related projects. Some programs combine multiple files of FBO data into a single file to make them into a single graph, as well as appending additional columns for better display. One takes ZTF data and calculates color coefficients from same-night observations in different filters, which I intend to expand on going forward. In the coming days I will finish a program capable of robustly combining column data from multiple files into a single file, such that users can pick columns out from multiple files and create a new, unified file. This will be used in tandem with previous years' work on other databases such as ATLAS and ASAS-SN to generate more data-complete lightcurves and/or to compare the databases on a single graph.

Research Fellows: Hana Ahmed (2027) — **Concentration:** Molecular Biology
Jenna Hayson (2026) — **Concentration:** Molecular Biology
Jenavieve Sherwood (2026) — **Concentrations:** Spanish; Molecular Biology
Faculty Mentor: Engda Hagos — **Department:** Biology

Title of Project: Investigating the Role of Klf4 in Epigenetics

Funding Source: Michael J. Wolk '60 Heart Foundation

Project Summary:

Epigenetics, the study of genomic changes that occur without affecting the coding sequence of DNA, is being increasingly studied as a significant factor in cancer development. Kruppel-like Factor 4 (Klf4) is a zinc finger containing transcription factor that acts as a tumor suppressor gene in colorectal cancer cells. It has been previously found that mouse embryonic fibroblast (MEFs) without Klf4 experience higher levels of genomic instability, DNA damage and chromosome aberrations (Hagos 2009). However, the mechanism by which KLF4 maintains genomic stability is not fully understood. It is possible that KLF4 is involved in epigenetic modifications, as dysregulated epigenetics is a common feature of most cancers. Previous work in our lab has focused on DNA methyltransferase (DNMT), a protein that silences gene expression by adding methyl groups to DNA, and O6-Methylguanine methyltransferase (MGMT), which repairs DNA damage. These studies have found that Klf4 downregulates DNMT1 and upregulates MGMT. In addition, β-Catenin, a gene involved in colorectal cancer development is also a protein of interest as it has been found to be inhibited by Klf4 and works to stabilize DNMT via a protein-protein interaction (Song 2015). In this study, we seek to identify a mechanistic connection between Klf4, MGMT and DNMT1 and how the effect of these interactions impacts genomic stability in cells lacking functional Klf4.

In order to determine the impact of Klf4 on DNMT levels, cells were treated with Kenpaullone, a Klf4 inhibitor (Figure 1). Kenpaullone is known to inhibit GSK3β, a protein that normally blocks the function of β-Catenin. However, Kenpaullone has been found to inhibit Klf4 through an unknown, GSK3β independent pathway (Lyssiotis 2009). Using Western blotting, we found an increase in DNMT1 protein expression, and a decrease in Klf4 expression (Figure 1).

Further, we compared the levels of MGMT mRNA by RT-PCR with or without 5-Azacytodine, a drug that inhibits DNMT. We found that Klf4 null MEFs display a lower level of MGMT. Consistent with our hypothesis, MEFs treated with 5-Azacytidine showed an increase in MGMT mRNA expression (Figure 2). Taken together, our findings indicate Klf4 is involved in epigenetic modification, giving another potential mechanism through which Klf4 protects genomic stability.

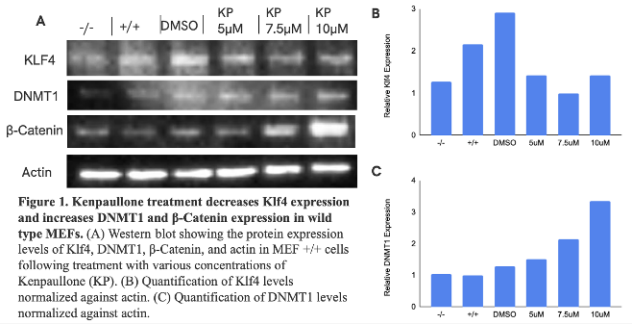


Figure 1. Kenpaullone treatment decreases Klf4 expression and increases DNMT1 and β-Catenin expression in wild type MEFs. (A) Western blot showing the protein expression levels of Klf4, DNMT1, β-Catenin, and actin in MEF +/+ cells following treatment with various concentrations of Kenpaullone (KP). (B) Quantification of Klf4 levels normalized against actin. (C) Quantification of DNMT1 levels normalized against actin.

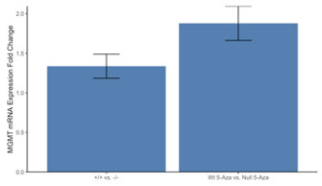
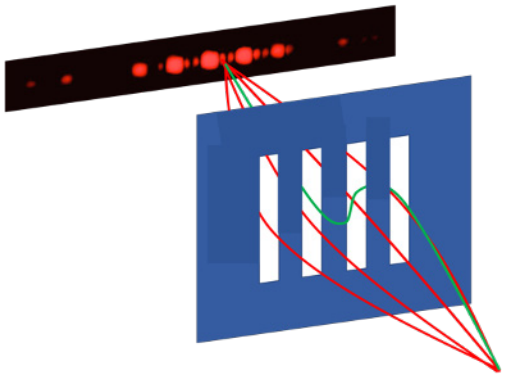


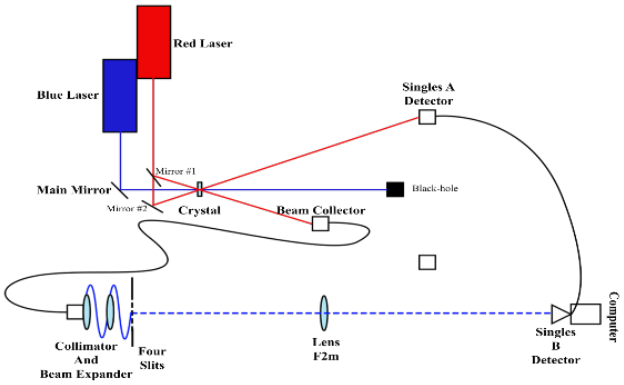
Figure 2. Increased MGMT mRNA expression in 5-Aza treated Klf4 +/+ MEFs compared to -/-. RT-qPCR was performed on MEF +/+ and -/- cells treated with 10uM of 5-Azacytidine and untreated cells. Data analysis was performed according to the ΔΔCt method. Values >1 represent a fold increase in MGMT mRNA expression normalized against actin, and values <1 represent a fold decrease. To test for significance, a student's one-sided two-sample t-test was performed. There is more MGMT mRNA expression in the 5-Aza treated group than the +/+ vs. -/- group (t=-2.898, n=2, p=0.0507). Error bars represent the standard deviation of the data.

Research Fellows: Abdul Almaweri (2028) — **Concentration:** Physics
Xinjian Qiu (2027) — **Concentrations:** Physics; Studio Arts
Faculty Mentor: Kiko Galvez — **Department:** Physics and Astronomy
Title of Project: Investigations of Novel Quantum Effects in Photon Interference
Funding Source: Division of Natural Sciences and Mathematics
Project Summary:

When you toss a stone in a pond, you see ripples that create bright and dark patterns where the waves meet; this is interference, as some waves add together and others cancel out. Light behaves in a similar way. In quantum mechanics, even a single photon can interfere with itself by taking every possible path to reach a detector. Traditionally, textbooks show these paths as the straight lines passing through open slits. But new research reveals something much stranger: photons can also take looped detours, skimming along the metal surface and moving between slits before going out to the detector. This was first seen with three slits, and we set out to push this further by testing four slits, where these unusual routes should be even more noticeable. Using a four-slit metal plate and carefully controlling the polarization, we mapped out the resulting interference patterns. The results suggest these odd, looped paths really do show up in the data. In short, photons don't always follow the obvious straight lines; the electromagnetic near fields around structured metal slits can influence them to move onto unexpected routes, revealing weird properties that light possesses.



We generate single photons by using a 405 nm pump laser that goes through a BBO crystal, producing ~810 nm photon pairs at about ±3° from the pump. One photon is sent straight to a detector to herald the presence of the other photon ("Singles A"), which enters a single-mode fiber, and is re-launched into free space. A beam expander spreads that beam to evenly illuminate a metal four-slit plate. An f = 2 m lens relays the interference to the detection plane, where a detector on a translation stage records time-tagged clicks ("Singles B"). We repeat the full scan twice, horizontal and vertical input polarization.



The resulting data were fit to the standard multi-slit interference model. From the least-squares fitting procedure, we extracted key parameters, including the overall amplitude, background counts, effective slit separation and width, as well as a relative phase term. The observed discrepancy in photon counts between the two polarization configurations suggests the presence of nontrivial effects beyond conventional interference behavior.

Research Fellows: **Obsidian Ammons (2026)** **Concentrations: Biochemistry; Molecular Biology**
Grace Fraser (2026) **Concentration: Molecular Biology**
Jerry Zhang (2026) **Concentration: Molecular Biology**
Faculty Mentor: **Geoff Holm** **Department: Biology**
Title of Project: **The Relationship Between Host Cell Metabolism and Reovirus Infection**
Funding Source: **Division of Natural Sciences and Mathematics; Michael J. Wolk '60 Heart Foundation**

Project Summary:

Reovirus is a double stranded RNA virus that is primarily benign in humans and has been shown to have oncolytic capabilities and an ability to alter cell metabolic state. However, the mechanism of this relationship is largely unknown. Therefore, we have decided to investigate how host cell metabolic state affects reovirus replication and viral infection's effect on cell metabolism.

Our project this summer has taken two directions: one to investigate known differing host cell metabolic states and their relationship with reovirus infectivity, and the other to investigate specific metabolic pathways' role in reovirus infection. Through a categorization of dog cell lines based on size and age, we aim to investigate the known differing metabolic profiles of each cell line and their effect on viral replication (1)(2). The experiments performed on each cell line included a general infectivity assay at 24 and 72 hours post-infection (h.p.i.), a measurement of mitobiogenesis, autophagy, and a Seahorse XF96 metabolic flux analysis, as well as qPCR to investigate infection stimulated cytokine activity (3).

To investigate specific metabolic pathways' role in reovirus infection, we treated infected cells with 2-Deoxyglucose (2-DG), a glycolysis inhibitor, and dorsomorphin, an AMPK inhibitor and analyzed infectivity 24 hours post treatment. Preliminary results show a mild increase in infectivity after treatment with 2-DG, analyzed by measuring intensity of viral antigen fluorescence and counting infected cells using immunofluorescence microscopy. Dorsomorphin treatment showed a decrease in both viral antigen fluorescence and infectivity values. The next step is to identify the presence of common cytokines, and determine whether infection increases or decreases are a result of metabolic inhibition or an altered infection defense mechanism.

References

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2. Duan, X., Liu, R., Lan, W., & Liu, S. (2025). The Essential Role of Mitochondrial Dynamics in Viral Infections. *International Journal of Molecular Sciences*, 26(5), 1955. https://doi.org/10.3390/ijms26051955
3. Klotz, D., & Gerhauser, I. (2019). Interferon-Stimulated Genes—Mediators of the Innate Immune Response during Canine Distemper Virus Infection. *International Journal of Molecular Sciences*, 20(7), 1620. https://doi.org/10.3390/ijms20071620

Research Fellow: Aryeh Andriola (2026) **Concentrations:** Chemistry; Biology

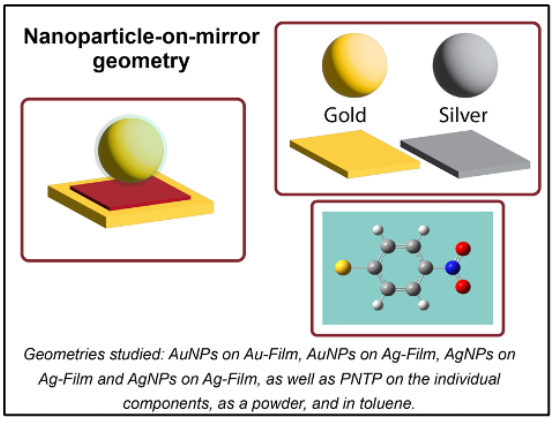
Faculty Mentor: Jason Keith **Department:** Chemistry

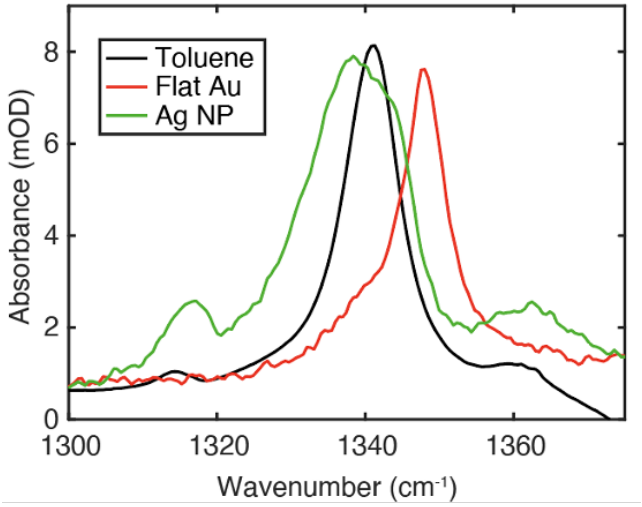
Title of Project: Surface Plasmon Induced Reactivity

Funding Source: Justus '43 and Jayne Schlichting Student Research Fund

Project Summary:

Plasmonic reactions are catalysed by waves of electron gas plasma kickstarted on a metal surface by incident light such as a laser or the application of electric current. The coupling of photons and surface plasmons between metals and air can create a surface plasmon-polariton which can help initiate reactions in chemicals bound to the surface of the metal. The products of these reactions are useful across a wide range of fields, including electronic manufacturing and reaction catalysis, but the mechanism of these reactions are unknown. We studied these reactions using a standard plasmonically induced system, the dimerization of para-nitrothiolphenol (PNTP) on a metal surface. Here, we investigated this reaction through standardizing the plasmonic environment of PNTP but varying the chemical environment utilizing a nanoparticle-on-mirror geometry. Gold and silver metal were used for both the nanoparticles and the surface metal, and varying combinations of silver and gold were used to alter the chemical environment.





PNTP was observed using ATR-FTIR and Raman Spectroscopy in both homogeneous local environments such as in toluene solution, and in inhomogeneous local environments such as the surface of silver and gold nanoparticles. Nanoparticles were characterized using AFM and UV-Vis measurements, indicating our silver nanoparticles having an average diameter of 70 nm and our gold nanoparticles having an average diameter of 100 nm. Plasmonic enhancement of our nanoparticles was confirmed using methylene blue, which indicated a roughly 1000-fold enhancement of signal. Bending modes were identified via comparison of measurements to Gaussian 16 predicted IR spectra of PNTP. The NO_2 bending mode peak was observed to change with local environments by upwards of ~15 wavenumbers (cm^{-1}), and the full width at half maximum (FWHM) was observed to change by upwards of ~25 wavenumbers (cm^{-1}).

Research Fellow: Georgia Banner (2026) **Concentrations: Anthropology; Psychological Science**

Faculty Mentor: Michelle Bigenho **Departments: Sociology and Anthropology; Africana and Latin American Studies**

Title of Project: Creativity, Connection, and Embodiment in Shared Art Spaces

Funding Source: Division of Social Sciences

Project Summary:

A conversation with the instructor of the youth art class I volunteer for inspired my research. The instructor said that she teaches her youth and adult students similar things, but sometimes finds that the adults have more trouble with the creative process. I conducted a literature review inspired by this question in Fall 2024 on creativity across the lifespan. At the beginning of the summer, my key question was: how is creativity understood, practiced, and valued by working adults? Throughout my work this summer, I conducted 80+ hours of ethnographic fieldwork in community art spaces and events, private art studios, farmers markets, and town hall meetings, and six semi-structured ethnographic interviews with individuals I worked with across many of these spaces. My focus shifted to understanding how these spaces serve as incubators for building social relationships of friendship and shared knowledge, how powerful affective atmospheres develop in these spaces, and how embodied knowledge is shared and experienced by participating individuals. My research will continue this fall as I complete approximately six more interviews and write my anthropology thesis.

My participant observation often took the form of apprenticeship, where I learned from others by participating as both a student and observer in art classes and studio settings. I was fully immersed in many of the spaces I worked in. As such I had the opportunity to work with individuals who were in their 20s, 40s, to 70s. However, the focus on age no longer felt central; ethnography works inductively and other themes were emerging as more important in my work. As I observed themes of community, the powerful affective atmosphere of creation, and the embodied knowledge that emerges from creative practices, I also noticed how the balance of work and creativity framed people's creative pursuits. Individuals navigated affording and making time for artistic creativity in a variety of ways, while multiple people explicitly described how their creativity was incorporated into their work, some describing how they shaped their work to be about artistic creation, or used their creative endeavors as a way to decompress from their work.

I am in the process of interpreting and analyzing the qualitative data I have spent the summer collecting. My thesis will expand upon the work I began here. While I am still developing ideas and will be completing several more interviews in the fall, I have preliminarily located themes of community (i.e., art spaces as social spaces for friendship and sharing ideas), embodied knowledge (i.e., the physical experience of creating and the knowledge that produces), affective atmospheres (i.e., the emotions and energies that are created in a space and noticed by the individuals within them), and relationships with work (i.e., striking the balance between creative practice and financial responsibility).

Research Fellows: **Rowan Barnes (2028)** **Concentration: Undeclared**
Riley Taylor (2026) **Concentrations: Geology; Natural Sciences**
Faculty Mentor: **Joe Levy** **Department: Earth and Environmental Geosciences**
Title of Project: **HeliHabitable Drone Research in the Alvord Desert in Eastern Oregon**
Funding Source: **NASA Grant**
Project Summary:

This project was conducted by NASA JPL and Colgate University as the second year in the PSTARS HeliHabitable mission. The primary objective of this study is to better understand recurring slope lineae (RSL) on Mars, using the Alvord Desert plume as a planetary analog. The Alvord Desert, located in eastern Oregon, is a dry lakebed with layers of saline fine silt and smectite clays. Because of the regular schedule of the satellites orbiting Mars, the RSL are always observed at around three or four in the afternoon at the hottest part of the day. Consequently, any potentially present water in the RSL may have evaporated by the time the satellite uses multispectral and thermal imaging to observe them. However, because of the fast-changing nature of the Alvord plume (timescale of minutes to hours), we were able to study the transgression and regression of the RSL analog in real time. The Steens Mountains and Mickey Butte also serve as parallels to the rugged topography on Mars. One of NASA JPL team's main goals is to test the feasibility of completing autonomous drone flights in environments with steep and rocky terrains, making the surrounding landscape ideal to address long-term mission goals. Being the second year in the project, we were able to collect more spectral, thermal, and moisture data. The missions completed this year can be repeated in the following field seasons to further improve our understanding of the Alvord as an analog RSL.
We spent ten day
s in the field this season, collecting data using a wide variety of equipment. RGB and thermal data were collected with the Parrot Anafi USA SE drone, used to create orthoimages with the help of DEMs (Digital Elevation Model(s)). Visible RGB mapping was conducted several times each day throughout the season to observe how the plume expanded and retreated over time. Thermal data (Fig. 1) was used in conjunction with an array of fifteen soil moisture probes inserted along the center and margins of the analog hotspot plume. Ten surface probes were placed horizontally on the transect of the plume and five additional probes were placed along a vertical profile at 30, 20, 10, 5, and 0 centimeters depth. Probes served as ground truth measurements for the thermal images taken aerially from 59 meters altitude by the Parrot Anafi USA SE drone.

Spectral data from the 2024 field season was analyzed prior to this year's field work using SpectralView and Agisoft Metashape. Using the orthoimage DEMs of the playa, we corrected the spectral images for radiance and reflectance, then orthorectifying them to overlay the images with satellite maps. We calculated the Continuum Removed Water Index (CRWI) for the orthorectified spectral images by using QGIS software to extract the 1.35 and 1.65 micron bands. We fit a line across the two points, then analyzed how that line intersected with the trough of the graphed spectra at 1.5 microns. This calculation was created to show how water absorption and soil moisture are correlated in arid and clay-rich environments where other methods have fallen short.

Research Fellow: **Rylie Berwanger (2026)** **Concentration: Geology**

Faculty Mentor: **Alison Koleszar** **Department: Earth and Environmental Geosciences**

Title of Project: **Tracing Magma Mixing through Plagioclase Populations at Augustine Volcano, Alaska**

Funding Source: **Doug Rankin '53 Endowment-Geology Research**

Project Summary:

Augustine Volcano is a young stratovolcano of intermediate composition, located as a remote island in southern Cook Inlet, ~290 km southwest of Anchorage. It is one of 50 active volcanoes in the Aleutian Arc and ranks among the most active. One of its most explosive late Holocene eruptions, Tephra C (~1100 ybp), deposited up to 60 cm of pumice (volcanic rock) on the volcano's southeast coast. Pumice clasts from this eruption are commonly banded at the centimeter-scale, with light-colored, crystal-poor, highly vesicular bands and dark-colored bands of lower vesicularity and greater crystallinity. These banded deposits provide a natural record of magma interactions between silicic and mafic parent magmas beneath Augustine. By studying their textures and compositions, we can better understand the dynamics of magma mixing, a process that influences not only eruption style but also the growth and evolution of volcanoes worldwide.

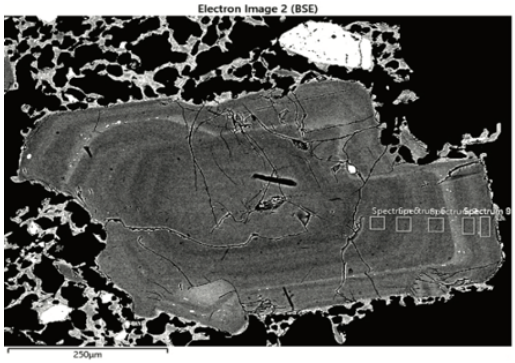


Figure 1. BSE image of a plagioclase crystal with concentric growth bands. Lighter and darker bands correspond to higher and lower FeO, respectively.

This summer, I investigated the populations of plagioclase crystals within banded pumice clasts from the early, middle, and late eruptive phases of Tephra C. My primary focus was collecting data on the scanning electron microscope (SEM) with backscattered electron (BSE) imaging (Fig. 1) and conducting quantitative energy-dispersive X-ray spectroscopy (EDS) (Fig. 2). I documented plagioclase textures and crystal zoning patterns that reflect magmatic histories, and obtained major element compositions to identify geochemical signatures of different crystal populations. I visualized my data in R to integrate geochemical data and textural observations for distinguishing plagioclase populations and evaluating magma mixing dynamics.

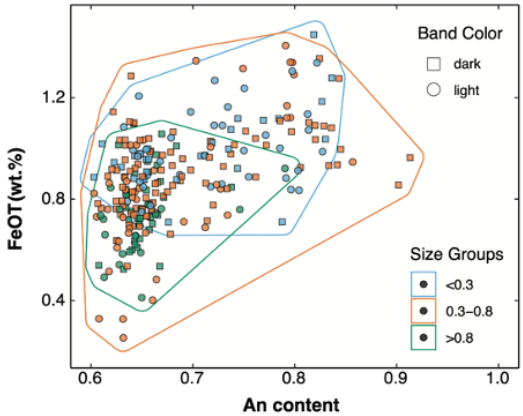


Figure 2. An content versus FeOT (wt.%) in Tephra C plagioclase. Smaller crystals (blue symbols) typically have higher FeOT and An than larger crystals (green symbols). High-FeOT crystals are more common in dark bands (squares) than in light bands (circles).

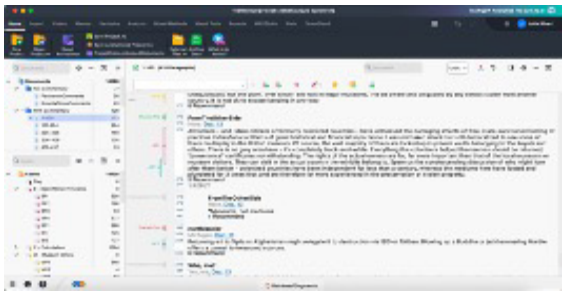
Plagioclase from different parent magmas can be identified principally by Anorthite(An)# (the ratio Ca / (Ca + Na + K)) and the concentration of FeOT. My results suggest that I have identified two main crystal populations: larger crystals (>0.8 mm) have lower FeOT (0.4–0.9 wt.%) and lower An# (An62–80), consistent with crystallization from a silicic melt, whereas smaller crystals (<0.3 mm) have higher FeOT (0.70–1.3 wt.%) and are moderately calcic (An62–83), consistent with crystallization from a mafic parent melt (Fig. 2). Crystals in the intermediate size range (0.3–0.8 mm) span both compositional populations and may represent a mixture of sources. Although high-FeOT crystals (0.6–1.3 wt.%) are more abundant in dark bands and low-FeOT crystals (0.3–1.0 wt.%) are more common in light bands, both populations are present in both bands. This overlap may support partial hybridization and crystal transfer during magma mingling prior to eruption.

Research Fellows: **Julia Bihari (2027)** **Concentration: History**
Addisyn Donfris (2026) **Concentration: Art History**
Elizabeth Wall (2027) **Concentration: Classical Studies**
Faculty Mentor: **Elizabeth Marlowe** **Departments: Art; Museum Studies**
Title of Project: **Art, Museums and Repatriation: An Attempt to Assess Public Opinion**
Funding Source: **J. Curtiss Taylor '54 Endowed Student Research Fund; Division of Arts and Humanities**

Project Summary:

Within the academic community, the repatriation of stolen antiquities to previously colonized countries is overwhelmingly supported. However, for the average museum-goer, repatriation is a foreign concept. Art repatriation is defined as the process of returning antiquities and cultural items to the culture of origin from which they were historically taken through unjust power dynamics such as looting, theft, or colonial occupation. The goal of our research is to gauge how "the public" feels about repatriation and to identify the kinds of arguments people use while discussing these issues. With this research and our findings, our advisor hopes to publish a scholarly article in a journal, such as the International Journal of Cultural Property.

Our research methods involved sorting and analyzing a set of 11,197 comments made on five articles and videos discussing repatriation, including a New York Times article, two Fox News articles, a short stand-up comedy sketch, and a John Oliver Late Night segment. With the hope of representing a wide cross-section of the public, the articles and videos came from several news sources believed to have different political leanings. Our advisor and her collaborators pinpointed seven general categories, or "buckets," that comments fell under. The seven "buckets" are "basic moral principles," "colonialism / problematic power dynamics of the past," "museum ethics," "figure out a way to share," "what is best for the objects," "identity of people/country of origin today," and "this is a money problem." Within these categories, we identified 74 distinct pro, con, and in-between arguments. Our work consisted of reading each comment and marking it with the arguments it makes and its overall stance (pro, con, or in between) or "irrelevant/unsure" if the comment was not relevant to the debate or if we could not determine their position on the matter. For example, the first comment from the image above, was given an "overall pro" tag, as well as the arguments "theft is wrong" (BP1: "basic moral principle" pro argument 1) and "it is ignorant to assume that the country can't take care of the object" (OP1: "what's best for the objects pro argument 1). We used MAXQDA, a software that is especially helpful in qualitative analysis, to 'code' a commentator's arguments. After our initial read-through and coding of the 10,000 comments, we then reexamined all comments within their given buckets, allowing us to read comments from all sources that made the same arguments to identify any common themes or inconsistencies.



The answer to our leading question shows that the public, similar to academic spheres, likely holds an overall opposition towards repatriation efforts. However, the data sets we used, as well as the trends we saw, revealed a new set of questions as well as limitations of the project. Our data set was not statistically comprehensive due to several flaws, such as the skew of left-leaning sources, the inconsistent range of dates of the articles and comments, and a widely varying number of comments on each source. Our data is more useful for identifying popular arguments, beliefs, and misconceptions on repatriation and colonial history. It is our hope that these findings will lead to better discussions between professionals about museum-goers' thoughts and museum ethics.

Research Fellow: Tori Broadnax (2027) **Concentration:** Philosophy
Faculty Mentor: Cosmin Ilie **Department:** Physics and Astronomy
Title of Project: Supermassive Dark Stars (SMDS)
Funding Source: Division of Natural Sciences and Mathematics
Project Summary:

The James Webb Space Telescope (JWST) has revealed a population of compact and extremely luminous high-redshift objects that challenge conventional astrophysical models of early galaxy and star formation. Some of these sources, including objects at redshifts greater than 12, appear too massive and bright to have formed within the first 500 million years following the Big Bang under standard processes such as hierarchical structure formation. One possible explanation for these observations is the existence of dark stars—hypothetical stellar objects powered by the annihilation of dark matter rather than nuclear fusion. Dark stars could arise if dark matter consists of Weakly Interacting Massive Particles (WIMPs) or self-interacting particles. In the dense environments of the early universe, these particles could accumulate in the cores of collapsing gas clouds, releasing energy via annihilation. This energy would be sufficient to counteract gravitational collapse, allowing the object to remain stable and grow in mass while remaining relatively cool compared to fusion-powered stars. Such stars would emit primarily in the infrared, making them detectable by JWST while avoiding the ultraviolet signatures typical of early fusion-driven starbursts. Importantly, these objects may act as precursors to supermassive black holes, potentially explaining their early appearance in cosmic history.

Our research seeks to identify new dark star candidates by building an independent photometric catalog based on JWST deep-field imaging. First we focused on replicating the photometric analysis pipeline of the JADES survey in the GOODS-South field using data from the Mikulski Archive for Space Telescopes (MAST). This involved reprocessing the calibrated NIRCam imaging to perform custom aperture photometry, computing fluxes and uncertainties, and applying aperture corrections to derive total flux(and not) estimates. Our methodology mirrors the JADES approach while allowing for full control over photometric parameters, aperture sizes, and corrections, enabling independent validation and refinement of their candidate list. We applied this pipeline to sources in GOODS-S, combining photometric measurements across multiple filters and are aiming to incorporate redshift constraints ($z \geq 8$). We will use the data in an automated process via chi-squared fitting to assess how well the observed spectral energy distributions (SEDs) are aligned with theoretical dark star templates. Our analysis also considered the mass distribution of candidates, particularly in the context of formation mechanisms such as dark matter capture and adiabatic contraction. While this initial catalog is still under development, preliminary results are promising, showing agreement with known candidates in the JADES survey. These findings support the feasibility of recalculating fluxes from public JWST so we could discover new objects without relying exclusively on pre-generated catalogs. In the next phase of the project, we will extend this methodology to construct an independent photometric catalog based on non-JADES deep fields. This will enable the identification of previously uncataloged high-redshift objects and allow us to further test the hypothesis that dark stars contributed to early cosmic structure formation.

Research Fellow: Caroline Brooks (2026) **Concentration:** Biology
Faculty Mentor: Jen Greenwich **Department:** Biology
Title of Project: Investigating the Dimerization of DcpA in the Regulation of Biofilms in *Agrobacterium tumefaciens*
Funding Source: Division of Natural Sciences and Mathematics
Project Summary:

Biofilms are a leading cause of bacterial infections. Biofilms form when bacteria attach to one another and a surface, making the bacteria stronger and more difficult to remove. The purpose of our research is to investigate the mechanism by which bacteria attach, with the hope that, in the future, an easy way to detach them will be created. We used Agrobacterium tumefaciens as a model, as it is a common soil microbe that can form complex biofilms on biotic and abiotic surfaces. I specifically focused on the protein DcpA and its role in attachment.

DcpA is a dual-function diguanylate cyclase-phosphodiesterase, meaning it has two domains: a phosphodiesterase (PDE) and a diguanylate cyclase (DGC). It plays a role in regulating cyclic-di-GMP levels, with the DGC domain involved in increasing c-di-GMP levels and the PDE domain involved in decreasing them. C-di-GMP, in turn, affects surface attachment, as high levels of c-di-GMP are known to promote surface attachment. What is interesting about DcpA is that other proteins with these two DGC and PDE domains are known to dimerize for function, yet only a dimerization motif is currently known for PDE activity in DcpA, not DGC activity. Moreover, the periplasmic domain of DcpA has two known conserved residues across thousands of identified homologues amongst mammalian pathogens, including human pathogens. These are Tryptophan 40 and Glutamate 48. The role of these residues is unknown.

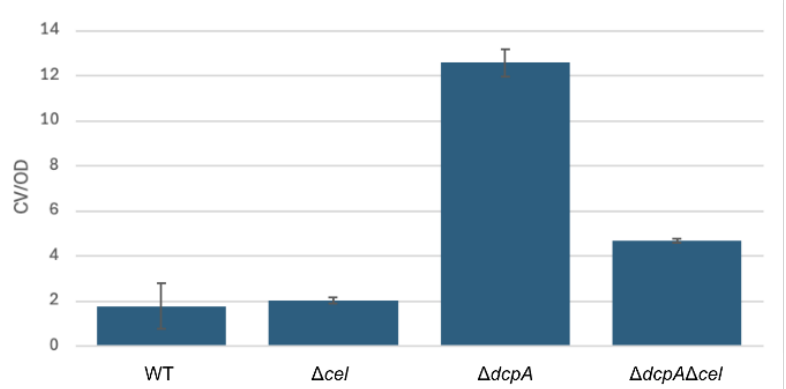


Figure 1. Average CV/OD of two duplicate biofilm assays comparing WT, Δ*cel*, Δ*dcpA*, and Δ*dcpA*Δ*cel*. Statistical significance was found between WT and Δ*dcpA* and between Δ*cel* and Δ*dcpA*Δ*cel*.

In my summer research, multiple experiments were conducted to highlight DcpA's role in biofilm formation, as well as to try and see what mutations to Tryptophan 40 and Glutamate 48 can cause. Biofilm formation was measured in CV/OD to normalize biofilm in comparison to growth. Figure 1 shows that without DcpA, biofilm had increased growth, likely due to the unregulated amounts of c-di-GMP. We also conducted this experiment with the removal of cellulose, as it is known to cause clumping in biofilms, inadvertently skewing data. In the future, we hope to perform random mutagenesis to identify residues that play a role in dimerization or biofilm formation. We also hope to investigate the conserved residues further.

Research Fellows: **Jessie Cai (2026)** — **Concentration: Psychological Science**
Maya Guha (2028) — **Concentration: Undeclared**
Lillian Kibby (2026) — **Concentrations: Psychological Science; Neuroscience**
Emy Pacheco Ramirez (2028) — **Concentration: Undeclared**

Faculty Mentor: **Erin Cooley** — **Department: Psychological and Brain Sciences**

Title of Project: **The Pain of Falling Behind: Contexts of Inequality May Shape Subjective Perceptions of Status, Emotions, and Health**

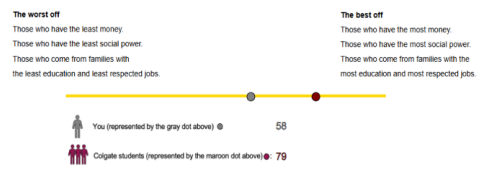
Funding Source: **Division of Natural Sciences and Mathematics; Mind, Brain, and Behavior Scholars Award**

Project Summary:

This summer, in Prof. Cooley's Hierarchy, Health, and Policy Lab, we worked on a variety of projects centering the physiological effects of subjective feelings of status: feelings of where one's status falls compared to others in their social context. Past findings from our lab suggest that feelings of "falling behind" one's social group predict worse health and well-being over time, even when controlling for objective indicators of status like income and education (Caluori, Cooley, et al., 2024). For example, our lab finds, across multiple representative samples of White Americans, that White Americans, on average, feel as if they are falling behind "most White people." We theorize that this pervasive feeling of "falling behind" is likely a byproduct of high racial economic inequality in the U.S. (e.g., the median wealth of White Americans is large and growing, while that of Black Americans is decreasing). Given our reasoning that pervasive feelings of "falling behind" are driven by contexts of high economic inequality (as is the case in the U.S. as a whole), we are extending this theory to the context of college campuses.

Some college campuses, like Colgate, have high economic inequality (Aisch et al., 2017). And, in data we analyzed this summer, we find that the average Colgate student feels like they are "falling behind" the perceived status of most Colgate students, who are stereotyped to be wealthy. In particular, we found that, on average, Colgate students in our sample (N = 103) reported feeling like they were statistically significantly lower status (M = 57.87, SD = 22.88) than they perceived "most Colgate students" to be (M = 79.02, SD = 11.62), $t(102) = 7.84$, $p < .001$, 95% CI [15.79, 26.50], when controlling for their objective status via parental income. We assessed these perceptions using a novel scale of within-group subjective status, which our lab has recently validated (Brown-Iannuzzi, Cooley, et al., 2025; see Figure 1). We also found, in longitudinal data collected via nightly surveys about perceived status and status comparisons, daily, over a 7-day period, that these feelings of falling behind among our student sample predicted more status-related negative emotions which then predicted more anxiety/depressive symptoms and worse sleep quality.

Figure 1
Average Perceptions of Personal vs. Most Colgate Students' Status among our Sample of Colgate Students Via Our Novel Scale



In addition to analyzing the data collected this past year in the Cooley lab, we also prepared two follow-up studies. This new study aims to first replicate our prior finding that Colgate students, on average, feel like they are falling behind "most Colgate students." Next, we will measure how these feelings of "falling behind" relate to stress reactivity to an in-lab social stressor. We will measure salivary cortisol at baseline, and then at two points after the onset of the stressor so we can assess how participants respond to a social stressor (via cortisol response) as well as how they recover. At the same time, we will record baseline RSA (Respiratory Sinus Arrhythmia) which indexes parasympathetic nervous system functioning, as well as RSA reactivity to the in-lab stressor and RSA recovery (i.e., return to baseline) after the stressor. Both cortisol measurements and RSA measurements will help us to assess whether feelings of "falling behind" may be related to known physiological mechanisms behind the types of mental and physical health outcomes that we have observed in our prior studies. Finally, we have identified 30 colleges/universities that vary in their degree of campus economic inequality (as recorded via these data), so that we can better assess whether feelings of "falling behind" are linked to the degree of campus economic inequality.

Together, these studies seek to test our theory that contexts of inequality lead to greater subjective feelings of falling behind (independent of objective status), which may have negative downstream consequences for our health and physiology.

Research Fellow: Corinne Campbell (2026) **Concentration:** Biology

Faculty Mentor: Jason Meyers **Departments:** Biology; Neuroscience

Title of Project: Fueling Regeneration - The Critical Role of Glycolysis in Zebrafish Sensory Organ Recovery

Funding Source: Mind, Brain, and Behavior Summer Grant

Project Summary:

Mammals are unable to regenerate their sensory hair cells, which are specialized cells that allow them to hear. Damage to these cells due to injury or aging leads to permanent hearing loss in mammals. Zebrafish however, can regenerate these cells, and I want to know what signaling pathways and genes allow this to occur in Zebrafish to apply it to mammals in hopes to restore human hearing. The sensory hair cells are located at the center of the neuromast (NM), a specialized sensory organ in zebrafish. The NM contains two additional cell types in addition to hair cells; the support cells directly surround the hair cells and can replace them upon injury, and the mantle cells surround the support cells and lead to regeneration of hair cells and support cells following more severe injury. When hair cells are damaged, the support cells re-enter the cell cycle and begin dividing rapidly to produce the cells that will then replace the hair cells. This concept is known as proliferation. Because of the high rates of proliferation in regenerating and cancer cells, I am interested in exploring similarities between cancer cells and NM cells in the zebrafish lateral line and whether our knowledge of cancer can inform our research of regeneration.

Specifically I am looking at the Warburg Effect, a phenomenon found in cancer cells in which cells change the way in which they break down glucose for energy. Highly proliferative cancer cells stop using the most efficient energy breakdown method, oxidative phosphorylation, and instead use glycolysis, a glucose breakdown process most often used in the absence of oxygen. Because proliferation is integral in regeneration, I am looking into whether the Warburg Effect plays a role in the regeneration of NMs in zebrafish.

To investigate this question, I use two methods of damage. I either kill only the sensory hair cells using neomycin, an ototoxic drug, or kill the hair cells and support cells through electroablation, which uses a UV light to selectively kill specific cells. After inducing damage, I block glycolysis by using 2-DG, a glucose analog that cannot be broken down by the cell. I have found that following both neomycin treatment and electroablation, 2-DG leads to much less regeneration when compared to a control (Figure 1). This suggests that glycolysis is necessary in NM regeneration in the zebrafish lateral line. To further expand on this I am exploring why this occurs and I am working to understand the specific effects of 2-DG.

I first thought that 2-DG may be disrupting the initial proliferative response, so I investigated this using BrdU, a marker of cell proliferation. Surprisingly, I saw no clear differences in the levels of proliferation between control and 2-DG treated NMs following damage, suggesting that 2-DG was not impacting proliferation in the way I had thought. These results lead me to believe that 2-DG may be impacting differentiation, the second process in regeneration.

In the future, I want to investigate at which specific time points 2-DG is specifically blocking regeneration and how it is able to disrupt the functional system. I also want to explore whether there are changes in gene expression or signaling pathways in zebrafish that are treated with 2-DG. Lastly, I am curious to see whether the Warburg effect in regeneration is distinct from the well-established Warburg effect seen in cancer or if there are clear similarities.

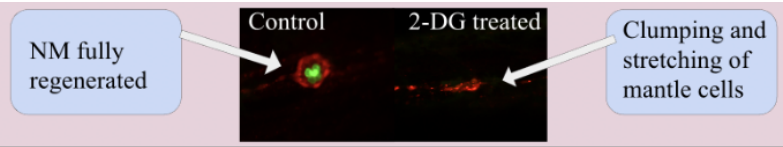


Figure 1: Blocking glycolysis with 2-DG blocks HC+SC regeneration.

Research Fellow: **Julia Card (2027)** **Concentration:** **Geography**

Faculty Mentor: **Julie Dudrick** **Department:** **Upstate Institute**

Title of Project: **The Demand for and Feasibility of a Shared-Use Value-Added Processing Facility in Madison County**

Funding Source: **Upstate Institute**

Project Summary:

Value-added processing offers profitable and exciting avenues for food growers to expand their agricultural businesses. But the upfront costs of owning an equipped commercial kitchen can prevent producers from tapping into this resource. This project sought to understand the value-added processing needs of Madison County producers in conjunction with the feasibility of a reasonably distanced shared-use commercial kitchen facility. Local value-added products are important resources for all community members: Their extended shelf-life, convenience, added nutrients, reduced risk of spoilage, and accessibility make them important items to keep stocked for moments of need and uncertainty. Producing value-added products locally contributes to Madison County's ability to be self-sustaining, meet this need, and support local producers in the process.

Conversations with 11 producers revealed the following themes: 1) Not in need of a commercial kitchen, shared-use or otherwise, 2) using their own commercial kitchen on site, 3) in need of a shared-use commercial kitchen facility, and 4) in need of a local co-packing service. Based on producers' insights, two kitchen locations in the county were determined to be feasible spaces for value-added processing. These facilities met the criteria of having their 20-C Food Processing Establishment Licence from the New York State Department of Agriculture and Markets, and expressed willingness to open and organize their space for shared use.

Theme 1: Not in need of a commercial kitchen, shared-use or otherwise: Producers who indicated they are not in need of a commercial kitchen space (Producers 1, 2, 7, 8, and 10) most often attributed their lack of interest to not having the time, labor, or excess product to have it be a meaningful contribution to their existing businesses.

Theme 2: Using their own commercial kitchen on site: Overall, producers (4,5,8, and 9) who are doing processing in their own commercial kitchen spaces are satisfied with those spaces, and don't have a strong desire to use a shared-use space in addition to or instead of their kitchens. No producer expressed an interest in making their individual kitchen space a shared-use space.

Theme 3: In need of a shared-use commercial kitchen facility: Producers (3, 5, 6, and 11) are in need of a shared-use kitchen space that is specific to their specialized interests and production. These needs included specific processing equipment (i.e., a large steam kettle of approximately 55 gallons, and equipment for packaging and freezing fresh produce), a space for growers to communicate about solutions to overcoming shared challenges, and a space to recipe test value-added products to inform the design and build of their own, future kitchen facility.

Theme 4: In need of a local co-packing service: Producers 5, 6, 7, and 8 expressed strong interest in a local co-packing facility. Some producers who aligned with this theme expressed little or no interest in a shared-use kitchen, suggesting that the time, labor, and hands-on involvement associated with working in a shared-use kitchen play a role in a producer's choice of whether or not to do value-added processing.

This study concluded that the need for a shared-use commercial kitchen in Madison county is apparent and specific, but not especially urgent. While many producers had ideas for potential value-added products they could add to their business, none conveyed that doing so would be imperative to their overall success as food growers and sellers. A shared-use commercial kitchen is most feasible in two locations: the SUNY Morrisville Shared-Use Commercial Kitchen, and the bottling facility at Ray Brothers BBQ. These findings hope to serve the Cornell Cooperative Extension of Madison County as they support producers seeking to do value-added processing with their raw or excess produce, and increase awareness of local food resources.

Research Fellows: Andres Carvajal Sanchez (2028) **Concentration:** Undeclared

Faculty Mentor: Aaron Gember-Jacobson **Department:** Computer Science

Kate Valete (research assistant)

Title of Project: Speech-to-Speech Translation Tools in Higher Education Classrooms

Funding Source: Tom and Liz Brackett Endowed Fund for Diversity, Equity, and Inclusion in Computer Science

Project Summary:

Students in higher education may encounter language barriers which can reduce their levels of comprehension and participation in class. Even when students have intermediate proficiency in the classroom language they may process information more easily in their primary language. This can make lectures, discussions, and assessments more challenging. One possible solution is live Speech-to-Speech Translation (SST), which converts spoken content from one language into spoken output in another in real time. Thanks to advances in artificial intelligence tools such as OpenAI's Whisper, high-quality STT is now more accessible than ever. However, its effectiveness in live learning environments where aspects like delay, tone, and conversational awareness are crucial, has not yet been deeply explored.

Our project investigates whether current SST tools can sustain effective learning in higher education classrooms. We mainly focus on factors such as translation delay (latency), and the preservation of a "human" voice, meaning one that is not monotone and robotic-sounding. The aim is to understand how these variables influence student's comprehension, engagement and satisfaction with the classroom content experience.

We used a qualitative experimental design, setting up a mock classroom where participants were listening to a 5 minute Computer Science 101 lecture. There was a control group that was listening to the class in its original language (English) and the participants identified English as their primary language. The experimental group were provided noise-cancelling headphones where they could hear an SST tool translate the content of the lecture which had been previously set up to follow along the slide show that the lecturer was using. In the middle of the session and at the end, participants answered comprehension questions and provided feedback via a survey about the quality of their experience and their overall rating for usefulness of the SST model. Our findings revealed that the student who received the low quality translation scored perfectly and the student with the high quality translation scored the lowest. This was an unexpected result suggesting that the high quality translation may not have been a key factor in performance.

Through this study, we aim to inform the design of future SST systems for higher education, especially those seeking to balance translation accuracy, speed, and naturalness of delivery. Findings could help universities implement inclusive technology that better supports multilingual classrooms, while also highlighting that each student's nuances will impact their interaction with the SST models.

Research Fellow: **Jahanvi Chamria (2028)** **Concentration:** **Undeclared**
Faculty Mentor: **Ramesh Adhikari** **Department:** **Physics and Astronomy**
Title of Project: **Peptide Nanowire Growth on Cellulose Sponges for Hydrophobic Surfaces and Oil–Water Separation**
Funding Source: **Justus '43 and Jayne Schlichting Student Research Fund**
Project Summary:

Oil–water separation is a critical environmental challenge due to increasing industrial discharge and oil spills which highlight the need for sustainable water treatment technologies. Traditional methods such as gravity separation and absorption have been explored, but conventional materials suffer from weak absorption capacity, low selectivity, poor efficiency, and limited recyclability. Sponges have emerged as attractive separation media due to their high absorbency, tunable structure, and ease of use. While synthetic sponges such as melamine, polyurethane, and carbon-based foams have been studied, they are not always environmentally friendly or scalable. In contrast, cellulose sponge offers a promising alternative as it is abundant, renewable, low-cost, biodegradable, and highly porous. Its low density also reduces water resistance at the surface, promoting oil penetration. To further enhance separation performance, we grew nanostructures on the cellulose sponge to tailor surface roughness and wetting properties.

In this project, cellulose sponges were modified with diphenylalanine (FF) nanowires, a short peptide known for its self-assembly into mechanically robust nanostructures with nanoscale surface roughness. Over an eight-week period, we treated sponges with FF solutions across a concentration range of 50–200 mg/mL in HFIP. Optimized samples (175 mg/mL concentration) displayed uniform nanowire growth and water contact angles up to 140°, with stability maintained across extreme pH values (0–14) and high salinity conditions (0–50 g/L NaCl), demonstrating potential durability in realistic seawater conditions. We observed oil absorption up to 13.8 times the sponge's own mass and partial retention of hydrophobicity after 10 repeated absorption–squeezing cycles, with a decline in hydrophobicity only under extended oil exposure (~3 hours). SEM imaging confirmed dense and uniform nanowire growth, though further work remains in achieving better vertical alignment, oil-water selectivity, and long-term stability.

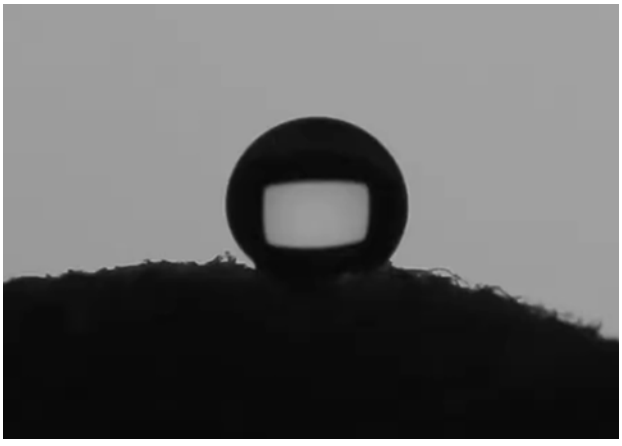


Figure 1: A saltwater (35 mg/mL) droplet on a 175 mg/mL FF treated sponge, demonstrating a water contact angle of 134°.

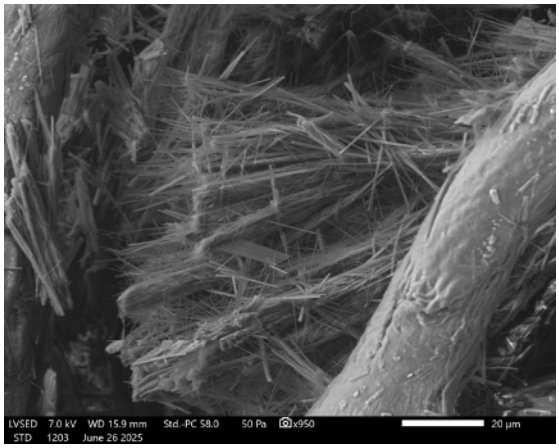


Figure 2: SEM imaging of the dense nanowire growth observed on a 175 mg/mL FF treated sponge.

Research Fellow: Jonathan Cheng (2027) **Concentrations: Japanese; Peace and Conflict Studies**

Faculty Mentor: Julie Dudrick **Department: Upstate Institute**

Title of Project: Curriculum Design for Teaching Reading to Refugee Adults

Funding Source: Upstate Institute

Project Summary:

This past summer, I carried out a project in partnership with the Midtown Utica Community Center (MUCC), an inclusive, multicultural, and refugee-friendly organization that offers over 110 hours of weekly programming for youth and adults. My fellowship primarily focused on MUCC's Beginner English as a Second Language (ESL) program for adults, operated in partnership with the Madison-Oneida Board of Cooperative Services (BOCES). My responsibilities included assisting in daytime classes taught by a BOCES instructor, supporting instruction through small group facilitation and occasional full-class teaching, and conducting an internal program evaluation. For this evaluation, I used a mixed methods approach, combining analysis of program data, staff interviews, classroom observations, and relevant literature.

The research design emerged iteratively as I responded to MUCC's initial proposal, which had identified literacy-based curriculum design as an area of interest. At the start of the fellowship, I was uncertain about my exact research question and methods, but those became clearer as I engaged directly in the classroom and spoke with program staff. This collaborative process grounded my research in MUCC's practical needs rather than in my own academic curiosities. I intentionally approached the project as adaptive and iterative, allowing insights from daily participation in ESL classes and MUCC-BOCES activities to guide the evaluation and keep it aligned with MUCC's goals.

My classroom experiences provided important context for understanding the challenges and opportunities of refugee-centered adult ESL education. Observing and assisting with instruction helped me see the diverse backgrounds, goals, and systemic barriers faced by learners, while also underscoring their determination to succeed. Through this work, I identified persistent challenges related to resources, curriculum design, and learner support, as well as potential strategies for improvement contingent on increased funding and staffing. These outcomes offered MUCC a set of actionable ideas to strengthen programming and better meet the needs of participants.

In addition to classroom-based work, I participated in MUCCamp, a week-long summer camp for immigrant and refugee youth. My responsibilities included logistical support, safety drills, and activity documentation, which deepened my engagement with MUCC's broader mission and strengthened my connections with staff and participants. This experience, combined with the program evaluation, gave me a richer understanding of nonprofit operations and the realities of community-based education in Utica. Ultimately, my project not only produced insights into programmatic challenges and outcomes for MUCC but also provided me with skills and perspectives that I will carry forward into future work in the nonprofit and education sectors.

Research Fellow: **Brigid Clive (2027)** **Concentration:** **English**

Faculty Mentor: **Julie Dudrick** **Department:** **Upstate Institute**

Title of Project: **One-Stop Shop: Consolidating Essential Services for Residents of Saranac Lake Central School District**

Funding Source: **Upstate Institute**

Project Summary:

Saranac Lake Central School District (SLCSD) is a rural community, serving over 1,000 students and bussing them in an area of 639.7 square miles. Its declining enrollment rate—a 2024 graduating class of 90 and kindergarten class of 53—illuminates the difficulty families face trying to stay or move to the area. Limited access to housing, child care, dental/health providers, and other community supports is a major complication to sustainable life in the Adirondack region. For Saranac Lake, the most prominent barriers include cost, amount of providers, and transportation. SLCSD works to alleviate many of these challenges through its one-stop shop model: a community school initiative that has established access points to free, essential services on the district's campus. These resources include two food pantries, Department of Social Services (DSS) and Joint Council for Economic Opportunity (JCEO) offices, a hygiene closet, mental and family health advocate/support, and a community school liaison who coordinates an abundance of other services.

Although SLCSD community school assistance extends far beyond its campus hub, this idea of a single, convenient access point inspired my project. My role this summer was to identify social determinants of health and agencies with services that fulfill these conditions. I organized my final 80 resources into at least one of nine categories: community/environment, education, family, food, healthcare, housing, safety, spirituality, and transportation. I then contacted each agency to ensure the information is current, but any future changes made to the document will automatically update in the public view link located on the district website. My document consolidates the services SLCSD and other community organizations provide, easing the burden on families to find and access these essential resources. Printable flyers for each category are also available to ensure this information is accessible in both digital and physical form.

Research Fellow: Ernest Clottey (2026) **Concentrations:** Computer Science; Economics

Faculty Mentor: Yang Song **Departments:** Economics; Asian Studies

Title of Project: Understanding Charter Schools State Laws: Patterns and Trends

Funding Source: Division of Social Sciences

Project Summary:

Over the past three decades, charter schools have emerged as a prominent alternative to traditional public education, with a growing number of states adopting them as part of broader educational reform efforts. Despite their expansion, controversy persists, particularly regarding accountability and the degree of autonomy afforded to these schools.

This study examines state-level policies regulating charter schools, evaluates their stringency, and explores potential political influences on policy trends. Charter policy data were collected from official legislative websites and legal databases for ten U.S. states, contributing to the development of a comprehensive charter policy database. Using statistical analysis, we examined changes in policy strictness over time and compared patterns across states with differing political affiliations.
We examined the extent to which charter school policies facilitated the growth and establishment of new schools, as well as the degree of autonomy afforded to charter schools. In 2024, Republican-leaning states demonstrated higher average support for charter school policies, with scores of 0.813 for growth and 0.520 for autonomy. By contrast, Democratic-leaning states exhibited negative average support levels, with scores of –0.822 for growth and –1.586 for autonomy. Democratic-leaning states exhibited greater volatility in changing charter school policies, while Republican-leaning states demonstrated comparatively stable policy environments.

The results suggest that, on average, Republican-leaning states exhibited more support for charter schools than Democratic-leaning states. This may be explained by Republicans' stronger emphasis on school choice and market-based reforms, while Democrats often align with teachers' unions and prioritize strengthening traditional public schools. Furthermore, the results indicate that the political affiliations of states influence the volatility of charter school policies. Future research will aim to identify which charter school policies are most favorable and effective in promoting improved student outcomes. Ultimately, this work will also assess which policy approaches best support long-term national educational development.

Research Fellow: **Henry Combs (2027)** **Concentration:** **Philosophy**

Faculty Mentor: **Thomas Balonek** **Department:** **Physics and Astronomy**

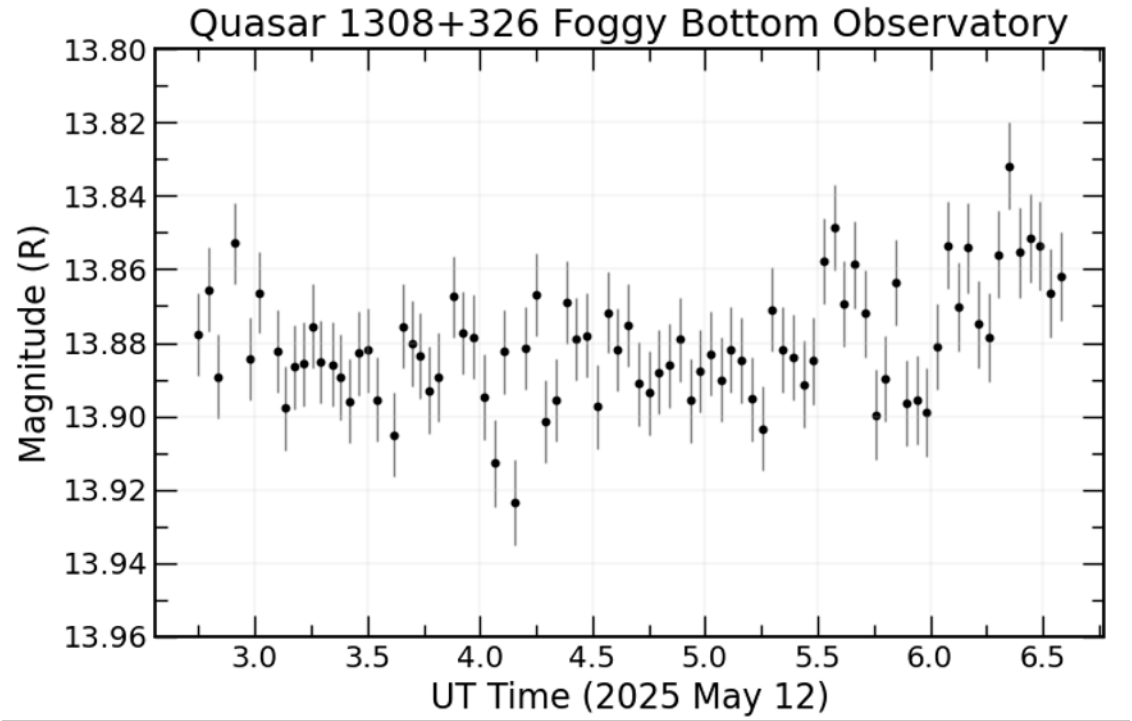
Title of Project: **Tracking the Short Term Changes in Brightness of Quasars**

Funding Source: **Division of Natural Sciences and Mathematics**

Project Summary:

Quasars can exhibit large changes in brightness over long time scales, but can also show microvariability over the course of a single night. At Foggy Bottom Observatory here at Colgate, we often observe an object for a prolonged period within a single night, taking many data points in the span of a few hours. We use that data to graph the changes in brightness. We combine this short term variability data with long term data from other observatories to get a full picture of how a quasar is changing over time.

Brightness is measured in magnitudes, which is a logarithmic scale. Lower magnitudes correspond to brighter objects. For a sense of scale, an object that is five magnitudes brighter than another is 100 times brighter, and a magnitude difference of one corresponds to about 2.5 times brighter. Below is an example light curve created using data from Foggy Bottom. For more information on how we collect, use, and combine this data with other sources, see the abstracts submitted by Alec Aggazio-Bach ‘26, Halle Hatten ‘27, and Duncan Earl ‘28.

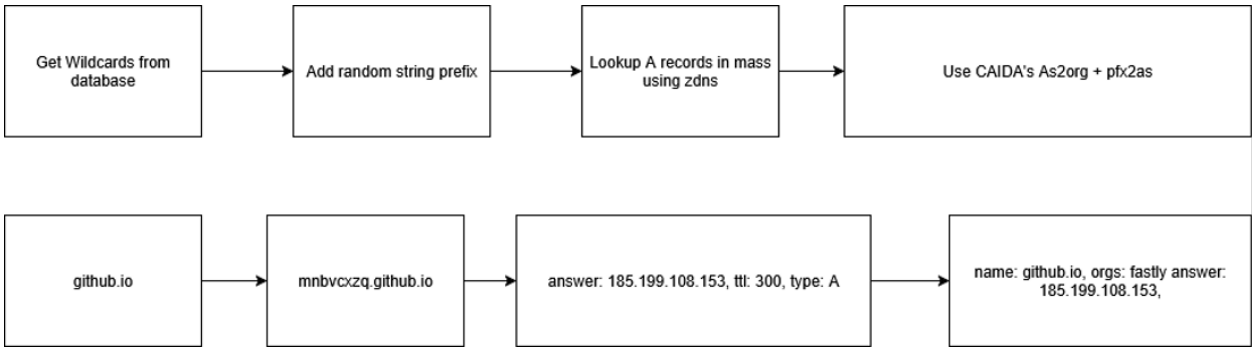


Research Fellow: **Renzo Cruzado (2026)** **Concentration:** **Computer Science**
Faculty Mentor: **Joel Sommers** **Department:** **Computer Science**
Title of Project: **Mapping DNS Wildcards and Organizations**
Funding Source: **National Science Foundation Grant**
Project Summary:

The DNS is a system that underlies the internet, it maps website names to IP addresses. This allows for easy and comprehensible access to navigation, similarly to a phone book. For instance, the URL, “Google.com” is connected to the proper IP for Google and its address thus reached. But within this system, there are several types of DNS entries. One of the features of DNS is that of wildcards. Wildcards allow for the access of a web page without needing to specify a subdomain, serving as a catch-all.

For the summer research, we focused on a large set of data obtained from Rapid7 due to observing that a great quantity of the DNS entries present in the dataset were wildcards. Because of this discovery alongside the presence of IP addresses embedded into the entry names that did not match the actual IP address of the entry, we decided to look further into these entries. After some analysis, it was decided that the next step would be to organize them.

The measurement process is outlined in the image below. We first grabbed names from our wildcard database, and then added a random string prefix to these names expecting them to return a proper entry, as they were wildcards. Next, using a mass DNS lookup tool called zdns, we were able to look up information regarding these entries. Following this information, we did some cleanup of the data to streamline the process of aligning each entry to an org and ASN. The final step was to employ two of CAIDA’s databases; As2org and pfx2as. Using these, we finished proper pairing of entries to org and ASNs.



Legend: Methodology for mapping organizations to entries.

Research Fellow: **Cinthia Destinville (2026)** **Concentration:** **Biology**

Faculty Mentor: **Ken Belanger** **Department:** **Biology**

Title of Project: **The Cave Microbiome: Exploring the Microbial Organisms in Titan Cave**

Funding Source: **Michael J. Wolk ’60 Heart Foundation**

Project Summary:

Caves typically have steady temperatures, high humidity, neutral pH, and little to no sunlight. With such conditions, it is expected that microbes would struggle to survive, but regardless of these cave environments, caves are filled with different microbes. This project analyzes the microbes present in Titan Cave, whether the microbiome of this cave is changing from year to year, and whether the location of samples taken shows a difference in microbial activity. Samples were collected from Titan Cave over three years, and bacterial DNA was extracted from these samples. Following DNA extraction, PCR was performed using 16S rRNA primers, and gel electrophoresis was run. The results of the gel showed that bacterial DNA was amplified. Extracted DNA samples were then sent out for sequencing, and the data were analyzed. Data analysis showed that samples taken from 2025 have an increase in Crenarchaeota and an increase in Bacteroidota in select samples. Microbial richness was observed, and microbes were similar from year to year, but there was low variability of microbes in samples from 2025 compared to 2023 and 2024. Microbes also seemed to differ across locations in the cave based on cave formation. To further my research, DNA extractions and DNA sequencing on cave samples from additional cave formations will be done. I will also analyze above-ground samples and compare them to the samples within the cave to see whether microbes above ground differ from microbes within the cave and whether the controlled burn in 2024 impacted the microbes present in and above the cave in 2025.

Research Fellow: **Anna DiSorbo (2027)** **Concentration:** **Economics**

Faculty Mentor: **Julie Dudrick** **Department:** **Upstate Institute**

Title of Project: **Developing Forecasting Tools for Charitable Fund Resilience at the Adirondack Community Foundation**

Funding Source: **Upstate Institute**

Project Summary:

This summer, I developed forecasting tools for the Adirondack Community Foundation, focusing on three areas: recovery modeling for underwater funds, the realization of legacy gifts, and the application of the Economic Scenario Planning (ESP) Model.

Project 1 involved constructing a financial model to project recovery timelines for permanently endowed funds valued below their original principal ("underwater"). The model requires two primary inputs: market return and spending rate. Users can select a percentile-based return assumption drawn from internal forecasts or input a custom rate. Spending policies are adjustable across several fields: (i) a base policy (current, no-spend, or an adjustment to current of ±25 basis points); (ii) optional modifications such as applying the selected policy at intervals or limiting spending to a percentage; and (iii) administrative fee controls, which can be toggled or delayed. The model produces a fifty-year projection of fund values, indicating the year at which the fund value exceeds its principal amount and regains "recovered" status. While results remain confidential, a notable takeaway was that recovery strategies varied with the severity of a fund's underwater status, as slightly underwater funds responded to different inputs than deeply underwater funds. To reflect this, output summaries are grouped by percent-underwater thresholds and by fund type, since funds with comparable structures and grantmaking patterns are likely to adopt similar recovery strategies. Overall, the model equips the foundation with a practical tool for evaluating each fund and weighing recovery options accordingly.

Project 2 involved designing a centralized database to track and forecast legacy gift commitments. The system standardizes records through structured fields for donor demographics, gift vehicle type (e.g., retirement accounts, trusts, real estate), and fund designations. These entries connect to actuarial life tables, which automatically calculate years remaining for single and joint-life donors. The system also accounts for vehicle-specific realization lags (the delay between a donor's passing and when the gift is received) and converts percentage allocations into dollar amounts relative to the commitment amount. The database then aggregates projected inflows by time horizon and destination fund, with an option to model administrative fee revenue. This tool allows for more consistent recordkeeping and prepares the foundation for the realization of legacy gifts.

Project 3 involved applying the Council on Foundations' Economic Scenario Planning (ESP) Model to assess the foundation's resilience under varying market conditions. I populated the tool with historical data on the endowment, operating reserves, and spending. The model evaluates this data against five variables: market performance, donor behavior, spending policy, other revenue, and operating expenses. For the first forecast, I focused on market performance and built three scenarios: a baseline case using internal forecasts, a pessimistic case modeled after the COVID-19 recession (2020–2024), and a super pessimistic case modeled after the 2008 financial crisis. Each scenario produced five-year projections across multiple financial metrics, showing how shocks could affect the foundation's broader financial outlook. To ensure continued use, I documented my population logic and trained the finance team on the model's fields and outputs, enabling them to test alternative scenarios and interpret results independently.

Research Fellow: **Ella Duchnowska (2026)** **Concentration:** **Neuroscience**
Faculty Mentor: **Anzela Niraula** **Department:** **Psychological and Brain Sciences**
Title of Project: **Neuroimmune Response in Xenopus laevis to Bacterial Infection**
Funding Source: **Division of Natural Sciences and Mathematics**
Project Summary:

The African clawed frog (*Xenopus laevis*) is a captivating model organism for many reasons, most notably its ability to undergo metamorphosis. In just six to eight weeks, the organism transitions from egg to tadpole to small frog, undergoing dramatic morphological changes such as limb generation, tail resorption, eye remodeling, and more. Beyond its metamorphic transformations, *Xenopus* is also of interest because of its diminished capacity for thermoregulation—the ability to alter body temperature. Thermoregulation is crucial for mounting an immune response, as seen in mammals like humans, who generate a fever to fight against infection. Lacking this physiological mechanism, the African clawed frog must instead migrate to warmer environments when it becomes sick. Beyond thermoregulation, *Xenopus* also differs from mammals in its reaction to certain bacterial components. While mammals like mice become extremely ill when infected with lipopolysaccharide (LPS)—an outer membrane component of gram-negative bacteria—*Xenopus laevis* has been shown to exhibit greater resistance to the pathogenic effects of LPS. This suggests the presence of a unique mechanism of immune defense that may offer important insights into host-pathogen interactions.

To better understand how the tadpole brain responds to infection, we conducted an experiment in which stage NF54 tadpoles were infected with heat-inactivated E. coli or LPS. After 4, 24, and 72 hours, we collected their brains and livers for analysis to observe the timing of immune response after infection. We then isolated RNA from these tissues and performed real-time qPCR analysis to measure changes in gene expression across conditions. Some of the genes we analyzed included il1b, tnf, and ifit1, among others, all involved in the neuroimmune response.

As we continue analyzing the data from our samples, we are interested in identifying what unique patterns *Xenopus laevis* exhibits in response to different types of infection. Our findings may broaden our understanding of the mechanisms underlying the immune response to various stimuli and how vertebrates respond to infection in the absence of fever.

Research Fellow: Topher Durette (2026) **Concentrations:** History; Native American Studies
Faculty Mentor: Chris Vecsey **Departments:** Religion; Native American Studies
Title of Project: Black Hills, Lakota World: Summer Research on the Lakota Sioux Relationship to the Black Hills Before and After U.S. Colonization
Funding Source: Division of University Studies
Project Summary:

The research that I performed over the summer of 2025 focused on the Lakota, an Indigenous people who live in the Great Plains, and their relationship to the Black Hills of South Dakota, the Lakota's historic homeland. The deeper goal of this research was to explore a more general aspect of Native Americans' relationship to the land: how do Indigenous groups' connection to a place, their homeland or spiritual sites, change or persist after colonial powers remove them from those places. Removal of Indigenous groups from their homelands has sadly occurred to many peoples around the world. The aftermath or lingering effects of that displacement can be destructive for the cultures and people that were removed; however, Indigenous peoples' relationship to the land is not erased as a result and in order to counteract the physical loss of place new ways to express their relationship to the land become more central. These new or different expressions of Indigenous, in this case Lakota, connections to place was what my research focused on.

To research this question, I used the Colgate library and online resources to find a diverse range of books, articles, primary texts, and other sources that explored the Lakota relationship to the Black Hills before and after the hills were taken. The sources examined topics such as history, religion, law, economics, tourism, activism, environmental concern, art, Indigenous ways of life, and more. Thanks to these diverse sources, a full contextual understanding of how the Lakota have maintained their connection to the Black Hills, despite no longer residing there, can be seen with legal cases, activism, tourism, and religion acting as the primary ways in which the Lakota have maintained their connection to place. The most central of these connections is Lakota religion and the geographic encapsulation of that religion in the Black Hills and the hills' spiritually significant features: Wind Cave, Bear Butte, Devils Tower, etc. Upon arriving in the Black Hills in the 1700s, the Lakota began connecting to the land there and "a clear sacred narrative developed around a geologic space [the Black Hills]" (Garcia, 34). Religion's centrality in this dynamic in turn fueled every other aspect of the current Lakota relationship to the hills; the legal cases and claims, artistic expression, environmental and political activism, and the myriad of other ways in which the Lakota have connected to the Black Hills are all fueled by the religious value of the hills. This close tie between Lakota religion and the Black Hills was and has remained foundational for the Lakota and their understanding of themselves as a people. Nick Estes, a Lakota leader, expresses this point perfectly, "The Black Hills are not for sale because we are not for sale" (in Tomaselli). The Lakota see the hills not just as an economic commodity or for the physical value of the place; instead, the Lakota see the Black Hills for its religious value and its spiritual, relational significance in understanding what it means to be Lakota.

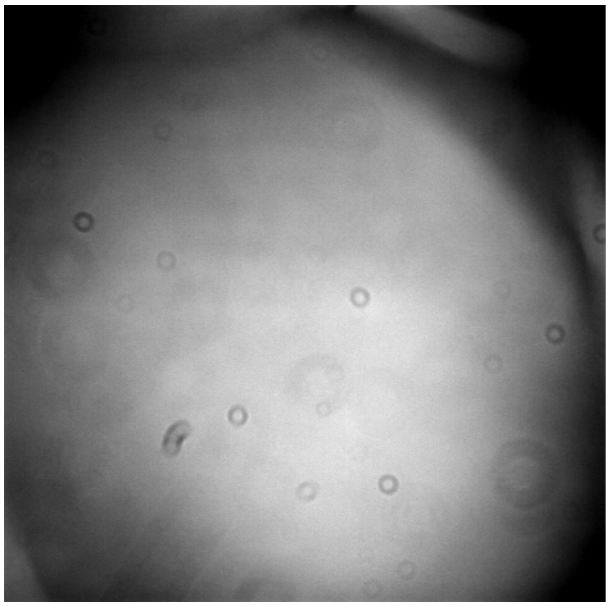
The final culminating work for this research was the creation of an annotated bibliography. This annotated bibliography lists all the sources which I found throughout the research process and then a brief summary of the content and significance of each source for the research question. In total I investigated nearly fifty sources over the course of the ten weeks.

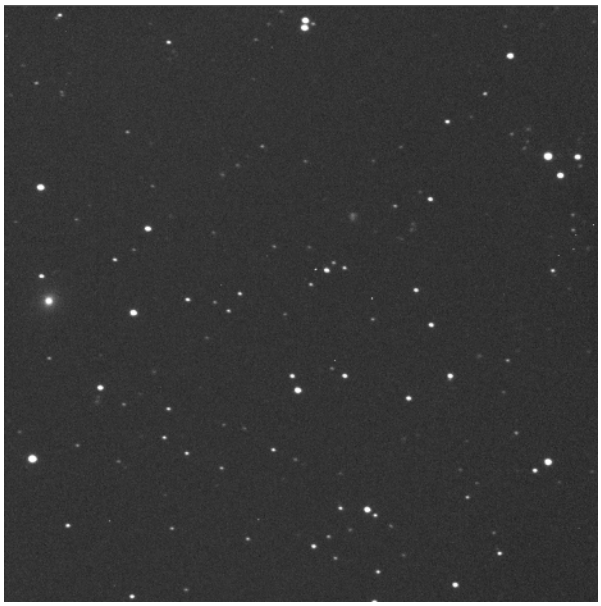
Citations:
Garcia, Jessica Fritz, Federico Garcia Lammers. "Origins from Wind Cave (Washun Niya): Sacred Space as Contested Territory." In Genius Loci-Lugares e Significados, p. 33-43. 2018.
Tomaselli, Laura, and Jesse Short Bull, dirs. Lakota Nation vs. United States. 2022. 120 minutes.

Research Fellow: **Duncan Earl (2028)** **Concentration:** **Undeclared**
Faculty Mentor: **Thomas Balonek** **Department:** **Physics and Astronomy**
Title of Project: **Combining Colgate and All-Sky-Survey Observations to Study the Long-and-Short-Term Optical Variability of Quasars**
Funding Source: **Division of Natural Sciences and Mathematics**
Project Summary:

During our research this summer my colleagues and I learned how to operate and collect images from the 16-inch telescope on campus, and we also learned how to correctly reduce as much error as possible from these images to get accurate data from them. Most of the images we took this summer were of multiple well-known quasars that have been varying greatly in brightness recently, however we also learned how to take images of the sky at dawn or dusk to create what is called a “sky flat”. The goal of a sky flat is to see and eventually remove any uneven responsiveness in our camera sensor which could hinder accurate data collection. After we took sky flats, we could then correctly calibrate and “flatten” our images.

A quasar is a type of active galactic nucleus that emits an incredible amount of light across the entire EMF spectrum, while also varying in brightness across both very long and very short time frames. To study the variability in brightness of any quasar in the night sky this summer, we had to calibrate all of our images correctly while accounting for various sources of error. The figure on the left shows a dawn flat from July 28th 2025, and the one on the right shows an image containing quasar CTA102 that has been flattened and calibrated correctly. Note in the image on the left, there are faint circles and lines that are actually dust grains on our filter and the camera sensor itself. These dust grains are actually removed from the images when we flatten them.





Research Fellow: Katarina Fechner (2026) **Concentration:** Chinese
Faculty Mentor: Jing Wang **Department:** East Asian Languages and Literatures
Title of Project: The Needham Revolution of Integration
Funding Source: Division of Arts and Humanities
Project Summary:

This project examines how Joseph Needham's (1900-1995) background in biochemistry and his commitment to an evolutionary and socially engaged perspective on science laid the groundwork for his later career as a pioneering historian of world science, with a focus on China. Known primarily for his monumental series, Science and Civilisation in China, Needham began his intellectual life in a very different realm: as a Cambridge biochemist interested in the nature of life, form, and process. My research traces how these early ideas — rooted in Needham's biochemical laboratory and his political and religious debates of the 1930s and 40s — shaped his later approach to comparing Chinese, Western, and global scientific traditions. For a general audience, this project offers a fresh perspective on a polymath whose career defied disciplinary boundaries. At a time when science was often imagined as cold, mechanistic, and inherent only to Western societies, Needham pursued a different vision: one in which science was embedded in culture, infused with ethical and political meaning, and capable of flourishing in many civilizational contexts. His early writings demonstrate a fascination with organicism, morphology, and dialectics — ways of thinking that emphasize dynamic relations over fixed categories. These conceptual tools were not discarded when Needham turned to China during World War II; rather, they were transformed and repurposed to interpret a vast, unfamiliar scientific tradition through a framework that was at once comparative, ecological, and cosmological.

Over the course of the summer, I conducted close readings of Needham's early works, such as his contributions to Perspectives in Biochemistry (1937), Christianity and Social Revolution (1935), and Time: The Refreshing River (1943), to build a foundational understanding of his worldview. I also engaged with a rich body of secondary literature, especially recent special issues of Technology and Culture and Isis journals that reevaluate Needham's intellectual legacy from multiple angles: linguistic, material, epistemic, and geopolitical. These secondary sources were especially important in framing how Needham's historical narratives can be read not only for their content but for their underlying assumptions about knowledge, translation, and cultural value. A central component of this research was analyzing how many contemporary scholars misrepresent Needham's approach as Eurocentric or narrow, when in fact his project was deliberately constructed to counter such frameworks. Critics sometimes mistake the "Needham Question" — which seeks to uncover why modern science developed only in the West, despite China's earlier scientific sophistication — as evidence of Eurocentric bias. Yet contextualizing his work makes clear that the question was posed not to reassert Western superiority, but to dismantle it. By highlighting China's long history of scientific achievement and conceptualizing science as a multicivilizational process, Needham sought to upend triumphalist narratives that attributed scientific modernity solely to Europe. The project also involved archival and contextual work on the broader intellectual networks that shaped Needham's thinking. I explored writings by his contemporaries and collaborators, such as J.B.S. Haldane, J.G. Crowther, and John Marrack, all of whom emphasized the social dimensions of science and envisioned a future in which science served human flourishing rather than military or industrial dominance.

By bridging intellectual history, science studies, and comparative philosophy, this project not only sheds new light on one of the twentieth century's most ambitious cross-cultural, cross-disciplinary, and cross-experiential thinkers, but also contributes to ongoing conversations about what counts as science, how knowledge travels, and what it means to compare linguistically, conceptually, and socially across civilizations. Ultimately, situating Needham within his intellectual and political milieu demonstrates that his project was far from simplistic or Eurocentric; rather, it anticipated the global turn in the humanities and provided a model for creative works — in his case, histories of science — that are comparative, dialogical, and ecumenical in scope.

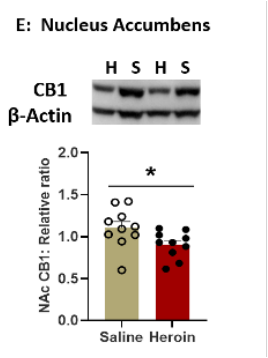
Research Fellows: **Anna Fleischer (2027)** — **Concentrations: German; Neuroscience**
Charlotte Morris (2027) — **Concentration: Neuroscience**
Holly Shortell (2027) — **Concentration: Neuroscience**
Coco Xie (2026) — **Concentration: Molecular Biology**
Faculty Mentor: **Ewa Galaj** — **Department: Psychological and Brain Sciences**

Title of Project: **Neuroadaptations of CB1 receptor and its involvement in heroin conditioned place preference**

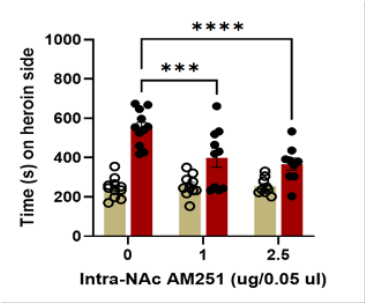
Funding Source: **Mind, Brain, and Behavior Scholars Award; Division of Natural Sciences and Mathematics; National Institutes of Health Grant**

Project Summary:

Chronic opioid use induces long-term dysregulation of systems related to reward, pain, and stress. Previous studies have shown that the endocannabinoid system is involved in opioid-driven behaviors, with the cannabinoid CB1 receptor playing a critical role. However, the neuroadaptations of CB1 receptors following heroin exposure remain unclear. In this study, we investigated CB1 receptor protein expression within the cortico-mesolimbic-basal ganglia circuit of heroin-dependent rats and its involvement in heroin conditioned place preference (CPP), a paradigm measuring the rewarding effects of heroin. In Exp. 1, Long Evans rats received a daily subcutaneous injection of saline or heroin for 16 days and then were subjected to naloxone-precipitated withdrawal. Chronic heroin-treated rats exhibited significantly more withdrawal symptoms compared to saline controls, confirming heroin dependence. The withdrawal symptoms included, but not limited to, rapid weight loss, abnormal posture, genital grooming, wet dog shakes, urination, diarrhea and salivation. Western blot analysis showed that CB1 receptors were downregulated in the nucleus accumbens (NAc), hypothalamus, substantia nigra (SN), and pedunculopontine tegmental nucleus (PPT) following prolonged heroin treatment, implicating that chronic heroin administration leads to region-specific neuroadaptations of CB1 receptors. In Exp. 2, conditioned place preference (CPP) experiment demonstrated that rats spent significantly more time on the heroin-paired side during CPP test day than they did during preexposure. However, pharmacological blockade of the CB1 antagonist, with AM251 (a CB1 antagonist), into the NAc, SN, or hypothalamus significantly blocked heroin CPP, suggesting that CB1 receptors in these regions are necessary for drug cue-driven behaviors. These findings illustrate that CB1 receptors are involved in opioid driven behaviors and repeated heroin exposure is linked with region-specific neuroadaptations in these receptors. Our study also points to CB1 receptor signaling as a candidate for modulating opioid-driven reward mechanisms and enhances our understanding of addiction neurobiology. Future studies could explore therapeutic strategies that selectively target CB1 activity to alleviate opioid addiction.



A. Chronic heroin causes downregulation of NAc CB1 receptor expression

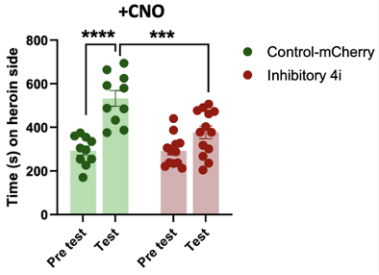


B. Heroin produces CPP but not when CB1 receptors in the NAc are blocked Intra-NAc

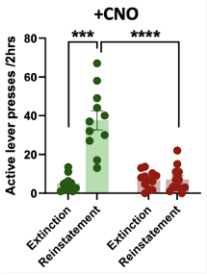
Research Fellows: **Anna Fleischer (2027)** — **Concentrations: German; Neuroscience**
Charlotte Morris (2027) — **Concentration: Neuroscience**
Holly Shortell (2027) — **Concentration: Neuroscience**
Coco Xie (2026) — **Concentration: Molecular Biology**
Faculty Mentor: **Ewa Galaj** — **Department: Psychological and Brain Sciences**
Title of Project: **The Role of the VTA → Insula Pathway in Drug Self-Administration in Rats**
Funding Source: **Mind, Brain, and Behavior Scholars Award; Division of Natural Sciences and Mathematics; National Institutes of Health Grant**

Project Summary:

Dopaminergic (DA) neurons are broadly known to be involved in drug-seeking and reinforcement behaviors. DA neurons originating in the ventral tegmental area (VTA) project to several brain regions implicated in addiction. Although the insular cortex has been associated with drug craving—evidenced by stroke patients with insular damage being more likely to quit smoking—less is known about whether DA neurons projecting specifically to the Insula are involved in opioid-seeking behavior. This study assessed the role of the VTA→Insula pathway in drug self-administration, relapse, and conditioned place preference (CPP) in rats. To isolate and manipulate this pathway, a chemogenetic approach was used. AAVrg-Cre, a retrograde virus taken up by axon terminals in the Insula, was injected to selectively label neurons projecting to this region. A Cre-dependent viral vector expressing either an inhibitory DREADD (AAV-DIO-hM4Di) or a control fluorophore (AAV-DIO-mCherry) was then injected into the VTA. This form of Cre-dependent DREADDs virus is expressed only in neurons that express Cre. Thus in this case, in VTA neurons to the Insula. The success of this targeting was verified via immunohistochemistry, which confirmed DREADDs expression in VTA→Insula DA neurons. Rats underwent 18 days of intravenous heroin self-administration (IVSA), during which both groups—control and inhibitory—demonstrated increasing infusion rates, suggesting comparable baseline drug intake. Following chemogenetic activation with clozapine-N-oxide (CNO), rats with inhibitory DREADDs in the VTA→Insula pathway showed a significant reduction in heroin self-administration, reinstatement of drug-seeking, and diminished preference for the heroin-paired chamber in the CPP test. Importantly, inactive lever presses remained low across all groups during both extinction and reinstatement, suggesting that the active lever pressing was drug specific. These findings demonstrate that chemogenetic inhibition of the VTA→Insula pathway, that involves DA neurons, reduces both drug taking and seeking behaviors in rats, suggesting that this pathway plays a key role in mediating opioid reinforcement and relapse. This study advances our understanding of the neurocircuitry underlying opioid addiction and highlights the VTA→Insula pathway as a potential therapeutic target.



A: Reinstatement



B: Conditioned Place Preference (CPP)

Research Fellow: **Kevin Fuentes Gonzalez (2027)** **Concentration:** **Molecular Biology**
Faculty Mentor: **Engda Hagos** **Department:** **Biology**
Title of Project: **Investigating the Role of KLF4 in Epigenetic Modification**
Funding Source: **Division of Natural Sciences and Mathematics**
Project Summary:

Krüppel-like factor 4 (KLF4) is a known tumor suppressor gene and zinc-finger transcription factor in colorectal cancer cells. It is linked to genomic stability, as cells lacking KLF4 have higher levels of apoptosis, DNA damage, aneuploidy, and chromosomal aberrations (Hagos et al., 2009). Methylation plays a significant role in epigenetics as it is involved in gene regulation. For instance, in colorectal cancers, DNA methyltransferase (DNMT), a key player in DNA methylation has been shown to hypermethylated tumor suppressor genes involved in DNA repair mechanisms. O6-methylguanine-DNA methyltransferase (MGMT), on the other hand, is a DNA repair protein that is involved in removal of methyl groups from DNA to prevent mutations (Silber et al., 2012). MGMT plays a significant role in the epigenetics of cancer, as MGMT has been shown to demethylate DNA damage repair genes and tumor suppressor genes. To determine the role of KLF4 in epigenetic modifications, we compared mouse embryonic fibroblasts (MEFs) expressing KLF4 ($KLF4^{+/+}$) and lacking KLF4 ($KLF4^{-/-}$). Expression of DNMT1 and MGMT protein levels within basal MEFs was measured through western blot analysis and actin was used as a loading control. Based on our western blot data, we found that MEFs containing functional KLF4 exhibited DNMT1 downregulation and upregulates MGMT as compared with MEFs lacking KLF4 (Fig. 1). In addition, we overexpressed KLF4 by transient transfection to determine whether KLF4 reintroduce into KLf4-null cells rescues the phenotype (Fig. 2a). KLF4 null cells transfect with empty vector-control plasmid showed similar expression of DNMT and MGMT as KLF4 null MEFs (Fig. 2b). On the other hand, overexpression of KLF4 by transfection into KLF4-null MEFs increases the level of protein expression of MGMT and decreases the expression of DNMT (Fig. 2b). Taken together, these results suggest that KLF4 plays a vital role in this epigenetic pathway by downregulating DNMT1 and upregulating MGMT to some extent; however, further experiments are needed to elucidate the specific interactions between the proteins and the significance of these findings.

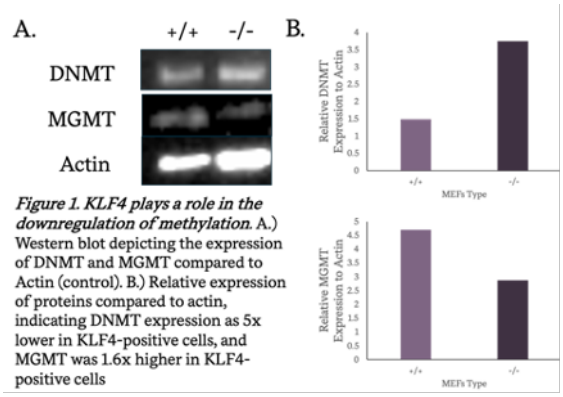


Figure 1. KLF4 plays a role in the downregulation of methylation. A.) Western blot depicting the expression of DNMT and MGMT compared to Actin (control). B.) Relative expression of proteins compared to actin, indicating DNMT expression as 5x lower in KLF4-positive cells, and MGMT was 1.6x higher in KLF4-positive cells

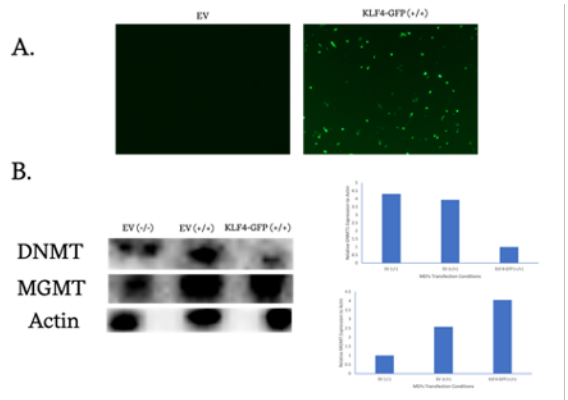


Figure 2. Transient transfection of KLF4 into MEFs correlates with the downregulation of DNMT and an upregulation of MGMT. A.) Fluorescent imaging depicting effective transfection of KLF4-GFP B.) Western Blot imaging and quantification of transfected MEFs, suggesting that KLF4 downregulated DNMT1 levels and upregulated MGMT levels.

Research Fellow: **Emery Furgason (2027)** **Concentration:** **Political Science**

Faculty Mentor: **Julie Dudrick** **Department:** **Upstate Institute**

Title of Project: **Campaign Marketing and ALICE**

Funding Source: **Upstate Institute**

Project Summary:

This summer I had the privilege of working with the United Way of Mid Rural New York (UWMRNY) through a fellowship offered by Colgate University's Upstate Institute Field School Program. UWMRNY is a non-profit organization based in Norwich, New York committed to ensuring every person in the communities they cover has access to education, healthcare, financial stability, and basic needs by allocating donations to various non-profit organizations in the surrounding area. These funded programs primarily target the Asset-Limited Income-Constrained Employed (ALICE) population; people who work everyday yet still struggle to make ends meet. My work this summer addressed this very issue. My first project with UWMRNY was to create a digital ALICE simulation, akin to a poverty simulation. This simulation is an interactive slideshow where participants are forced to live a month in the life of an ALICE family, making critical spending decisions each week while watching their budget shrink. This presentation can be shared in a variety of settings including Zoom meetings and in-person campaigning, thus spreading the applicability and impact of the simulation. My second project this summer was to direct and produce a promotional video. The final product included interview clips of leaders at six funded partner organizations sharing who their organizations are and how United Way funding impacts them. I also strategically chose these funded partners by ensuring I included geographical and industry diversity; the six organizations include Madison Rural Health Council, Family Planning of South Central New York, The Place, Chenango Health Network, American Red Cross of the Southern Tier, and Community Action Partnership of Madison County. These clips were supplemented with statistics on the number of individuals each organization served the previous year through the help of United Way funding.

Research Fellow: **Evelyn Gao (2026)** **Concentration:** **Economics**

Faculty Mentor: **Carolyn Hsu** **Department:** **Sociology and Anthropology**

Title of Project: **Lying Flat or Competing? Chinese Youth Attitudes in a Time of Economic Slowdown**

Funding Source: **Division of Social Sciences**

Project Summary:

Our research question is: what do Chinese young people really want, and who do they blame during the current economic downturn in China—characterized by stagnant wages, high inflation, and high youth unemployment? During the pandemic, criticisms of China's competitive culture went viral through a meme called "lying flat", which advocated dropping out of the rat race. The "lying flat" attitude became prevalent among young people during the height of the pandemic, but it is not clear whether this attitude still persists. This question is significant because understanding what worries and motivates the younger generation in China can offer deeper insights into how Gen Z is reacting to the fact that they are the first generation that will not experience social mobility in the PRC, and how this generation's views will affect China's economy and support for the government moving forward.

We chose Douyin (the Chinese version of TikTok) and Little Red Book (Xiaohongshu) as the two social media platforms where we collected short videos. These videos explore the fears, desires, and the most discussed topics among Chinese youth. Currently, we have a total of 200 videos—100 from each platform—covering issues related to mortgage pressure, consumerism, unemployment, and the decline of the birthrate. We plan to continue coding and analyzing these videos during the fall semester.

Research Fellows: **Jeriah Garcia (2028)** **Concentration: Undeclared**
Emma José (2028) **Concentration: Undeclared**
Faculty Mentors: **Paul Harnik** **Department: Earth and Environmental Geosciences**
Rebecca Metzler **Department: Physics and Astronomy**
Title of Project: **Examination of Bryozoan Feeding Rates in the Gulf of Mexico**
Funding Source: **Sonya Lee-Chung ’85, P’21 Endowed Research Fund; Norma Vergo Prize**
Project Summary:

Understanding how marine ecosystems respond to the rapidly increasing rate of anthropogenic nutrient input is critical for effective conservation and restoration efforts. In the northern Gulf of Mexico, these nutrient inputs have led to increased primary productivity, triggering eutrophication and seasonal hypoxia, conditions that significantly affect marine life; however, the extent of said eutrophication varies by location in part because of the differences in watersheds. While Alabama is mainly connected to the Mobile Bay watershed, Florida is composed of many smaller watersheds. However, few studies have examined how these stressors impact the life histories of species in this region. Bryozoans are colonial marine organisms composed of numerous genetically identical individuals, called zooids, which live together in a connected colony. Each zooid performs specialized functions such as feeding, reproduction, or transportation. Autozooids, zooids in charge of feeding, feed by extending a tentacular structure called a lophophore through an opening known as the orifice. The size of the orifice is important because it directly influences the autozooids ability to capture food and may reflect environmental conditions like nutrient availability and primary productivity. For this project, we investigated how the size of bryozoan orifices vary across location and how different primary productivity levels in these areas may affect their feeding rates.

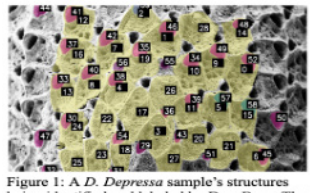
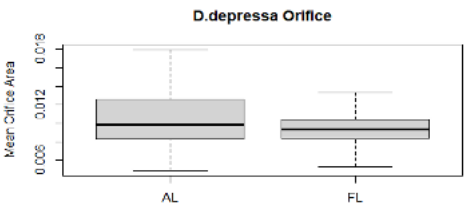


Figure 1: A *D. Depressa* sample’s structures being identified and labeled by DeepBryo. The yellow structures are autozooids. The pink structures are orifices.

The Paleo Lab team has collaborated with various marine laboratories to collect live and dead bryozoan colonies that feed off phytoplankton and algae, from coastal areas of Alabama, Louisiana, and Florida. From these collections, three bryozoan taxa - Discoporella depressa, Cupuladria, and Reusirella doma - were selected and prepared for scanning electron microscopy. After these specimens were imaged by the scanning electron microscope, the images were then put through a web-based platform called DeepBryo. DeepBryo uses AI-assisted technology to detect and identify different structures within a bryozoan, thus providing relevant information such as different zooid types and their respective size measurements. This provided us with the ability to generate large amounts of data from our images and provided a basis for our examination of bryozoans and their feeding rates.

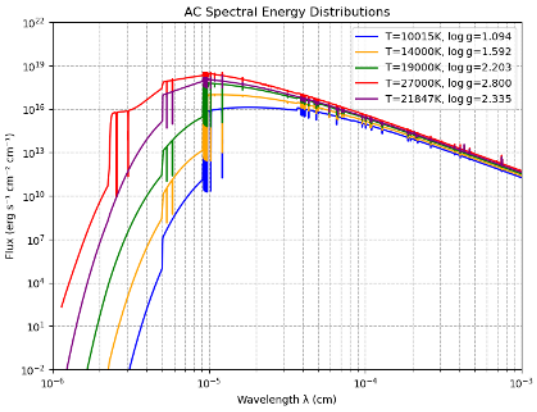


As seen in Figure 2, efforts have already started to yield some preliminary results. Here, comparisons have been made between the mean orifice areas of D. depressa bryozoans based on their location of origin. Bryozoans from Alabama exhibited a higher median value compared to their Floridian counterparts. This implies that the regional differences between Alabama’s and Florida’s watersheds influence their coasts’ respective eutrophication rates. The larger orifice areas in Alabama suggest bryozoan feeding rates are higher, likely a result of initial increases in primary productivity. However, this creates implications for the harmful effects that might follow as anthropogenic processes increase eutrophication in these areas to the point where this productivity becomes unsustainable.

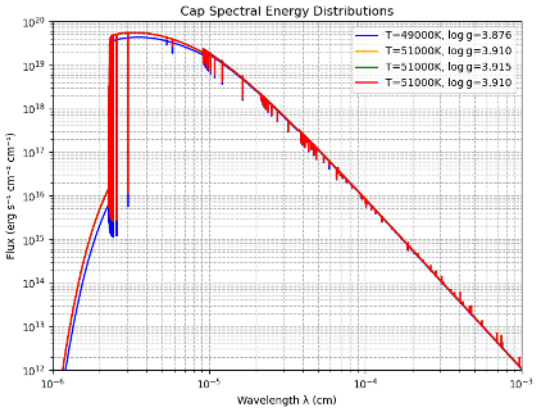
Research Fellow: **Gunnar Gasper (2028)** **Concentration:** **Undeclared**
Faculty Mentor: **Cosmin Ilie** **Department:** **Physics and Astronomy**
Title of Project: **Probing the nature of Dark Matter with the first stars and galaxies in the Universe**
Funding Source: **Justus '43 and Jayne Schlichting Student Research Fund**
Project Summary:

The James Webb Space Telescope has discovered many compact objects in the young universe that are much too large and luminous for them to have formed so early. An explanation for such objects are Supermassive Dark Stars, stars which are powered by the self-annihilation of dark matter. A dark matter candidate such as WIMPs, weakly interacting massive particles, could theoretically annihilate when interacting with themselves. These WIMPs could then build up in the cores of these early stars, and the energy from the annihilations could fuel much larger and luminous stars that we potentially see in the early universe.

Numerous Dark Star candidates have been identified by the JWST using both photometric and spectroscopic data. As any luminous body shines, the wavelengths of light it emits roughly follows a blackbody. Along this continuum, however, certain wavelengths of light will be much less intense than others due to their absorption within the star. The wavelengths of light that are absorbed are determined by the composition of the star, as different elements and their ions absorb certain specific levels of energy that correlate to the wavelengths of light. For example, with Dark Stars, they have a signature absorption due to He II that other objects in the early universe would not have, allowing us to identify them.



In order to recognize the spectra of Dark Stars (the continuum of wavelengths and absorption features), it is helpful to simulate such bodies using software to get an idea of what their spectra would look like. One such software that we used was Tlusty, useful for modeling the stellar atmospheres of these Dark Stars. Modifying different input parameters in the program would allow us to simulate the spectra that would be produced by such bodies. Other inputs include the composition and abundances of elements within the Dark Stars. In the figure is an example of some data that the software can produce, with the SEDs of different Dark Stars shown. Each is parameterized by the surface gravity and the effective temperature of the star, as shown in the legend. The two graphs show the SEDs for two different types of Dark Stars, with extended AC being where the dark matter is brought into the star through gravity only, and Capture through elastic scattering. In our work, we have also developed code to speed up the use of the Tlusty program, as well as utilizing the on-campus supercomputer for fast execution.



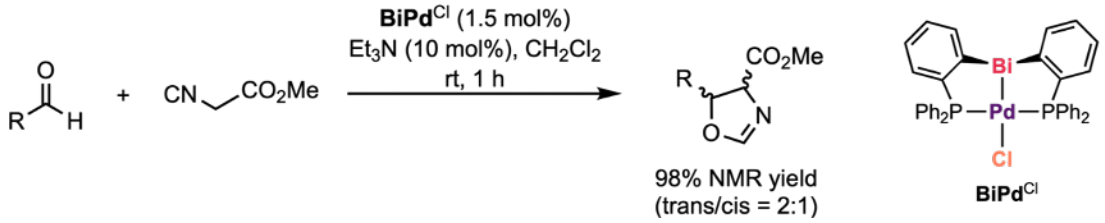
Research Fellow: **Kim Gates (2026)** **Concentration:** **Chemistry**

Faculty Mentor: **Gongfang Hu** **Department:** **Chemistry**

Title of Project: **Mechanistic Study of Aldol Reaction of Aldehyde and Methyl Isocyanoacetate Using Bismuth–Palladium Bimetallic Complex**

Funding Source: **Justus '43 and Jayne Schlichting Student Research Fund**

Project Summary:



Scheme 1. BiPdCl catalyzed aldol reaction between aldehyde and methyl isocyanoacetate to afford oxazoline product.

Heterobimetallic systems are gaining increased attention for use in catalysis due to potential synergistic effects that cannot be achieved with a single catalytic center. Our group is particularly interested in using bismuth as a supporting ligand for transition metals in these bimetallic systems. Largely underexplored, bismuth stands out as the heaviest non-radioactive pnictogen with low toxicity and low cost. We previously synthesized a series of Bi–Pd and Bi–Ni complexes, and discovered that these complexes effectively catalyze the aldol reaction between an aldehyde and methyl isocyanoacetate. In particular, $BiPd^{Cl}$, shown in Scheme 1 above, afforded the highest yield of oxazoline amongst known catalysts.

Curious about the superior ability of $BiPd^{Cl}$ to catalyze this aldol reaction, I investigated the reaction mechanism with the aim of elucidating the full catalytic cycle. I performed a series of kinetics experiments using ^{1}H NMR spectroscopy to monitor reaction progress over time. Experiments included reaction order determination for the base, aldehyde, isonitrile, and catalyst, effect of changing the substrate identity on rate, and effect of changing initial concentrations on rate. We are still working to understand the full catalytic cycle and the role of our $BiPd^{Cl}$ catalyst in facilitating the reaction. In the future, we plan to compare the mechanism to other complexes like $BiNi^{Cl}$.

Research Fellow: **John Griffith (2026)** **Concentration:** **Physics**

Faculty Mentor: **Ken Segall** **Department:** **Physics and Astronomy**

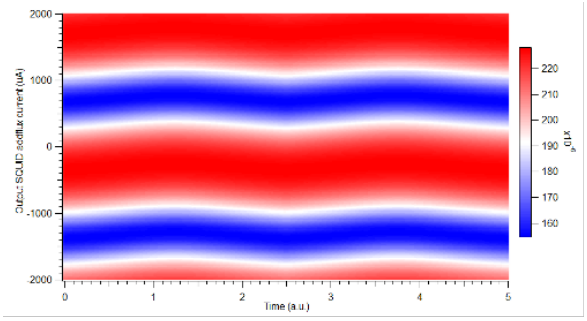
Title of Project: **Simulating and Testing a Superconducting Analog Multiplier**

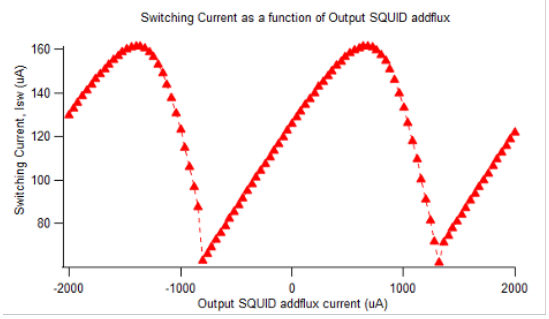
Funding Source: **Division of Natural Sciences and Mathematics**

Project Summary:

The goal of our summer research was to simulate and test an analog multiplier made of two Superconducting Quantum Interference Devices, or SQUIDs, which are superconducting electronic components made of two Josephson Junctions (JJ's). Multipliers will be essential components of superconducting neural networks due to the need to multiply the weight of a synaptic connection to the state of that connection, being either 1 for "on" or 0 for "off". The multiplier chip itself was provided by the startup company Great Sky AI. To do experiments on the chip, it had to be placed in a freezer and cooled to 2.7 Kelvin in order for the superconducting components to function properly. The objective was to observe the multiplication of the input currents, Ix and Iy. The first SQUID performs an analog operation mathematically equivalent to $(I_x + I_y)^2$, while the second one performs$(I_x + I_y)^2$. The outputs of these operations are then summed through mutual coupling of inductors to yield an output proportional to the product of the two inputs, $I_x * I_y$. Simulations were conducted using Xic circuit-editing software. Files containing information about the digital circuit, along with WRspice scripts controlling the currents sent to different parts of the multiplier were then submitted to the Colgate Supercomputer for processing. The simulations were then compared with the experiments and were found to display similar trends.

The graph at the bottom left shows the output voltage as a function of output SQUID addflux current. This simulation was helpful in determining the addflux current yielding the signal with the greatest modulation. The graph at the bottom right shows how the switching current, the current at which the multiplier enters the superconducting phase, changes with increased addflux current. Creating this graph helped us decide to operate in the linear regime (between -800 and +800 μA, for example). Our results show that the multiplier works well for a very limited range of input currents.





Research Fellow: Yufeng Gu (2027) **Concentration:** Physics

Faculty Mentor: Kiko Galvez **Department:** Physics and Astronomy

Title of Project: Laboratory Gravitational Lensing of Binary Stars

Funding Source: National Science Foundation Grant

Project Summary:

Gravitational lensing is the bending of light or gravitational waves by massive objects such as stars and black holes. It produces striking visual effects, including arcs and Einstein rings, and is a key tool in astrophysics for probing dark matter and distant galaxies. While single lenses are well studied, binary systems—pairs of masses orbiting one another—are common in the universe and produce more complex lensing signatures that remain less explored.

We model binary lensing in the lab using a Spatial Light Modulator (SLM), which encodes the spacetime-like phase shift that massive objects would produce. A laser beam diffracted by the SLM generates patterns that mimic light deflection by black holes or binary stars. For binaries, we combine two single-lens phase profiles and vary parameters such as the effective Schwarzschild radius to simulate changes in wavelength of backlight or merging systems.

We compared experimental intensity images with theoretical predictions by our colleagues. The locations of maxima and minima agree well, validating the simulation, while small discrepancies in brightness arise from SLM noise and model approximations. Our results bridge theoretical models with experimental validation, highlighting how wave-optics effects in binaries can inform the interpretation of astrophysical observations.

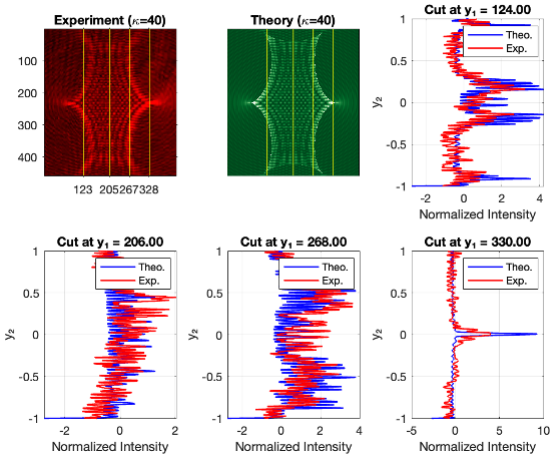


Figure 1: Comparison between theoretical and experimental interference patterns

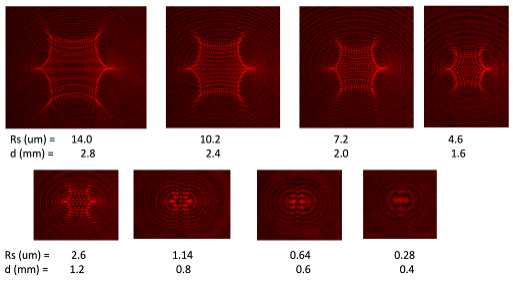


Figure 2: Experimental interference patterns showing how decreasing the effective Schwarzschild radius causes fringes to blur and merge, mimicking the signals with decreasing wavelength from binary black hole systems.

Research Fellow: **Anika Gurjar (2028)** **Concentration: Undeclared**

Faculty Mentor: **Elodie Fourquet** **Department: Computer Science**

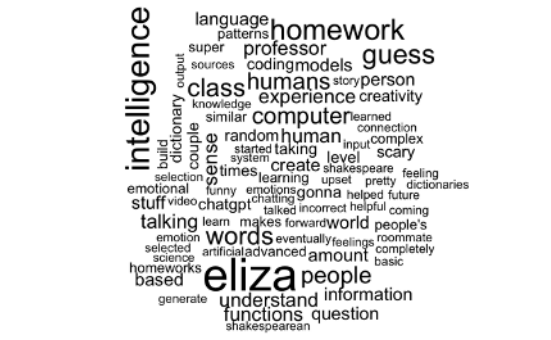
Title of Project: **An Exploration of Sentiment Analysis Methods to Study Student Perspectives on Artificial Intelligence**

Funding Source: **Tom and Liz Brackett Endowed Fund for Diversity, Equity, and Inclusion in Computer Science**

Project Summary:

This summer, I worked with Professor Fourquet to learn how to conduct sentiment analysis on text using the programming language R. Sentiment analysis is the process of computationally deriving emotional tone from a text, such as determining if a text has a more positive or negative tone. The data that we used to aid our learning was collected from COSC 101 students at the end of the spring 2025 semester. Students submitted short videos discussing their thoughts on AI and whether or not they think that AI could be intelligent. Professor Fourquet turned these videos into text files using a text transcription software. Then, I cleaned the text files by correcting any incorrect word transcriptions and organizing the text in a clear manner. Throughout the summer I used these text files to conduct a pilot experiment of what sentiment analysis can tell us about student thoughts on AI. The goal of this experiment is to learn sentiment analysis techniques that will aid Professor Fourquet's future plans to study how student sentiments towards AI change after taking an introductory computer science course (COSC 101). She will do this by conducting pretest and posttest design to compare and contrast student thoughts about AI at the beginning and the end of the semester.

To begin our research, I learned key functions of R such as fundamental libraries to download and basic data visualization methods. I also wrote code using prebuilt datasets to familiarize myself with R. Next, I researched how text files can be interpreted into data frames. This research helped me code a program that reads and cleans a text file, and then outputs a visualization of the most frequent words in the text. Then I learned about the bing sentiment lexicon, which is a prebuilt list of words labeled as positive or negative. Using this lexicon, I created the following data visualizations from a single student text file: a bar chart of the number of positive vs. negative words, a horizontal bar chart of which words contribute the most to the positive and negative word counts, and a visualization of how the positive and negative sentiment changes over time. Next, I created a large text file compiled of twelve student text transcriptions. I used this comprehensive text file to create two word clouds, which are data visualizations with the size of each word indicating its frequency or importance in the text. Displayed below, the word cloud on the left visualizes the most common words overall, while the one on the right visualizes the most common positive and negative words. Lastly, I wrote a technical report explaining my research on sentiment analysis, including the code I wrote to produce the bar charts and word clouds to visualize the text data.



Research Fellows: **Wyatt Hall (2026)** **Concentration: Biology**
Abigail McGuire (2026) **Concentrations: Biology; Native American Studies**
Faculty Mentor: **Tim McCay** **Departments: Biology; Environmental Studies**
Title of Project: **Long-term Macro-invertebrate Response to Watershed Liming in the Adirondacks**
Funding Source: **Division of Natural Sciences and Mathematics**

Project Summary:

Twenty years ago, Colgate research students scattered crushed limestone onto plots in the Adirondack Park and took samples to determine how the lime affected invertebrate populations. The Adirondacks were chosen because they have been affected by acid rain, which limestone can counteract. They found that certain invertebrates like millipedes and snails increased in population. Our research group went back to these plots 20 years later to sample invertebrate populations to determine if the effects observed 20 years ago stayed consistent.

We re-established plots on the coordinates of the original 8 sites and took samples of the leaf litter. We used Tullgren-type extractors to extract bugs from leaf samples and worked to identify every invertebrate >2 mm. We also sought to determine how much unintentional soil there was by sifting each sample after extraction. Samples were also collected from 3 reference sites on nearby Colgate-owned land as a control. Later, pitfalls filled with ethanol were left in all 11 plots for 4 days to capture invertebrates and additional earthworm sampling was conducted by using mustard vermifuge on 5 randomly generated plots within each site. This research will be ongoing and continue into the fall. Additionally, our research team was assigned a niche project which involved sampling earthworms within the Adirondack Park, of which there are very few records of. We sampled worms at various locations within the park using a combination of mustard vermifuge and hand-sampling. Identification of these worms is still ongoing and will likely continue into the fall semester as well.

Fig 1. An example of the type of plot setup and sample collection that was performed

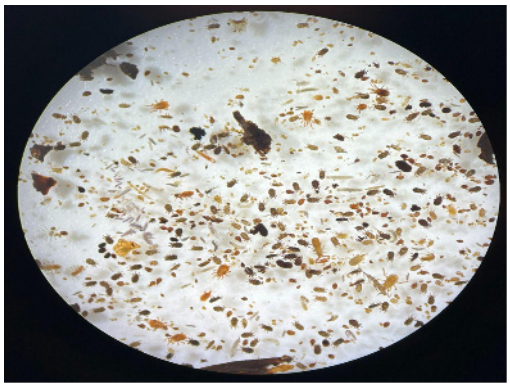


Fig 2. A microscopic view of the invertebrates found within a single soil sample

Research Fellow: **Theo Hauptman (2027)** **Concentration:** **Biology**

Faculty Mentor: **Julie Dudrick** **Department:** **Upstate Institute**

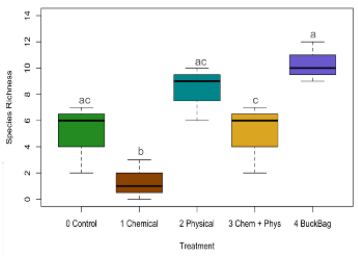
Title of Project: **Uncovering the Roots: Understanding Invasives Species and their Impacts in the Adirondacks**

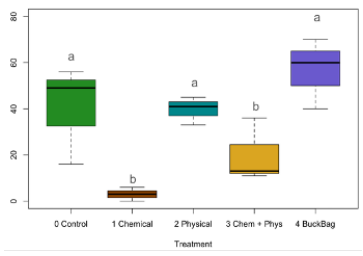
Funding Source: **Upstate Institute**

Project Summary:

Champlain Area Trails (CATs) is a non-profit organization based in Westport, NY in the Champlain Valley region of the Adirondacks. They operate in close connection with the surrounding community to protect the native environment, remove invasive species, and increase the accessibility of their expansive trail network. This summer, I was able to help CATs achieve their mission by conducting trail maintenance, attending community outreach events and volunteer days, and managing/researching in Essex Quarry Nature Reserve. Essex Quarry is a unique limestone woodland environment with a beautiful quarry speckled with fossils and surrounded by an extensive network of trails. During my fellowship, I took the quarry under my wing, reworking and updating the management plan, maintaining the trails, and conducting research on the removal of buckthorn, an aggressive invasive species. Buckthorn is capable of not only altering the soil chemistry, but scaling and taking over other plants, transforming heavily infested areas into buckthorn monocultures.

Last summer, Peter Biss, another Colgate Fellow working with CATs began a research project which investigated various methods of buckthorn removal, discovering that the most effective and efficient method was through the use of buckthorn bags, plastic bags that can be placed on the stumps of buckthorn after physical removal in order to limit sunlight exposure and prevent regrowth. This summer, after taking careful inventory of the native species present in the quarry, I expanded upon Peter's project in order to determine the effect of the various mitigation strategies on the growth of native plant species. To do so, I placed three 1x1 m plots in random locations in each of the tested regions, and then counted the number of native species present and how many individuals from each species there were. I averaged out the data and used an ANOVA test to determine the mitigation tactic that will best maintain the limestone woodland natural community.





Data suggests that chemical removal should be avoided in the quarry, as it has a significantly negative impact on the native plant growth. However, no strategies proved to be significantly more effective than the control region with no mitigation. Further data should be collected in order to determine which method is most beneficial.

In addition to targeted scientific research, I was able to investigate the management of the quarry by thoroughly reworking the management plan and exploring the technicalities of the property involving easements and property lines. Furthermore, I observed the operations of volunteer organizations such as the Adirondack Garden Club and how they interact with non-profits like CATS, taking note of how the Champlain Valley community is essential to the survival of Essex Quarry.

Research Fellow: **Ja'Zhana Henderson (2028)** **Concentration:** **Philosophy**
Faculty Mentor: **Jason Meyers** **Departments:** **Biology; Neuroscience**
Title of Project: **Not All Support Is Equal: Functional Compartmentalization of Supporting Cells in Zebrafish Hair Cell Regeneration**
Funding Source: **Division of Natural Sciences and Mathematics**
Project Summary:

Hair cells are specialized sensory receptors that convert mechanical vibrations into neural signals, essential for hearing and balance. In mammals, these cells are not naturally replaced if damaged, leading to permanent hearing loss. In contrast, zebrafish and other non-mammalian vertebrates can regenerate lost hair cells, making them valuable models for discovering mechanisms that could be translated to human therapies.
In this study, we explored compartmentalized regeneration in the zebrafish lateral line system—a network of sensory organs (neuromasts) containing both hair cells and their surrounding support cells (SCs). Using transgenic zebrafish lines that fluorescently label different subsets of SCs, we demonstrated that regeneration is spatially restricted: anterior/posterior (A/P) SCs (labeled by 19A) and dorsal/ventral (D/V) SCs (labeled by 3196) autonomously repopulate their own regions after injury, indicating localized progenitor behavior rather than a shared regenerative pool.

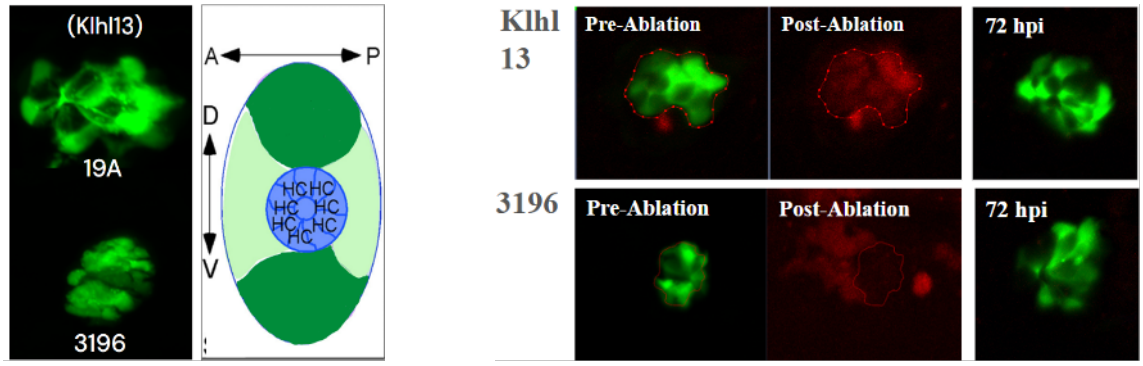


Figure Legend: Confocal images show that both Klhl13-labeled (A/P) and 3196-labeled (D/V) support cell populations regenerate autonomously (right) within 72 hours post-ablation, indicating spatially compartmentalized regenerative capacity (left) in the zebrafish neuromast.

We chose Klhl13 and Eya2 because our GFP insertions landed in/near these genes, so GFP marks their normal expression in those support-cell compartments. This made them clear candidates to test for driving the observed cell behaviors. Laser ablation and ototoxic injury (neomycin treatment) were used to induce region-specific cell death, followed by BrdU incorporation to track proliferative response. Our results revealed that A/P SCs act as replenishers of D/V cells, which then directly differentiate into hair cells. These findings offer insight into the hierarchical organization of SCs and their roles in neuromast regeneration, with implications for inducing hair cell regeneration in the human inner ear.

Research Fellow: Victoria Houser (2027) **Concentration:** Biochemistry
Faculty Mentor: Anthony Chianese **Department:** Chemistry
Title of Project: Screening Pincer Catalysts for Various Hydrogenation Reactions
Funding Source: National Science Foundation Grant
Project Summary:

The Chianese lab usually focuses on hydrogenation reactions using organometallic catalysts. Catalysts are molecules that speed up the rate of reactions by changing the way a reaction proceeds. They allow reactions that are too slow to be useful to occur in a reasonable amount of time. That is why catalysis is important. For the first part of the summer, I screened carbene pincer catalysts for the hydrogenation of carbon dioxide to methanol. Using carbon dioxide as a method of storing hydrogen has a lot of potential for sustainable energy. For this project, I tested various catalysts under conditions that had previously worked for carbon dioxide hydrogenation. However, none of the conditions worked for these catalysts. For the rest of the summer, I tested catalysts for the hydrogenation of amides. This type of compound is usually difficult to hydrogenate, and doing so has useful applications in the synthesis of other compounds from amides. While all of the catalysts I screened produced some of the desired product, none made it in very high yield. Further testing is required to determine whether this line of research is worth pursuing further.

For my initial project, I spent most of my time synthesizing pure versions of the required catalysts. This was so they could be tested without the worry that impurities would interfere with the desired reaction or produce false positive results. The organic ligand for the catalyst had to be synthesized and isolated first. There was a good amount of trial and error involved when building off procedures in the literature. Then, the ligand had to be mixed with a metal precursor to obtain a catalyst, which was further purified to obtain the catalyst. We screened two carbene catalysts, which each had a CNC pincer bonded to a metal center (ruthenium and manganese respectively). They were tested under conditions using an amine additive, as well as with a Lewis acid additive. We used proton NMR to determine whether methanol was present in the product mixture. Neither produced any methanol, so we decided the project would not be worth continuing.

For the amide hydrogenation project, my time was spent screening the catalysts we had available. This mainly involved determining the best procedure for running the experiment and analyzing the data, since we had trouble with our solvent evaporating and with the reactant not being soluble in our solvent at room temperature. One of our first trials with catalysts generated in situ appeared to have over 50% yield, which gave us confidence. But on the last day we realized these results may have not been fully accurate due to the moderately polar reactant not being soluble enough in the nonpolar solvent without mixing in THF for the GC analysis. Because of this, we need to be careful about further tests. One potential future step is to try to reproduce the results from the literature, since I realized afterwards that we never did so. This would tell us if something about our procedure was interfering with the reaction, since it has been proven that that catalyst worked well.

Research Fellow: Young Hu (2027) **Concentration:** Economics

Faculty Mentor: Takao Kato **Department:** Economics

Title of Project: The Effects of Working Hours on Career Advancement and Gender Disparities in Promotions

Funding Source: Division of Social Sciences

Project Summary:

Growing evidence shows that long working hours can enhance career advancement/promotion or the hours-career nexus. However, career advancement is usually more complex. Beyond working hours, factors such as training, education, gender, age, and the size of the company all can play a role in shaping who gets promoted. This study provides new evidence on the hours-career nexus by analyzing a recent longitudinal dataset of Japanese workers, the Japanese Panel Study of Employment Dynamics (JPSED) over 2016-2024. The data were made available for academic research only recently, and no rigorous analysis of the data has been conducted. I first spent much time familiarizing myself with the data and processing it for my analysis. I produced summary statistics for many variables, checked for extreme values, and assessed the suitability of each variable for my own analysis carefully. The data analysis reveals that while long working hours matter for individuals' career advancement, investments in human capital, including educational attainment, on-the-job training, off-the-job training, and self-development, as well as corporations' characteristics, have a much stronger contribution to career advancement.

Specifically, using a logit model, working hours are found to have a statistically significant positive effect on the probability of promotion. However, the impact of working hours on promotion probability significantly weakens after accounting for firm characteristics such as firm size and industries.

Furthermore, considering various individual characteristics, I find that educational attainment, the amount of on-the-job training, off-the-job training, and self-development significantly enhance the promotion probability. Finally, I observe evidence of a significant gender gap in promotion probability, and that previous leadership positions and firm characteristics account for the observed gender disparities in promotion probability.

I expand my analysis by conducting separate analyses for promotion to different levels of leadership positions, i.e., C-level executive positions, Department Head positions (Bucho in Japanese), Section Head positions (Kacho in Japanese), and Sub-Section Head positions (Kakaricho in Japanese). Working hours are found to have a significant positive effect on the odds of promotion to Department Heads, but not to the other three levels. I speculate that promotion to Department Head is likely to be the most important screening mechanism through which a select group of future corporate leaders are chosen.

Overall, my analysis suggests that the need for human capital differs greatly across promotion levels: Department Head focuses on work commitment and practical experience, while promotion to Section Head and Sub-Section Head depends more on educational background, training, and other variables capturing potential for further development.

Research Fellows: Joy Huang (2027) — Concentration: Neuroscience
Evan Sheldon (2026) — Concentrations: Neuroscience; Classical Studies
Cenjing Wang (2028) — Concentration: Undeclared
Faculty Mentor: Bruce Hansen — Departments: Psychological and Brain Sciences; Neuroscience

Title of Project: Building a novel brain-guided convolutional neural network augmented with large language models to study how knowledge influences perception

Funding Source: Division of Natural Sciences and Mathematics

Project Summary:

Visual perception is not merely a rote processing of light, but a complex cognitive process that depends on various factors such as the task being performed, previous experiences of the individual, and attention levels. Previous research has established that our brains dynamically prioritize features based on behavioral goals, shaping perception according to the task at hand. Understanding this interplay is crucial both for cognitive neuroscience and for advancing AI systems that adapt their processing in context-sensitive ways.

In this study, we developed a brain-guided convolutional neural network (CNN), wherein each convolutional layer was separately trained using time-resolved EEG responses recorded as participants performed one of two tasks on the same set of images. These tasks involved pre-cued object detection or scene affordance judgments (termed navigation and sitting respectively). Neural guidance came from six EEG-derived components representing distinct feature spaces. Initially, direct use of neural distances failed to differentiate tasks, possibly due to units mismatch or variable feature spaces. However, transforming these neural features using representational similarity analysis (RSA) and multidimensional scaling (MDS) enabled stable training of the network. This approach is effective because it captures a core principle of visual system: the brain encodes visual information not in the activity of single cells, but in the distributed activation patterns across populations of neurons, which is a relational structure that RSA extracts. Control models verified that brain data was critical to learn task-dependent differences.

To interpret how the brain-guided CNN prioritized information, we reconstructed each convolutional layer's activation maps via deconvolution (see Figure 1) and compared these to behavioral clickmaps from participants. This revealed that navigation tasks emphasized global spatial layout features, while sitting tasks highlighted localized object affordances. Because the exact same images were used in both tasks, task differentiation relied solely o n neural signals encoding task-dependent processing. Control experiments showed that explicit instructions to not shift eye gaze did not significantly alter EEG feature patterns, confirming that these differences reflect intrinsic task-driven neural dynamics.

We further explored semantic guidance by integrating sentence embeddings from a large language model (LLM), encoding task instructions such as "navigating a path" versus "finding a place to sit." Training the network to provide semantic responses and probing how language-based semantics interface with visual and neural representations. The CNN actively learned feature representations under the constraint of neural guidance. Early CNN layers aligned with early EEG components, reflecting shared low-level visual features, while later layers mirrored later EEG components, encoding upper-level affordances. This layered correspondence underscores how visual processing evolves dynamically over time in response to behavioral goals.

Future work will extend brain guidance from a single convolutional layer to a full deep convolutional neural network comprised of multiple convolutional layers, incorporate richer semantic embeddings for more precise vision — language fusion, and feature alignment across training. This approach advances a new class of AI systems that learn not only from static images but from the temporal structure of human neural and semantic processing itself.

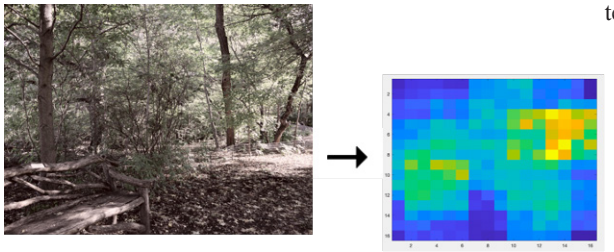


Figure 1: Example of deconvolution of a scene image

Research Fellows: **Josephine Jenne (2027)** **Concentrations: Psychological Science; English**
Carlie Rzeszotarski (2026) **Concentrations: Psychological Science; Sociology**
Faculty Mentor: **Jennifer Tomlinson** **Department: Psychological and Brain Sciences**
Title of Project: **Sleep and Relationships in Adulthood**
Funding Source: **Division of Natural Sciences and Mathematics**
Project Summary:

The Sleep and Relationships in Adulthood study focuses on cohabiting couples over age 55, exploring how relationship factors—such as partner interactions, partner sleep, and relationship satisfaction—affect sleep quality in adulthood. It builds on research linking relationships to well-being and long-term health (Pietromonaco & Collins, 2017) and is conducted in collaboration with the University of Texas at Dallas's Psychological and Brain Science department.

The study has been ongoing for two years, aiming to recruit 100 couples (200 participants) before concluding and publishing results. This summer focused on advertising and recruitment. Eligible participants complete a baseline visit, where they consent, review the study protocol, and fill out a questionnaire on demographics, health, sleep, emotions, and relationships. They then wear actigraphy sleep watches for 10 days while completing daily morning and evening diaries. Afterward, they return the watches and complete follow-up surveys at 2 months and 1 year. The study combines objective sleep data from the watches with subjective diary entries and survey responses to analyze sleep, relationships, and daily activities.

The majority of our work this summer has consisted of analyzing actigraphy data from participant watches, exporting the analyzed data, and creating sleep reports to send to the participants. These reports contain information from their subjective diary answers in comparison with information from the objective actigraphy data analysis. In addition to data analysis and sleep reports, the bulk of our time has been dedicated to participant communication, study organization, compensation payments, and baseline questionnaire sessions.

Figure 1 is a theoretical model developed for this study (and found in the original grant proposal) that links certain relationship processes with physical and mental health outcomes. Therefore, as seen in the model, it was hypothesized that sleep quality (measured through both actigraphy and subjective reports) and well-being would serve as the mechanisms that foster this relationship. This is only one way of looking at possible associations between the factors shown below, and so therefore, bidirectional associations (in contrast to the directional associations shown in the model) will also be tested.

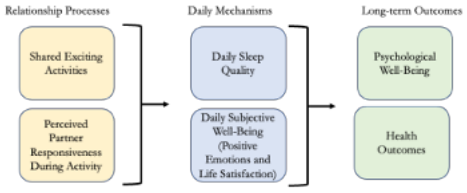


Figure 1. *Theoretical Model of Relationship Processes, Daily Mechanisms, and Long-term Outcomes*

Pietromonaco, P.R., & Collins, N.L. (2017). Interpersonal mechanisms linking close relationships to health. American Psychologist, 72(6), 531-542.

Research Fellow: **Vivian Jiang (2026)** **Concentration: Biochemistry**
Faculty Mentor: **Stephanie Sanders** **Department: Chemistry**
Title of Project: **Solution-Phase Aggregation-Induced Emission of Properties of a Tetraphenylethylene Derivative for Bioimaging**
Funding Source: **Division of Natural Sciences and Mathematics**

Project Summary:

Proteins exhibit a wide variety of functions necessary for life. When proteins misfold, their functions are negatively altered. As a result, protein aggregates — clusters of misfolded proteins — are associated with a broad range of diseases. Fluorescence imaging techniques are commonly utilized to study protein aggregation. Fluorescent dyes, such as Congo Red and Thioflavin T, have been used to study protein aggregates, but are not able to probe early-stage aggregation. Other commonly used dyes, like Nile Red and BODIPY, have been used to study early-stage aggregation, but are only applicable to certain proteins. Thus, a fluorescent probe capable of detecting aggregation in a wide range of proteins over the entire process is highly desirable.

Aggregation-Induced Emission (AIE) is the phenomenon in which molecules fluoresce more strongly when aggregated. Tetraphenylethylene (TPE) is a prototypical AIE and can be used to make derivatives for further studies. (Bis)Triphenylphosphonium Tetraphenylethylene (TPE-TPP), a TPE derivative, has been used to study protein aggregation in the early stages. However, the photophysical characteristics of TPE-TPP still remain unexplored. The aim of our work is to characterize TPE-TPP's electronic structure to understand its function as an AIE luminogen. We started investigating TPE-TPP in solution in mixtures of water and tetrahydrofuran, where increasing the water fraction tunes the solvent environment.

To characterize TPE-TPP solutions, UV-Visible (UV-Vis) spectroscopy, fluorescence (excitation and emission) spectroscopy, IR spectroscopy and dynamic light scattering were employed. From the UV-Vis and fluorescence spectroscopy, we found that TPE-TPP exhibits minimal solvent dependence. Weak vibronic coupling exists in all of the solutions, and the fluorescence spectrum of TPE-TPP depends on the excitation wavelength. From dynamic light scattering, we found that TPE-TPP forms two aggregate sizes in solution, with the larger aggregates being the more prominent size in higher water concentrations. In the future, we plan to continue exploring the photophysics of TPE-TPP by looking at pH, concentration, solvent, and temperature dependence of its AIE properties.

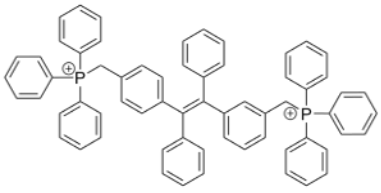


Fig. 1: Structure of (Bis) Triphenylphosphonium Tetraphenylethylene (TPE-TPP)

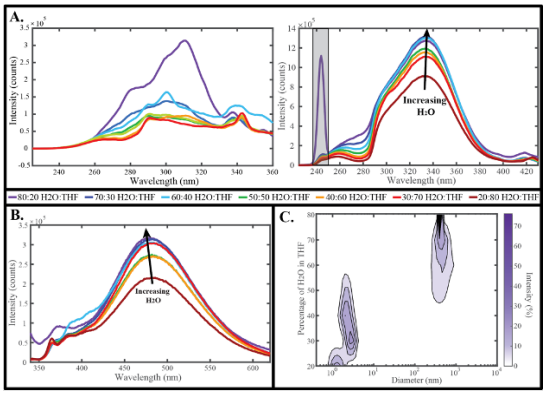


Fig. 2: A. Fluorescence excitation spectra detected at 380 nm (left) and 485 nm (right). B. Fluorescence emission spectra excited at 330 nm. C. Contour plot of aggregate sizes from dynamic light scattering data.

Research Fellows: **Carlyn Johnson (2026)** **Concentration: Biology**
Melissa Kennedy (2028) **Concentration: Undeclared**
Mary Thomas Powell (2026) **Concentrations: Environmental Studies; Biology**
Faculty Mentor: **Catherine Cardelús** **Departments: Biology; Environmental Studies**
Title of Project: **Canopy Latrines and Nutrient Cycling in Costa Rica and Perú**
Funding Source: **Division of Natural Sciences and Mathematics**
Project Summary:

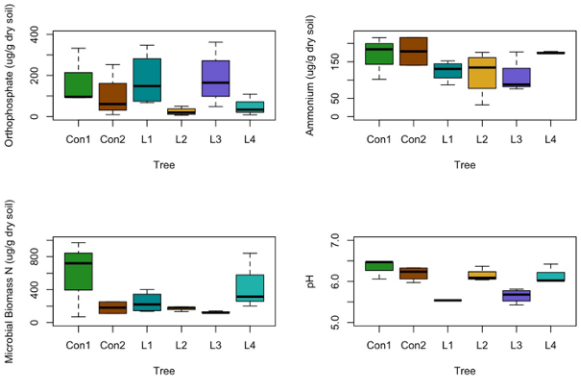
The canopy habitat in tropical rainforests is an understudied environment, yet they serve as a hotspot for species richness. They are home to 25% of the vascular flora despite containing very little nutrients in the system as a whole. In the canopy, soil collects on branches or platforms in the trees, and due to its highly organic nature, this soil acts as a nutrient hotspot in an otherwise limited system. Multispecies latrines, or bathrooms shared among different species of animals, can serve as a concentrated nutrient input in the canopy. In this study we are seeking to understand the role of multispecies canopy latrines in nutrient cycling in rainforest canopies.

We conducted fieldwork in Monteverde, Costa Rica and Manu, Peru in May and June of 2025. At each site we climbed strangler fig (Ficus) trees to collect plant and soil samples as well as deploy a camera trap. We also collected soil from the forest floor and deployed a camera trap at the base of the tree. In Costa Rica we climbed a total of seven trees: three controls and four with latrines. Soil samples were sieved in the field and shipped back to Colgate. Plant samples were identified, dried, and shipped back to Colgate. We focused primarily on samples from Costa Rica for analysis this summer. Once back on campus, we processed the soil samples to measure available phosphorus and nitrogen, microbial biomass phosphorus and nitrogen, pH, and water content. Additionally, we watched over 3,000 videos from the trail cameras to identify what mammals are present and what behaviors they exhibit in the canopy.

We anticipated that trees without a latrine would have lower nutrients and microbial biomass. However, we found similar nutrient levels across all trees (figure to left). When compared against the trail camera footage, we found that mammals, specifically Nasua narica (coati), were defecating in the tree. This suggests that the animal density may influence canopy nutrients opposed to presence or absence of a latrine.

Analysis of the trail camera footage revealed seasonal variation in mammal sightings between the wet and dry seasons. In August 2024 we detected a total of 360 mammals, versus 296 detections in January-March 2025. Across three trees analyzed we observed a total of 18 different mammal species.

Fig. 3a) (left) Preliminary results showing orthophosphate, ammonium, microbial biomass nitrogen, and pH levels of the soils of six trees; b) (right) Coati pooping in Con1.



Research Fellows:	**Karla Joseph (2027)**	**Concentration: English**
	Lilly Post (2028)	**Concentration: Undeclared**
	Elizabeth Rainey (2026)	**Concentration: English**
	Everett Shinn (2027)	**Concentration: English**
	Maxwell Walker (2026)	**Concentration: English**
Faculty Mentors:	**Jennifer Brice**	**Department: English**
	CJ Hauser	**Department: English**
Title of Project:	**Creative Writing Fellowship**	
Funding Source:	**Division of Arts and Humanities**	

Project Summary:

The role of the Creative Writing Fellows this summer was twofold: to assist Professors Brice and Hauser with the preparation for the Living Writers course that will take place in the fall, and to staff and provide support for several events hosted by the Department of English and Creative Writing over the summer.

Living Writers is a for-credit course in the Department of English and Creative Writing that is structured around a series of visits by authors who engage with students in the classroom and give a public reading. It is offered to 40+ students from all departments every fall, who read and discuss one work by each author at a rate of about one book a week. Living Writers readings are open to the general public, and the class offered to students also provides the basis for a program available to alumni, family, and friends of Colgate who wish to follow along at their own pace, with over 6,000 participants every year.

To help prepare for this class, the Creative Writing Fellows closely read and analyzed the eleven books selected for the 2025 series. Additionally, each fellow was assigned several authors on whom to conduct research with the goal of creating a profile of important information about the author. This information is to be used to inform Professor Hauser's preparation for and interaction with the author. It was also used to generate copy for the website and physical materials that will promote and provide information about the series. The fellows participated in a twice weekly book club with Professor Hauser for a portion of the summer, during which time we discussed the books, gave an overview of our written research, and discussed other logistics of the program, including book-specific events which will be conceived of and executed by the Fellows.

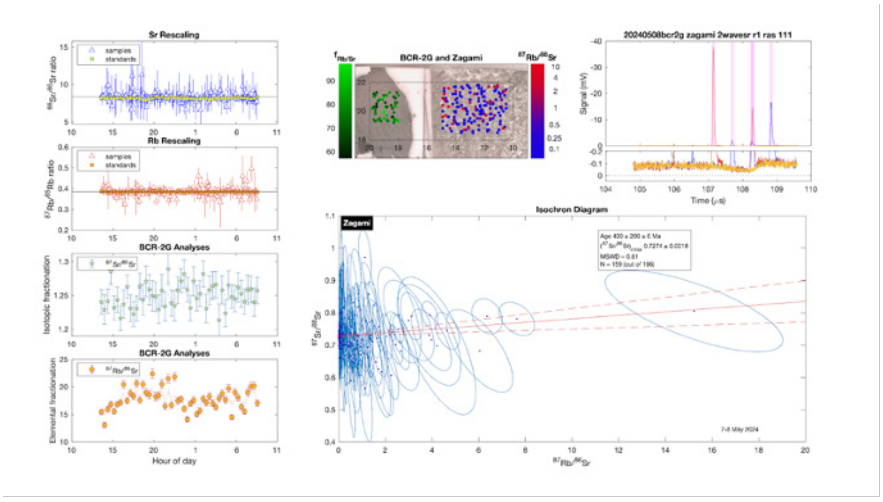
The Department of English and Creative Writing saw the return of the Colgate Writers Conference this summer for the first time in several years. The CWC is a long standing tradition in the department in which authors at different stages in their careers are invited to Colgate's campus either as faculty members or participants to participate in a series of workshops, readings, and other events, as well as to develop community and connections with other authors. The Creative Writing Fellows served as staff and participants in the week-long conference, held June 8-13 this year.. Each Fellow was assigned several faculty members to assist, a workshop to attend as a student, and crucial individual tasks assigned based on each Fellow's interests and abilities. These individual roles ranged from staffing a help desk and phone line, helping manage the conference's events, to running the social media, among other tasks.

The Creative Writing Fellows were also responsible for staffing the Department of English and Creative Writing's table and events during Alumni Weekend. A primary goal during this weekend was to promote the Living Writers program and future Colgate Writing Conferences to returning alumni.

Research Fellow: **Daniel Kaper-Barcelata (2028)** **Concentration:** **Astronomy/Physics**
Faculty Mentor: **Jonathan Levine** **Department:** **Physics and Astronomy**
Title of Project: **DIMPLE Console Development Research Project**
Funding Source: **Division of Natural Sciences and Mathematics**
Project Summary:

The goal of this research project was to develop a console view with integrated figures to support the control team of DIMPLE (Dating an Irregular Mare Patch with a Lunar Explorer) in data collection and analysis. The console includes plots that monitor instrument performance and consistency, helping identify whether incoming data is skewed. These figures track the instrument's sensitivity to specific elements and isotopes, enabling rescaling and ensuring accurate measurements. Additional panels display the characteristics of each sample and their associated uncertainties, providing the control team with critical context during data collection. I wrote a python code that gathers all the graphical representations of data gathered while the DIMPLE experiment is active on the Moon and presents it in a compact single-view format, so that science team members can, at a glance, understand the progress, quality, and results of their measurements.

To further enhance control over data analysis, I designed and implemented a graphical user interface (GUI) that allows team members to set analysis parameters directly. This interface enables flexible, independent analysis both during and after the mission. It also supports the examination of past data and can animate datasets into videos that simulate data arrival over time—a feature particularly valuable for presentations that demonstrate instrument performance and the underlying analytical process.



Research Fellow: Sophie Karbstein (2026) **Concentrations:** Russian and Eurasian Studies; Peace and Conflict Studies

Faculty Mentor: Mieka Erley **Department:** Russian and Eurasian Studies

Title of Project: Radioactive Mutants and Toxic Sovereignty: (Post-)Soviet Strategies of Irradiated Subjectivity

Funding Source: Division of University Studies

Project Summary:

Millions of Soviet and post-Soviet citizens found themselves navigating not just radioactive contamination but competing state narratives about their biological subjectivity in the wake of the Chernobyl nuclear disaster and the nuclear testing program in Semipalatinsk, Kazakhstan. My research examines how people in these irradiated regions created unexpected responses to narratives that variously insisted on the harmless nature of radiation or acknowledged radiation danger while simultaneously denying responsibility for it, particularly through the figure of the radioactive mutant that emerged in both testimonial accounts and science fiction. Building on Soviet cultural traditions where biomedical science served as a resource for reimagining (post)human transformations, (post-)Soviet irradiated populations appropriated similar scientific language to claim agency over their irradiated bodies, shifting radiation exposure from a pathology into a foundation for identity and community solidarity.

Along with theoretical work on Soviet subjectivity, the posthuman, and environmental justice, I analyzed testimonial literature and speculative fiction from Ukraine and Kazakhstan, examining how irradiated communities develop nuclear subjectivity and practice toxic somatography, and tracing how typical Soviet-era strategies of navigating authoritarian power through performance and irony adapted to irradiated embodiment. Instead of accepting either narrative of state secrecy or state acknowledgment, (post-)Soviet irradiated subjects appropriated scientific discourse to assert toxic sovereignty – a claiming of expertise over their own contaminated bodies and landscapes. Testimonial accounts reveal the distinctive Soviet nuclear experience. As Chernobyl witnesses observe, Soviet citizens were used to terror and oppression, yet radiation represented something unprecedented and unexplainable. Most significantly in the testimonial literature, Semipalatinsk-adjacent rural residents in Kazakhstan explicitly claimed exposure as enhancement, describing themselves as radioactive mutants with superior biology and challenging both medical classifications and state narratives about radiation harm. This inhabiting of bodies that fundamentally challenge boundaries between human and non-human, healthy and contaminated, represents another posthuman subjectivity that can also be traced backwards and outwards through a rich Soviet science fiction tradition.

This research contributes new frameworks for understanding environmental justice beyond victim narratives. Rather than viewing radiation exposure solely through a lens of harm, my work reveals how irradiated subjects generate posthuman agency that exceeds state biopower and creates new forms of solidarity. The Soviet experience of navigating authoritarian power through simultaneous resistance to competing narratives created uniquely fertile conditions for creative responses to forms of nuclear catastrophe. These (post-)Soviet irradiated subjects' radioactive mutant subjectivity represents an alternative way of being human that emerges from the breakdown of universal categories. My work demonstrates how political context fundamentally shapes identity and embodiment and offers critical insights for understanding resistance strategies in our increasingly irradiated world.

Research Fellow: **Isabel Kats-Rodgers (2027)** **Concentration:** **Chemistry**
Faculty Mentor: **Eric Muller** **Department:** **Chemistry**
Title of Project: **2D Quantitative Model for Infrared Scattering Scanning Near-Field Optical Microscopy (IR s-SNOM)**
Funding Source: **Justus '43 and Jayne Schlichting Student Research Fund**
Project Summary:

Nanoscale structure at the liquid-solid interface is essential to many chemical reactions and biological processes. We have developed a new experimental approach to understanding molecular structure and intermolecular interactions at the liquid-solid interface using total-internal reflection scattering-scanning near-field optical microscopy (TIR s-SNOM). In this technique, we focus infrared light through a prism in a TIR geometry onto the metallic tip of an atomic force microscope operating in liquid (Fig. A). This approach enables simultaneous measurement of nanoscale morphology and vibrational nanospectroscopy with few-molecule sensitivity and ~20 nm spatial resolution. Despite our experimental success, existing models are inadequate to describe the optical processes and measured nanospectroscopy.

We have developed a novel computational approach to modeling TIR s-SNOM spectroscopy. Our new approach is built upon far-field reconstruction of the optical signal calculated with a Maxwell's equations solver. We have found our model has compelling agreement with experimental results in the calculated near-field confinement and spectroscopic line shapes needed to understand chemical structure and local environment. Our new modeling approach provides a solid basis for understanding TIR s-SNOM vibrational spectroscopy of adsorbed molecular materials at the liquid-solid interface.

During this project, we worked to expand our model to understand the structure of liquid water at the interface, while reducing the computational cost of our model for practical use. We built an improved 2D model of TIR IR s-SNOM using the Maxwell's equation solver COMSOL, simulating a ZnSe/air interface with a gold tip modeled as an ellipse with a spherical top (Fig. B-C). We then perform a near-to-far field transformation using the open-source software package RETOP. Finally, we simulate lock-in detection to obtain the demodulated TIR s-SNOM signal (Fig. D). We apply this model to examine the bending mode of water and its response to changes in different variables, allowing us to study water behavior at the nanoscale. We are currently working to compare our modeled nanospectroscopy to our experimental measurements to understand nanoscale changes in hydrogen bonding of water at functional interfaces.

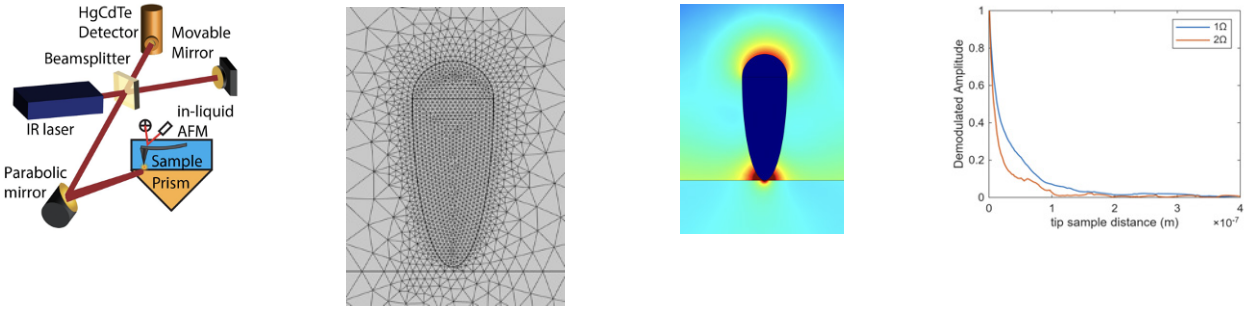


Figure: (A) Schematic of TIR IR s-SNOM showing the IR laser, prism, in-liquid AFM, and detector. (B) COMSOL mesh of the AFM tip at the ZnSe/air interface. (C) Simulated optical field at a 1 nm tip-sample distance. (D) Approach curve of demodulated amplitude vs. tip-sample distance in D2O at the first and second harmonics.

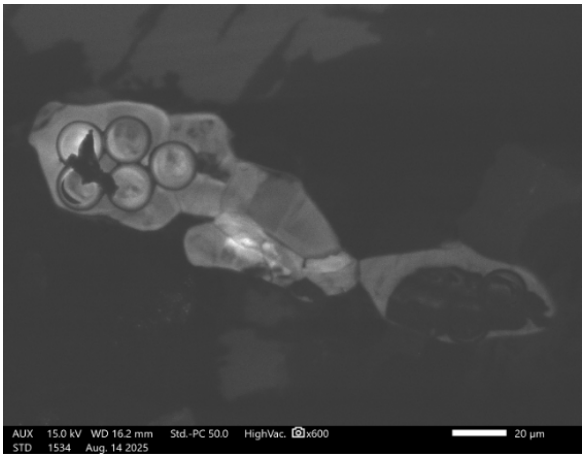
Research Fellow: Aidan Kenefick (2026) **Concentration: Geology**
Faculty Mentor: William Peck **Department: Earth and Environmental Geosciences**
Title of Project: Timing of the Cheney Mountain Shear Zone, Adirondack Highlands, New York
Funding Source: Doug Rankin '53 Endowment-Appalachian Research
Project Summary:

The primary purpose of this project is to date the age of deformation and metamorphism in the Cheney Mountain Shear Zone of the New York Adirondack Mountains. This structure is a region of recrystallized material from the eastern Marcy anorthosite massif in the. Formation of the shear zone is attributed to the collapse of the Grenville Orogeny during the Mesoproterozoic era.

Samples collected are gabbro or granite, commonly with garnet coronas and containing zircon. Many metamorphic and alteration minerals can be found, including: hornblende, clinopyroxene, ilmenite, magnetite, apatite, plagioclase feldspar, and potassium feldspar. Zircon crystals range from small irregular shapes to well-formed large grains. Samples containing a variety of zircon textures were selected for analysis.

Zircon textures were analyzed using backscattered electron imaging and energy-dispersive X-ray spectroscopy , and different generations of zircon were dated using laser ablation mass spectrometry. Additionally, cathodeluminescence (CL) allowed for identification of zoning in zircons (Figure 1). Generally speaking zircons located in the rocks' recrystallized matrix yield a range of ages, expressing both igneous and metamorphic growth, whilst those growing in relation to ilmenite and garnet have more constrained ages and are interpreted as reflecting the metamorphism. Across examined samples, no zoning patterns were observed, however several zircon grains express a CL-dark zone that seems to correlate with metamorphic ages.

Age data collected at Arizona LaserChron Center supports an age of ~1050 Mya as being the maximum age of deformation, with trends seen in zircon grains growing in relation to ilmenite and garnet suggesting a textural relationship to this age. X-ray fluorescence has been performed on select samples to obtain element composition data, but has yet to be considered in conjunction with age data– a potential area of future research.



(Fig 1.) 24AD9A. Cathodeluminescence image of zircon showing 20 µm laser ablation spots.

Research Fellow: Spencer Kidd (2026) **Concentration:** Political Science
Faculty Mentor: Julie Dudrick **Department:** Upstate Institute
Title of Project: Helping the Historical Society Go Digital
Funding Source: Upstate Institute
Project Summary:

This summer I worked with the Chenango County Historical Society located in Norwich, NY to help broaden its accessibility and appeal to a diverse population using the digital space. The museum's digital guide is available through a platform called Bloomberg Connects. I worked on expanding the guide and using it in novel and creative ways to make it more engaging for users. I also concentrated my efforts on seeking out underheard voices in Chenango County through a project called Chenango Stories which aims to chronicle peoples' experiences in a short oral history format.

The beginning of my project was marked by learning and acclimating to the context in which I would be working. It was vital to understand the nuances of the rural Chenango county setting and the mission of the museum within it. There was a large emphasis placed on cultural competency which was particularly pertinent given the fact I would be interacting with a diverse array of people in my pursuit of stories to add to Chenango Stories.

Consistent outreach was crucial to gather candidates to share their oral history. Emails were sent to prospective interviewees who were recommended to me by others. Perhaps more crucially, I attended multiple farmers markets in New Berlin, Pharsalia, and Oxford in order to interact with attendees and share more about the project. I also attended the Chenango County PrideFest in early July in addition to the Chenango County Fair in August. For me to staff a table on behalf of the Historical Society at all of these events was a large boost in public outreach and promoted visibility and interest in the Museum in addition to recruiting potential storytellers.

Once a recording was set up I would conduct it using my computer and a lapel microphone provided. I would then edit the raw audio and clean it up to be succinct and smooth. Posting the story to the website involved creating a transcript for the audio and cover image. I learned how to manipulate the back end of the website and create content in this manner. By the conclusion of my six weeks with the Historical Society I was able to produce ten stories that I had recorded and edited in addition to an exhibit expansion on the digital guide for the temporary exhibit "Creativity in Bloom". The long term goal for the Historical Society is to continue to help it expand its digital presence and market its digital materials more effectively.

Research Fellow: MG King (2027) **Concentration:** Classics

Faculty Mentor: Geoffrey Benson **Department:** Classics

Title of Project: **"Quis nominis umbram horreat?": The Ghastly Power of Shades in Lucan's Pharsalia**

Funding Source: **The Kraynak Institute for the Study of Freedom and Western Traditions (James Madison Fellow)**

Project Summary:

The *Pharsalia (De Bello Civili)* of Marcus Annaeus Lucanus (Lucan) is a historical epic poem which concerns itself with one of the most consequential moments in Roman history: the civil war between Gaius Julius Caesar and Gnaeus Pompeius Magnus. The scope of the poem aligns with the period of time covered in Caesar's own *Comentarii de Bello Civili*, beginning with the crossing of the Rubicon in January of 49 B.C.E. to the death of Pompey and beginning of the Alexandrian War in the autumn of 48 B.C.E. Lucan himself wrote under the emperor Nero (r. 54-68 C.E.). Born in 39 C.E. into the distinguished Annaei family in Spain, Suetonius writes that Lucan eventually became a quaestor and a close acquaintance of Nero until the emperor imposed a ban on Lucan's poetry in 64 C.E. According to Tactitus (Ann. 15.49.3), on account of this ban he became the figurehead of the ill-fated Pisonian Conspiracy to assassinate Nero, and, when exposed, was made to kill himself, reciting lines of his own supposedly-unfinished *Pharsalia* as he did so (Ann. 15.70.1).

The *Pharsalia* is unique among the epic tradition for its abundance of graphic violence and dismemberment, as well as for its very involved narratorial style, boasting nearly two hundred apostrophes. Unusual, too, is the role that umbrae (shades) and manes (spirits) play throughout the poem. Rather than featuring a singular contained moment in which the epic protagonist travels to the underworld to communicate with the dead as in prior epic poems, ghosts haunt the *Pharsalia* throughout. The first shade appears in the poem's opening lines – Crassus, demanding vengeance against his killers, the Parthians (1. 11). Others rapidly follow: Pompey Magnus "stands in the shade of his great name" (stat magni nominis umbra, 1.135); the shades of Sulla and Marius rise from the Campus Martius (1.580-3); Punic shades fight against Curio in Libya (4.788); Sextus Pompey consults the Thessalian witch Erictho to divine the future through the umbrae of Dis (6.433); on the night following the battle, all the phantoms of Pharsalus haunt Caesar's dreams (7.776); the shade of Pompey posthumously plants himself in the hearts of Brutus and Cato (9.15-18).

This paper aims to reconcile the grotesque and dreary imagery of Lucan's poetry with its defiant, subversive narratorial voice. The*Pharsalia*'s landscape of death and desolation does not preclude the deliverance of Lucan's ultimate revolutionary promise: that his retelling of events, not Caesar's, will be what future generations remember of the Civil War. In fact, such a landscape – in which ghosts are central – is necessary in order to achieve this. My argument is structured around the dissection of three main scenes: Caesar in the Massilian lucus (3.399-452), Sextus Pompey in Erichtho's lair (6.413-830), and Caesar at Troy (9.950-99). Applying the frameworks of Freud's unheimlich, Kristeva's abjection, and Derrida's hauntology, I argue for a reading of the poem as such: just as Caesar desecrates the ancient lucus (grove) in Massilia in order to build his ramparts, so too does Lucan, although palpably disgusted with himself and reluctant to write, desecrate the lucus (subject-matter) of Caesar's *Commentarii* and man his ramparts – the poem – with a cast of ghosts and names to which he ascribes meaning. Lucan makes use of his vantage point as a vates (poet-prophet) of the future to become, like his infamous witch Erichtho, a necromancer of the past. The *Pharsalia* is ultimately a claim to the eerie power that his resurrected ghosts and their names wield, a power that will forever be superior to that of Caesarism.

Research Fellow: Sarah Kinnard (2026) **Concentrations:** Middle Eastern and Islamic Studies; Peace and Conflict Studies

Faculty Mentor: Danielle Lupton **Departments:** Political Science; International Relations

Title of Project: Threat Construction During Crises: How Leaders Justify Coercion Abstract

Funding Source: Division of Social Sciences

Project Summary:

The purpose of the research was to create crisis narratives from which a dataset could be compiled on threats and their justifications during crises. These narratives aimed to encompass utterances of threats, ultimatums, demands, and so forth (henceforth referred to as coercion) as well as who issued them, whether they were successful, and the outcome of the crisis. In doing so this would allow for future analysis pertaining to "how leaders justify coercion".

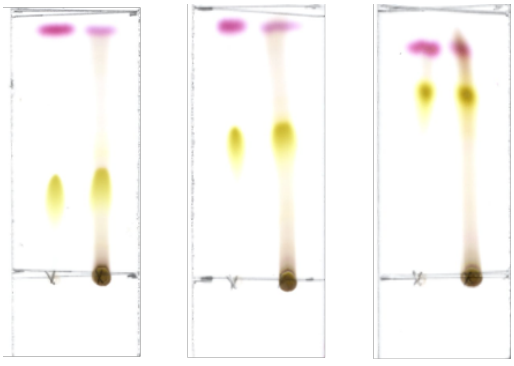
In order to have an established timeline of crisis events and a baseline for which crises had instances of coercion, this research referenced the International Crisis Behaviors project (ICB-e), starting from the post-1945 period. The crisis events detailed by ICB-e were cross-referenced by a team of three research assistants for mentions of coercion, with each individual instance of coercion followed up on once the relevant events were established. Instances of coercion were verified through mean ranging from finding copies of the source documents (i.e 1st-person account, government records, transcripts, etc.) to finding quotations and references in other scholarly sources. Primary sources were given priority, but on the occasion that none were available, these second hand quotations were listed and referenced in the narratives composed. To ensure a thorough scope for future work with this research material, all such sources were referenced that were found by our team. When coercion was noted to have occurred in ICB-e's dataset, but sources were unable to be located by our team, this was similarly noted. Such instances do not discount the validity of the original dataset, but may indicate that sources pertaining to these instances are more difficult to access. This research was conducted primarily through search engines like Google, Google Scholar, the university library, JSTOR, and so on for reputable sources of an archival or scholarly nature.

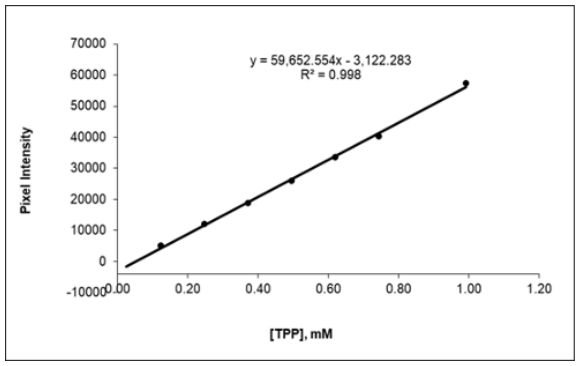
Research Fellow: **Jordan Lazaar (2026)** **Concentration:** **Chemistry**
Faculty Mentor: **Rick Geier** **Department:** **Chemistry**
Title of Project: **Development of a TLC Method for Monitoring Reactions Leading to Mixtures of Porphyrinoids, and Comparison to UV-vis and HPLC Methods**
Funding Source: **John C. Cochran Endowed Fund for Undergraduate Research**
Project Summary:

Porphyrins are a family of compounds of biological, fundamental, and commercial significance. Key to the study of porphyrins is the discovery of efficient methods for their synthesis. To refine reaction conditions, several reaction parameters often need to be examined which can require a large number of reactions. To do so efficiently, reactions are performed on the analytical scale which requires methods for assessing yield from small aliquots. Previously, UV-vis and HPLC have been used, but each method has weaknesses. To overcome some of these weaknesses, our group has been exploring the quantitative application of thin layer chromatography (TLC). TLC is simple, rapid, low cost, and does not require specialized equipment. While quantitative TLC has been applied to studies of other reactions, it has yet to be extended to porphyrin forming reactions. Key items to explore pertain to accuracy, sensitivity, reproducibility, applicability to mixtures.

Previously, we investigated a TLC method for the analysis of only TPP. This work involved control/reproducibility experiments for the digitization and image analysis of TLC plates, calibrating integrated pixel intensity for the concentration of TPP, and performing comparative analyses of samples from reaction mixtures using UV-vis, HPLC, and TLC.

This summer, we extended the analysis to include NC-TPP. This involved determining a suitable TLC condition to separate TPP, NC-TPP and other impurities. Using the selected TLC conditions, we then conducted control/reproducibility experiments and pixel intensity calibrations for TPP and NC-TPP, along with HPLC detector response calibrations for TPP and NC-TPP. Finally, we examined crude reaction mixtures from trial reactions, and compared yields of TPP and NC-TPP determined by UV-vis, HPLC, and TLC.





Research Fellow: **Jessica Lee (2027)** **Concentrations:** **Environmental Studies; Biology**

Faculty Mentor: **Julie Dudrick** **Department:** **Upstate Institute**

Title of Project: **Thriving Together: Advancing Adirondack Pollinator Conservation Through Research, Restoration, and Community Engagement**

Funding Source: **Upstate Institute**

Project Summary:

The Adirondack Park is known for its remarkable environment and ecology, while the Champlain Valley within it has a strong agricultural presence. Both depend on pollinators, which nationally are threatened by pesticides, disease, parasites, habitat loss, poor management of non-native colonies, and climate change. These threats exist in the Adirondacks as well, but the region lacks data on what pollinators are present and where. Without clear targets, conservation efforts are difficult. To address this, AdkAction collaborates with Paul Smith's College, Northern New York Audubon, and the Wild Center on the Adirondack Pollinator Project, which expands pollinator habitat and data. As an intern, I worked on a Capped Landfill Reclamation Project in Indian Lake and helped enhance the project's community science initiative to raise awareness and expand research-grade data.

Because clay-capped landfills cannot support forest regrowth, AdkAction secured a DEC grant to transform the eight-acre Indian Lake landfill into an ADA-accessible pollinator garden with native plants. Perennial groundcover species such as sweet goldenrod, beebalm, and blue flag iris were chosen for their pollinator value, shallow roots, and light weight. I collaborated with an ecologist to plant test plots in varied microenvironments, monitored species success, and provided data-based recommendations to guide future phases of the three-year project. I also designed a baseline pollinator assessment for comparison with 2025 test plots and partnered with Indian Lake Central School to link students with the project.

For the community science effort, I identified major data gaps across the park and targeted recreationists as key participants. Through trail interviews, I found strong interest in iNaturalist programming, especially as a personal learning opportunity. I then partnered with trail systems and ecology programs across the park to integrate pollinator monitoring into their operations. Together, we began developing initiatives to increase education, expand data collection, ensure accessibility, align with partner missions, and allocate resources effectively. These efforts will grow pollinator data for scientists while engaging residents and visitors in meaningful, hands-on conservation.

Research Fellow: **Alec Lehtman (2027)** **Concentration:** **Environmental Studies**

Faculty Mentor: **Julie Dudrick** **Department:** **Upstate Institute**

Title of Project: **Laying the Groundwork for a Regional Economic Analysis: Small Business Trends and Gaps in the North Country**

Funding Source: **Upstate Institute**

Project Summary:

This research project supports the Adirondack North Country Association's (ANCA's) regional economic analysis by identifying structural gaps, challenges, and opportunities in the small business ecosystem of Northern New York's rural counties. Using 5-year estimate data from the Annual Business Survey and American Community Survey, the research highlights six priority areas where the region significantly diverges from state and national trends. These themes, ranging from business succession risk to disparities in capital access, were further explored through qualitative interviews with eight regional stakeholders. The combination of data and insights from local non-profit leaders and business owners grounds the findings in economic data and on-the-ground reality.

The research revealed several key challenges facing the small business ecosystem in the North Country. First, business succession risk is pronounced as more than 60% of business owners in ANCA counties are over the age of 55 and many lack a transition plan, especially in family-owned businesses, which are more prevalent in ANCA counties than statewide or nationally. Second, access to capital emerged as a persistent barrier, with many entrepreneurs and non-profit leaders reporting difficulty securing startup or growth financing. Third, demographic and cultural dynamics are important to observe as veteran-owned businesses are significantly overrepresented in the region, and immigrant, disabled, and tribal entrepreneurs often face unique hurdles ranging from language barriers to culturally responsive support. Finally, the educational profile of business owners skews toward trade credentials and lived experience rather than formal degrees, suggesting a need for more targeted technical training in finance, operations, and business planning.

This work positions ANCA to advance solutions in areas such as ownership transitions, succession planning, flexible lending models, and culturally specific support for entrepreneurs. It also points to strategic directions for future analysis such as identifying underserved business communities and aligning workforce training with sector strengths like agriculture, trades, and small-scale manufacturing. Through grounding regional strategy in data and local insight, the research lays the foundation for more targeted investment and inclusive economic development in the North Country.

Research Fellow: **Matt Leopold (2026)** **Concentration:** **Molecular Biology**

Faculty Mentor: **Eddie Watkins** **Department:** **Biology**

Title of Project: **Exploring the Influence of Polyploidy in Hybrid Wood Ferns**

Funding Source: **Division of Natural Sciences and Mathematics**

Project Summary:

This study aims to elucidate the comparative ecophysiology of hybrid wood ferns by measuring the effects of polyploidy on plant functional traits over time. We investigated how physiological and morphological characteristics of diploid and tetraploid ferns, as well as their sterile triploid hybrid, change over the course of the growing season. We conducted this investigation using three members of the Dryopteris Wood Fern species; *Dryopteris xbootii,* a sterile triploid hybrid that is common in forested wetlands: *Dryopteris cristata*, a tetraploid wetland endemic and *Dryopteris intermedia*, a diploid widespread forest-wetland taxon. We measured and compared the photosynthetic rates, respiration rates, intercellular CO_2 concentrations, and conductance of ten plants per species at three time points over the course of the growing season using a Licor 6400-XT. In addition, we measured and compared stomatal density, stomatal size, and the plant's nutrients by testing for their stable isotopes.

Our findings suggest that time across the growing season plays a stronger role in driving physiological change than species identity. However, when species-level differences were significant, the traits of the sterile-triploid hybrid were often more closely aligned with the tetraploid rather than the diploid parent. We found that the photosynthetic rates of *Dryopteris xBootii* and *Dryopteris Cristata* exhibited similar patterns of change over the growing season in comparison to the lower and more static rates of *Dryopteris Intermedia*. Further observations of the traits that were measured suggest that stomatal conductance may drive the initial increase in photosynthetic rate from the early season to the middle of the season, as the plant works to meet the carbon and nitrogen demands of spore production. The decreasing trend in photosynthetic rate from the middle of the season to the end of the season could be driven by nitrogen reallocation from the leaves to the rhizomes to support the development of new fronds in the following growing season.

Photosynthesis vs. Date by Species Conductance vs. Date by Species %N vs. Date by Species

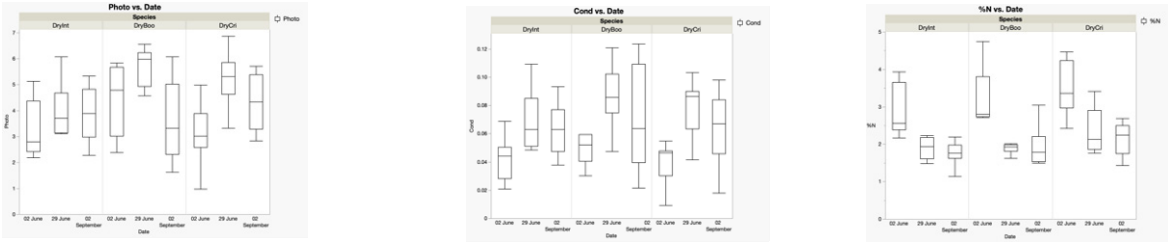


Figure 1. graph of relationship between photosynthesis (left), conductance (middle), and %N (right) vs. date across species

Research Fellows: **Emma Lewis (2025)** — **Concentrations: Biology; French**
Meredith Shapiro (2028) — **Concentration: Undeclared**
Allison Wen (2028) — **Concentration: Undeclared**
Faculty Mentors: **Paul Harnik** — **Department: Earth and Environmental Geosciences**
Rebecca Metzler — **Department: Physics and Astronomy**

Title of Project: **Microstructure and Genetic Differences of *Nucula proxima* across Coastal Regions of North America**

Funding Source: **Picker Interdisciplinary Science Institute; Bob Linsley/James McLelland Fund; Hackett-Rathmell 1968 Memorial Fund**

Project Summary:

Anthropogenic climate change is affecting oceans globally. Coastal regions of North America are currently experiencing a variety of changes in water conditions, including rising sea surface temperatures (SSTs), which can impact biomineralization and genetic diversity. To understand the impacts of a changing climate on coastal organisms, we investigated changes in the shell microstructure and population genetics of *N. proxima* geographically and over time. *N. proxima* is a small deposit-feeding bivalve found in the Gulf of Mexico and the western Atlantic. Their innermost layer is made up of calcium carbonate nacre tablets, which can act as a proxy for environmental factors (e.g., temperature) at the sites where the organism grew, since these factors affect nacre tablet thickness. The nacre layer also has organic material present between crystal tablets, within which genetic material can be preserved, making *N. proxima* a good study specimen for extracting DNA from shell material, which can be used to assess genetic diversity among populations to provide insight into population health and gene flow.

Previous studies found that warmer SST positively correlated with thicker nacre tablets. Thus, we hypothesized that *N. proxima* that grew in warmer waters of the Gulf of Mexico, or were live-collected, would have thicker tablets than those from cooler locations and/or older time periods. In our research, we considered the organism's life stage, whether it was collected live or dead, and the temperature of the marine environment, and how these might impact nacre tablet thickness (TT). We first assessed TT variability throughout *N. proxima*'s life and found no significant ontogenetic trends; despite this, for consistency, we collected TT data at the growth edge for all subsequent specimens. We then compared TT of dead-collected *N. proxima* from Alabama (AL), Florida (FL), and Louisiana (LA) and found shells from cooler sites (LA) had the smallest median TT, and those from the warmest sites (FL) had the largest median TT, consistent with our hypothesis. We then compared the TT of live- versus dead-collected *N. proxima* in AL and FL. However, contrary to our hypothesis, we found in AL, the median TT was greater for live versus dead, whereas the opposite was true for FL.

To assess population differences across environmental conditions, we extracted DNA from *N. proxima* specimens. We isolated and amplified the mitochondrial COI gene due to its abundance and the diversity encapsulated within the DNA sequence. We compared the sequences of specimens we collected from AL and FL with those of specimens sent to us from Maine (ME) and New York (NY), plus sequences from the Chesapeake Bay and New Brunswick, Canada taken from an online database (GenBank). We found that populations from FL, the Chesapeake, and NY were more closely related to each other than to populations from AL, which showed a slightly closer relationship to the two specimens from ME and New Brunswick (Fig 2). The genetic similarities between specimens from FL, the Chesapeake, and NY are interesting considering FL's proximity to the AL collection sites, which suggests that environmental conditions may hinder gene flow between these adjacent populations. The relationship between the ME and New Brunswick specimens with the AL specimens is more unexpected and requires further analysis.

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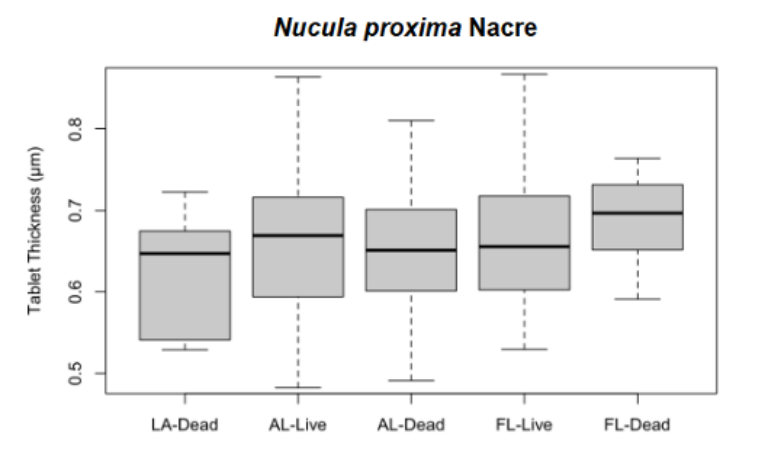


Figure 1: TT (µm) of N. proxima across LA, AL, and FL for dead-collected and live-collected specimens.

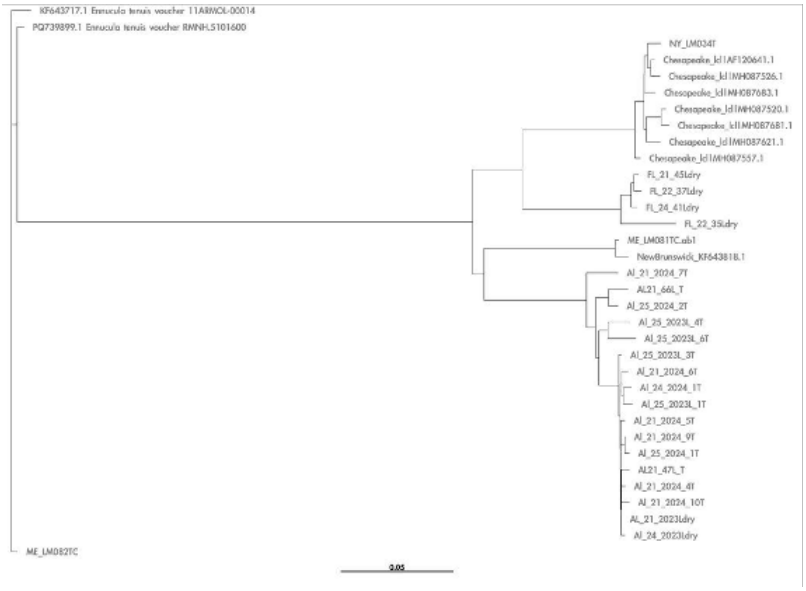


Figure 2: Phylogenetic tree showing genetic relationships between N. proxima across collection sites, with Ennucula tenuis outgroups. Branch length represents percent change in the DNA sequence between specimens, determined by the number of base pair differences.

Research Fellow: **Jiongchen Li (2027)** **Concentration:** **Philosophy**
Faculty Mentor: **Jing Wang** **Department:** **East Asian Languages and Literatures**
Title of Project: **Joseph Needham's Early Scientific Work and Its Role in Shaping a Global History of Science**
Funding Source: **Division of Arts and Humanities**
Project Summary:

This summer, my research focused on how Joseph Needham (1900-1995)'s early work in biology and biochemistry laid the intellectual groundwork for his later contributions to the comparative history of science, particularly his focus on China. Needham demonstrated a remarkable capacity to draw connections between biological systems and human society in his scientific writings, from technical studies in embryology to philosophical reflections on life and organization. He saw analogies between the self-organizing tendencies of simple organisms and the evolutionary trajectory of human civilization, proposing that societies, like living beings, strive toward higher levels of integration and complexity.

Rooted in his training as a biochemist, Needham's worldview emphasized the interconnectedness of knowledge and the value of integrating insights across disciplines. Rather than isolating science from its cultural and historical contexts, Needham approached it as an evolving, global phenomenon shaped by diverse civilizations. His ability to synthesize insights from biology, sociology, philosophy, and history allowed him to challenge Eurocentric narratives and reframe science as a culturally embedded human activity. These intellectual qualities, his interdisciplinarity, cultural openness, and synthetic method, were instrumental in shaping his landmark project, *Science and Civilisation in China,* which continues to influence how scholars understand the development of science across cultures.

In addition to studying Needham's early writings, I also explored his contemporary legacy through an extensive review of secondary literature. This exploration revealed a legacy that is dynamic, multifaceted, and actively debated. Scholars continue to engage with his work from a range of perspectives, reflecting both deep admiration and critical scrutiny. While some build upon and expand his comparative framework, others critique its limitations, whether for its teleological assumptions, Eurocentric framing, or methodological challenges. This diversity of perspectives reflects the enduring relevance of Needham's work and underscores the evolving nature of the history of science as a field of study.

Overall, this research deepened my understanding of how disciplinary boundaries can be transcended to produce more holistic approaches to scientific and historical inquiry. Studying Needham's work not only illuminated the intellectual foundations of *Science and Civilisation in China*, but also offered a broader model for thinking across cultures, disciplines, and times.

Research Fellows: Yangqi Li (2028) — **Concentration:** Undeclared
Delaney Lobell (2026) — **Concentration:** Psychological Science
Natalie Woodson (2026) — **Concentration:** Psychological Science
Faculty Mentor: Lauren Philbrook — **Department:** Psychological and Brain Sciences

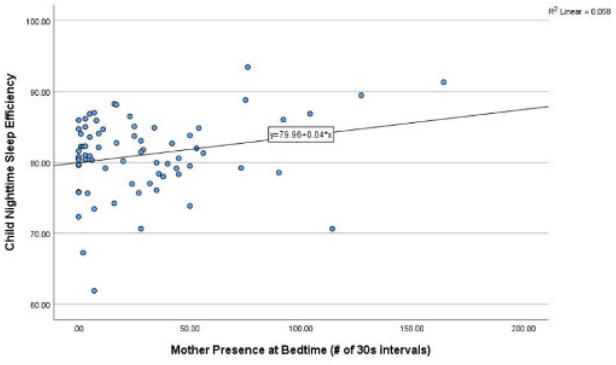
Title of Project: The Role of Neighborhood and Family Contexts in Children's Sleep

Funding Source: Division of Natural Sciences and Mathematics: Mind, Brain, and Behavior Summer Grant

Project Summary:

The goal of the Summer 2025 iteration of this study is to identify neighborhood and family factors that affect how well 3-5 y.o.children sleep in hopes of informing researchers, and ultimately, families, ways to improve children's sleep since healthy sleep is strongly associated with academic and behavioral outcomes.

Factors such as neighborhood danger are measured with self-reported surveys by parents, while family factors are measured by observing nighttime routines and logging certain occurrences/practices that may arouse/soothe children. After being logged, all data is analyzed and tested for correlations through SPSS. Sleep quality is measured with a motion-sensing watch (Actiwatch), and defined using 4 variables, Minutes (time asleep), Latency (time taken to fall asleep), Efficiency (ratio of sleep to time in bed), and Wake After Sleep Onset (WASO, total time awake after start of sleep). Different variables may be analyzed with different factors to discover new implications. For example, this iteration of the study found several significant correlations, such as between maternal presence and sleep efficiency (shown below). Due to a temporarily small sample size (n=84) the correlation seems weak, but it suggests that when the mother is present longer, children tend to have more efficient sleep.



Other significant correlations include, but are not limited to, positive correlations between lack of neighborhood safety and sleep latency (implying that children take longer to sleep when they don't feel safe), TV and WASO (indicating that children were more restless after screentime), and most curiously between sharing the bed with a sibling and sleep latency. This last correlation is an interesting finding because, upon cross-examining the effects of two factors—sibling quiet activities and neighborhood danger—on children's sleep latency, it was discovered that the effects of sibling quiet activities mitigates the effects of neighborhood danger (see to the right).

Future iterations of the study will analyze cortisol samples taken from participants to further understand the relationship between aforementioned factors and sleep quality/ stress, and a longitudinal study is currently being conducted to track the effects of sleep on cognitive development.

Research Fellow: **Zach Lightfoot (2026)** **Concentration:** **Biology**

Faculty Mentor: **Damhnait McHugh** **Department:** **Biology**

Title of Project: **Geneic Analysis of a Soil Dwelling Species Introduced from France to Ireland: An Interdisciplinary Research Opportunity in Spain**

Funding Source: **Division of Natural Sciences and Mathematics**

Project Summary:

Pablo Vivas Rivera and I collaborated with researchers and graduate students at the Complutense University of Madrid on their projects investigating the reproductive cycle, taxonomy, and genetics of multiple species of earthworms. In managing the university's worm cultivars, we prepared worm habitats for experiments with varying humidity and temperature to determine the effects on life cycle and reproduction and the worms' ability to adapt to harsher environmental conditions. Additionally, we recorded changes in weight, signs of reproductive maturity, and fertilized eggs laid.

For genetic experiments, we extracted DNA and RNA from tissue samples. The DNA we amplified via PCR for double digest restriction-site associated DNA sequencing (ddRADseq), a sequencing technique that uses two different enzymes to create DNA fragments of different sizes that can be traced back to specific individuals, allowing multiple specimens to be sequenced at once. For the RNA, , we determineddifferences in RNA expression across individuals, treatments, and populations. Finally, we learned to perform genome wide association studies (GWAS) to identify relationships between identifiable traits and segments of the genome, to construct DeNovo assemblies (a technique allowing researchers to reconstruct a DNA sequence without a known genome for reference), and to map the phylogenetic relationships of a species's populations within the Iberian peninsula.

The data we collected was incorporated into on-going projects at UCM. Over the course of our research, we found new evidence for parthenogenesis in a species it had not been recorded in previously. We also found evidence for multiple closely-related earthworm species cohabitating at various sites. Our data also expanded upon the biogeographical database for the species Prosellodrilus amplisetosus, an earthworm species native to France and invasive to Ireland. Our data will help allow the team to identify how P. amplisetosus arrived in Ireland and how it has adapted to the remarkably different climate found there.

Research Fellow: **Jiayi Liu (2026)** **Concentration:** **Chemistry**
Faculty Mentor: **Gongfang Hu** **Department:** **Chemistry**
Title of Project: **Catalytic Aldol Reactions of Aldehyde and Methyl Isocyanoacetate Using Bismuth–Group 10 Metal Bimetallic Complexes**
Funding Source: **Division of Natural Sciences and Mathematics**
Project Summary:

Bismuth, known as the heaviest element with low toxicity and low cost, has been used in a growing number of applications in catalysts. While bismuth(III) compounds have been used as Lewis acids in catalytic reactions, their impacts on transition metal centers when resided in the primary coordination sphere remain underexplored. We hypothesized that the Bi ligand would increase the Lewis acidity of the Pd center, promoting its effectiveness as ab Lewis-acid catalyst in this reaction. In this study, we investigated the aldol reaction between aldehydes and methyl isocyanoacetate catalyzed by a series of bimetallic palladium complexes featuring a tridentate biphosphine–bismuthinide (PBiP) ligand. The studied complexes mediated the aldol reaction at room temperature at a rate more than 20 times faster than the literature examples under the same condition. Experiments on the substrate scope and the effects of counterions, bases, and solvents were also carried out. In-depth mechanistic investigations to reveal the role of bismuth are in progress. A comprehensive screening study was conducted to investigate the effects of different solvents, bases, counterions, and aldehyde substrates on the catalytic performance. Base screening indicated that the presence of a moderately strong base is essential for high yield, while weaker bases gave substantially lower yields. Counterion effect screening showed that chloride anions play a key role in the catalytic cycle. Substrate screening demonstrated that both electron-donating and electron-withdrawing substituents on the aldehyde can give good yields, although aldehydes with lower electron-delocalization ability, still underwent the aldol reaction but with reduced efficiency.

Research Fellow: Matthew Liu (2027) **Concentrations:** Computer Science; Mathematics
Faculty Mentor: Silvia Jimenez Bolaños **Department:** Mathematics
Title of Project: Homogenization of Second-Order Elliptic PDEs
Funding Source: Division of Natural Sciences and Mathematics
Project Summary:

Homogenization theory provides a framework to analyze materials with complex microstructures—like composites formed from multiple constituent substances. Instead of modeling every microscopic detail, this theory enables scientists and engineers to approximate the material as an effectively uniform, or "homogeneous", medium at the macroscopic scale. In essence, it is similar to zooming out from a detailed pattern until it becomes a smooth, continuous whole. This simplifies the prediction of a material's overall behavior, replacing the need to model its underlying internal structure. This theory is critical in materials science, where many advanced materials, such as carbon fiber, foams, or reinforced concrete, are composed of combinations of different substances. Understanding how these mixtures respond to pressure, heat, or stress is essential for applications ranging from aerospace engineering to sports equipment.

Homogenization allows researchers to efficiently estimate key material properties, including strength, flexibility, or conductivity, thereby reducing the need for exhaustive experimental testing and accelerating the design and development process. Building on this foundation, our work focuses on applying homogenization theory to the wave equation, a fundamental partial differential equation capturing the propagation of sound waves, light, and other physical disturbances. When waves travel through materials with microscopic structures, their behavior is not only influenced by the average properties of materials but also by interactions with the microscopic structure. By deriving a homogenized model for wave propagation, we aim to capture these effects in a simplified yet accurate form.
For simplicity, we investigate the behavior of the wave equation when each unit cell contains a central hole surrounded by material. The solution can be extended by zero into the region occupied by the hole, with boundaries subject to a mix of Neumann and Dirichlet conditions. We use the asymptotic expansion method, assuming that the solution depends on both macroscopic and microscopic scales:

$$u(x,y) = u_0(x,y) + \epsilon u_1(x,y) + \epsilon^2 u_2(x,y) + \ldots,$$

where $y = x/\epsilon$ represents the microscopic variable. Substituting into the equation and matching terms yields the equation:

$$-\nabla \cdot (\nabla A^{\text{eff}} u_0(x)) = \omega^2 \theta u_0(x)$$

where A^{eff} is the homogenized coefficient matrix, ω is the external frequency, and θ is the volume fraction of the material. We further validated the result using the two-scale convergence method. Compactness results in H^1 ensures convergence of the gradient, allowing a variational formulation posed in the product space $H^1(\Omega) \times L^2(\Omega; W_{per}(Y))$. Choosing specially constructed test functions and using the compactness results above, we derive a system that captures both the periodic cell problem and a homogenized partial differential equation with an explicitly computed effective tensor A^{eff}. This confirms the asymptotic expansion and provides a systematic path to the homogenized equation without explicitly constructing oscillatory functions.

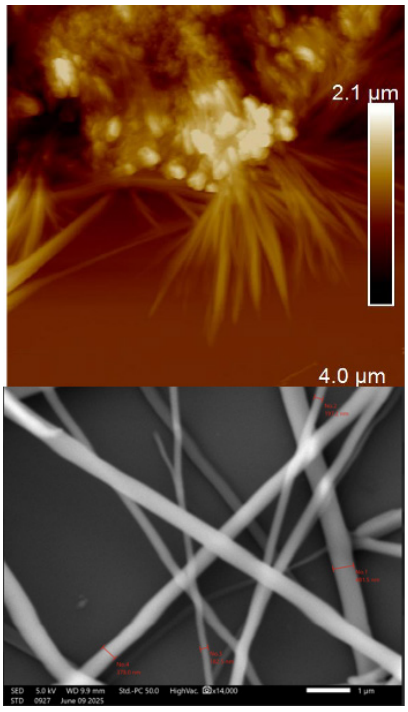
Research Fellow: **Jackson Lowell (2027)** **Concentration:** **Physics**
Faculty Mentor: **Ramesh Adhikari** **Department:** **Physics and Astronomy**
Title of Project: **Characterization of Electronic Properties of Peptide Nanowires**
Funding Source: **Division of Natural Sciences and Mathematics**
Project Summary:

This summer I worked with amino acids, the building blocks of proteins, and ran several experiments on them to try and understand how they transport charges in response to applied voltages. I would add these to a solution (typically, water) and then allow them to dry on a clean surface. Once dried, nanowires would appear on the surface. These nanowires are nanoscale rods that form under specific conditions. Certain temperatures, humidities, and pressures allow the amino acids to link together repeatedly and form these "wires".

During my first two weeks, I was practicing using lots of new lab equipment. I got familiar with the probe station with a microscope where I did a lot of our work. This setup included tiny metal needles underneath an optical microscope that we then attached to different things such as leaves or electrodes. These probes were then used to send electricity and measure how it flows through. At this station we measured current, voltage, and impedance.

AFM -50% PEDOT-Fucoidian, 50% 17mg/mL solution of L-Phe in DI water

I also used Atomic Force Microscope (AFM) to take images of things one cannot see under an optical l microscope. This machine has a probe that gets so close to samples that the atoms of the sample and the atoms on the probe start to repel each other. This force is then measured and mapped out onto images like the one shown in Figure 1. The white lines protruding from the bottom are clusters of nanowires. Another microscope I used this summer was the Scanning Electron Microscope (SEM). This machine uses an electron gun to fire electrons at the sample surface and then uses detectors to observe how these electrons bounce off. This machine does not have as high of a resolution as the AFM, but is much quicker.



SEM -L-diphenylalanine Nanowires (FF-2 sample)

Beyond the microscopes, I used many things to create these nanowires in the first place. A major part of this process was keeping the surfaces that they form on clean. We would use silicon wafers or glass as substrates, with electrodes made of platinum or gold to make electrical measurement on the nanowires. These substrates were no more than 1cm^2, making them challenging to work with. For instance, their size made using tweezers or other tools to hold the substrates more difficult and took some getting used to. I used hot plates to dry samples or heat them for cleaning. A more effective drying method was using the vacuum oven that allowed us to evaporate the water more quickly without changing temperature. I also used basic cleaning chemicals such as acetone and isopropanol under the fume hood. Another thing we used to clean surfaces was the UV Ozone cleaner. This helps remove organic materials from the surface, but also makes it extremely hydrophilic, meaning any moisture in the air could gather and throw off our measurements.

Research Fellow: Kajol Luplunge (2028) **Concentration:** Undeclared
Faculty Mentor: Wan-chun Liu **Department:** Psychological and Brain Sciences
Title of Project: Co-Song Gestures on Birds
Funding Source: Division of Natural Sciences and Mathematics
Project Summary:

Birdsong is a central mode of avian communication. Mounting evidence suggests that birdsongs are accompanied by physical gestures that enhance their communication. Our study during summer examined the coordination of vocal production and lateral head movements (LHM) in zebra finches. Additionally, we performed playback experiments to test the functional relevance of co-song gestures on the female birds.

For the first component, we used BORIS to code the LHMs of various male finches. Their songs were also analysed using Sound Analysis Pro (SAP) to quantify the acoustic features such as amplitude, and variance. We utilized Raven to segment the songs into several syllables distinguished by their difference in amplitude, at least 5 ms of silence in between and repetition across the song period. By matching LHM data with the SAP analyses, we observed that head movements were often aligned with syllables of higher structural complexity.

Pur341

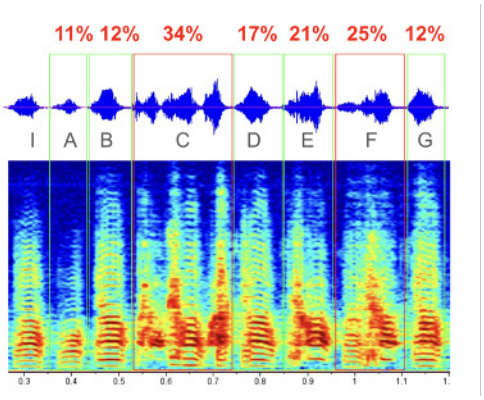


Fig.1: Syllable segmentation of bird-song using Raven

To test if the synchronization of co-song gestures influences mate perception, we conducted playback experiments with 12 virgin and experienced females. We used two ipads that presented video-audio song recordings of several male finches. One of the videos would be intentionally delayed so that the audio played before the gesture occurred while the other one had it normal. iPads were randomly placed on either side of the cage. We observed female behaviors such as side preference (left or right), perch use locomotor activity and head movements to assess their interest in the delayed/normal male. We predicted that female finches would prefer the non-delayed condition and consistent with the hypothesis that the alignment of co-song gestures enhance male attractiveness. However, our experiment did not gather enough strong evidence to support the prediction. Birds took 3-5 days to adjust to the new environment to be able to react well. Moreover, we also observed that they needed familiarity with the experiment.

To conclude, our research focused on the multimodal function of co-song gestures on zebra finches which offers insights into the mechanisms of mate attraction and the evolution of avian communication systems.

Research Fellow: **Lulu Manco-Stenz (2026)** **Concentrations:** **Sociology; Environmental Studies**

Faculty Mentor: **Julie Dudrick** **Department:** **Upstate Institute**

Title of Project: **Researching the Role of Community Science in Pollinator Habitat Restoration at Rogers Environmental Education Center**

Funding Source: **Upstate Institute**

Project Summary:

Rogers Environmental Education Center, located in Sherburne, New York, is the oldest environmental education center in New York State. Since 2011, the non-profit Friends of Rogers has operated the center. Rogers is home to 600 acres of diverse ecosystems, including wetlands, pine forests, and farm fields. Rogers offers a variety of educational programs and volunteer opportunities for people of all ages, backgrounds, and abilities. Rogers Center has worked with the Upstate Institute for the past three summers, hosting a Colgate student to serve as the B-Team Community Science Project Lead. The B-Team was a survey to collect baseline data on native bee populations across Central New York. This project utilized a community science framework, which involves public participation in creating scientific knowledge and collecting data.

The research goals of the summer 2025 fellowship with Rogers Center were to advance the existing community science programming at Rogers, increase community engagement, and work in the field to identify pollinator species. In June 2025, Rogers was awarded $254,000 in grant funding from the New York Community Trust's New York Pollinator Conservation Fund. This generous funding will be transformative for Rogers throughout the next two years, and the Upstate fellow plays a crucial role in guiding the pollinator habitat restoration made possible by this grant.

To achieve these goals, my research focused on three actions. The first was altering the scope of the B-Team Project. Building on three years of community participation in the B-Team, I created a new community science project. The Great Pollinator Project: Rogers Center Survey expands the focus species to all native pollinators, but limits the geographic range to Rogers Center's 600 acres of public lands. Like previous iterations of community science at Rogers, the project operates through iNaturalist, a free and intuitive application for recording and mapping observations. To promote the project, I created a brochure and a pocket field guide. The second objective was to create mockups of interpretive signage to place at pollinator habitat plots. I researched and wrote about pollinator species, then designed three interpretive signs to educate visitors about the pollinator habitat restoration taking place at Rogers. Finally, each day I explored the ecosystems at Rogers in search of pollinator species. My field observations will guide Rogers Center's habitat restoration. An additional part of my fellowship was advancing the relationship between Rogers Center and the surrounding Indigenous communities, namely the Onyota'a:ka (Oneida People). I designed volunteer experiences that embraced the Indigenous worldview, led volunteer groups, and drafted an indigenous Engagement plan to guide future actions.

My role at Rogers was crucial to the longevity of community science at Rogers Center. The physical materials I developed ensure that future staff can easily pick up the work and continue teaching visitors and volunteers about the importance of pollinators and Rogers-specific initiatives. Additionally, the work I did to adapt the project to encompass all pollinator species will shape habitat restoration at Rogers Environmental Education Center for the next two years.

Research Fellows: **Benjamin Marks (2027)** **Concentration:** **Molecular Biology**

Faculty Mentor: **Bineyam Taye** **Departments: Biology; Global Public and Environmental Health**

Title of Project: **Co-infection with G. lamblia, C. parvum, and E. histolytica disrupts gut microbial diversity and enriches specific bacterial taxa in school-aged children.**

Funding Source: **Michael J. Wolk '60 Heart Foundation**

Project Summary:

Intestinal protozoan infections are a major yet underappreciated global health problem. In low-resource tropical regions, they cause widespread illness, particularly among children. More than 500 million people worldwide are infected, with three parasites–*Giardia lamblia, Entamoeba histolytica, and Cryptosporidium parvum*–responsible for much of this burden. While their clinical impacts are well known, much less is understood about how these protozoa interact with the gut microbiome–a dense, dynamic microbial ecosystem essential for digestion, immune function, and disease resistance. Sharing the same intestinal niche creates opportunities for these parasites to influence gut microbial composition and function, with effects that may extend beyond infection. Because co-infections are common in endemic settings, understanding how multiple protozoa collectively affect gut health is critical. Despite their clinical relevance, protozoan co-infections and their consequences for the gut microbiota remain poorly studied. To investigate this, we analyzed stool samples from 57 Ethiopian schoolchildren to assess how co-infections with *E. histolytica, G. lamblia*, and *C. parvum* affect gut microbial diversity and composition. Parasites were identified by quantitative PCR, and bacterial communities profiled via 16S rRNA sequencing. Single infections had little impact on the gut microbiota, except for *C. parvum,* which altered community structure. Co-infection with *G. lamblia* and *C. parvum* increased bacterial diversity and produced distinct microbial profiles, while triple infection enriched five taxa (*Prevotella, Prevotellaceae, Lachnospiraceae, Erysipelotrichaceae, Solobacterium*). A genus-level machine learning model accurately predicted G. lamblia infection (AUC = 0.75; balanced accuracy = 75%), with top predictors matching taxa altered during infection (*Muribaculaceae, Haemophilus, Erysipelotrichaceae* UCG-008) (Fig. 1). These findings show protozoan co-infections disrupt gut microbial diversity and composition more than single infections, underscoring the need to study parasites within their shared intestinal ecosystem.

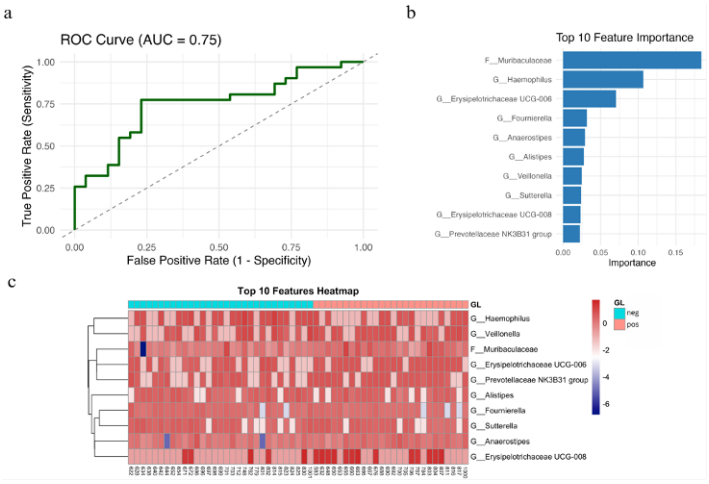


Figure 1. Predictive modeling of G. lamblia (GL) infection status using genus-level gut microbiome composition. (a) The ROC curve shows the performance of a 10-fold cross-validated XGBoost classifier in a study population of 57 participants, achieving a balanced accuracy of 75% and an AUC of 0.75 (b) A bar plot highlights the top 10 most important features identified by the final XGBoost model. (c) A heatmap displays the CLR-transformedabundances of these top 10 features, comparing *G. lamblia*-infected and non-infected individuals.

Research Fellow: Avery Mathews (2027) **Concentration:** Environmental Geology
Faculty Mentors: Paul Harnik **Department:** Earth and Environmental Geosciences
Rebecca Metzler **Department:** Physics and Astronomy
Title of Project: Impact of Ocean Warming on Seafloor Communities: Initiating a Conservation Paleobiology Study in the Gulf of Maine
Funding Source: Doug Rankin '53 Endowment-Geology Research
Project Summary:

The Gulf of Maine is rapidly warming due to anthropogenic climate change. As a result of this warming, processes such as ocean acidification and deoxygenation are becoming increasingly prevalent. My research aims to understand the impact of warming waters on the Gulf of Maine's marine communities.

To address this, the Paleo Lab partnered with benthic (seafloor) scientists from Maine's Department of Marine Resources (DMR) to conduct field work and accelerate our initial data collection process. We participated in two off-shore days in Casco Bay, Maine where we helped to collect over forty grab samples. Back in the lab, I sieved sediment samples and separated the live-collected invertebrates from the dead-collected shell fragments. I used 0.5 mm and 2 mm sieves to develop a better understanding of how species abundance varied among size classes. I then used a light microscope to collect preliminary data on species composition, richness, abundance, and shell preservation (Figure 1). I took photographs of each taxonomic group I encountered in order to build an initial biodiversity database for the Maine samples. Shell fragments, rocks, and articulated bivalves were then sorted and stored for later analysis.

To reduce potential post-mortem bias, I collected abundance data by only counting shells with intact umbos; the "umbo" is the rounded area near the hinge line of a shell. This helped to eliminate the double-counting of shell fragments from the same individual organism. I recorded the number of live bivalves and dead bivalve umbos to compare the abundance of live and historical dead individuals in each sample. In total, I processed 133 samples which were collected, on average, at a depth of 33.45 meters below sea level. The maximum water depth was 155 meters, with a minimum depth of 0mm. I found that shell preservation was often associated with sediment composition and water depth. Sandy samples often had larger shell fragments, more complete shells, a greater abundance of shells, and a greater diversity of species. Most clay samples had no shell material > 2 mm.

The emerging field of conservation paleobiology is making an increased effort to build community-based research partnerships. The Paleo lab is thrilled to be collaborating with scientists from Maine's Department of Marine Resources to engage in meaningful, community-relevant, climate change research. As anthropogenic climate change continues to impact the Gulf of Maine, there is an increased need for scientists and community partners to work together as equal contributors to the research process. As I continue my research, I hope to further connect our work to community scientists and partners from the coastal Maine region by enriching the Gulf of Maine coastal biodiversity database.

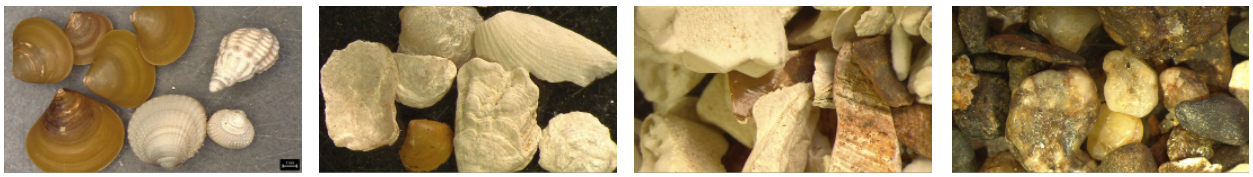


Figure 1: Seafloor sample (GOME2) imaged using a stereomicroscope (Leica M125). From left to right: articulated bivalves and a snail shell; bivalve umbos; shell fragments lacking umbos; rocks. Note, 1mm scale in lower right corner.

Research Fellow: Jordan Maxham (2026) **Concentration:** Political Science

Faculty Mentor: Dominika Koter **Department:** Political Science

Title of Project: Media Ecosystems and the Asymmetric Rise of the Populist Right in Europe

Funding Source: The Kraynak Institute for the Study of Freedom and Western Traditions (James Madison Fellow)

Project Summary:

Throughout Europe, populist parties are challenging the political establishment and reshaping debates over immigration, economics, and democracy. While both right-wing and left-wing populists (RWP and LWP) appeal to anti-establishment sentiments, they have experienced very different levels of political success. Of the most prominent populist parties in Europe, an overwhelming majority of them are right-wing, while the left has struggled to break into the political mainstream. Understanding why this asymmetry exists is important not only for explaining relevant political phenomena, but for understanding how differences in messaging impact electoral performance. Within this paper, I investigate how media ecosystem construction accounts for divergent electoral outcomes between right and left-wing populists, despite their shared ideational framework of "pure people" versus "corrupt elites".

While existing theories about the rise of populism shed light on how external factors, such as demographic change and economic displacement, have impacted European electorates, they fail to fully explain why the right has outstripped the left in electoral performance. I instead focus attention on how political messaging can shape voter attitudes towards external factors and issue salience. The primary way parties achieve this messaging is through the use of media ecosystems, which can be separated into two spheres: liberal and conservative. Whereas in the past voters mainly got their news from a few legacy outlets, today's media landscape is divided between alternative and mainstream media platforms, social media platforms, and even high/low information audiences. Emerging research suggests that RWP and LWP media ecosystems differ in terms of stratification between alternative and mainstream media, identity construction techniques, and use of algorithmic amplification. Analyses of news consumption habits reveal that LWP media ecosystems are highly stratified due to limited interaction between mainstream and alternative outlets, which in turn isolates their message and makes it difficult to appeal to mainstream voters. In contrast, RWP ecosystems feature low levels of stratification, allowing for greater ideological cohesion and the introduction of populist narratives into the mainstream. This builds credibility amongst moderate voters and reduces costs by utilizing existing media infrastructure. Additionally, LWPs tend to construct political identity along abstract economic lines and use rhetoric high in logical and moral appeals. This has failed to resonate with voters as effectively as emotional appeals and ethnic/cultural identity construction, which are the dominant techniques in RWP political messaging. Finally, LWPs engage in traditional social media strategies using informative and policy-based content, which have generally struggled to generate the outrage or engagement necessary for virality. Conversely, the use of slogans, memes, and confrontational language are all key aspects of the RWP social media strategy. By creating visceral reactions among their audience, RWPs increase engagement and the likelihood of algorithmic amplification.

On the whole, these findings suggest that to be successful in the digital age, political parties must employ a combination of algorithm-friendly content and emotionally resonant rhetoric, while being mindful of existing media institutions. The extent to which differences in media ecosystem construction between RWP and LWP are inherent versus constructed, and the external factors contributing to alternative and mainstream stratification, are both areas of inquiry that would make for substantive future research.

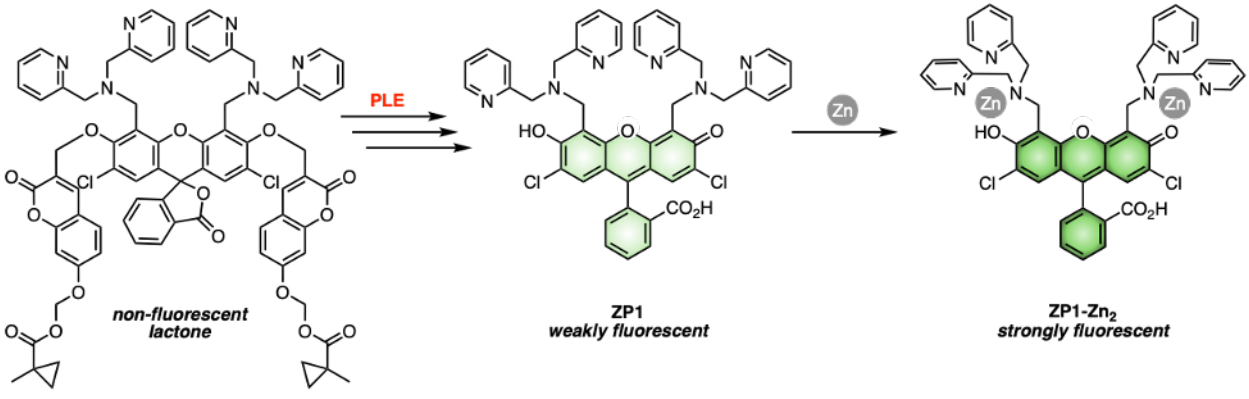
Research Fellows: **Liam McCarthy (2026)** **Concentration: Biochemistry**
Jason Mrosla (2027) **Concentration: Biochemistry**
Brian Pallares (2026) **Concentration: Biochemistry**
Faculty Mentor: **Jacob Goldberg** **Department: Chemistry**
Title of Project: **New Methods for Imaging Zinc(II) Ions in Biology**
Funding Source: **Organic Syntheses PUI Summer Research Grant; John C. Cochran Endowed Fund for Undergraduate Research; Division of Natural Sciences and Mathematics**

Project Summary:

Zinc(II) ions have various roles in human health; dysregulation of zinc homeostasis has been implicated in many diseases and pathological conditions. Because zinc(II) is spectroscopically silent, it cannot be detected by conventional methods, as with other metals in biological systems. As a result, investigators seeking to image zinc(II) frequently turn to small-molecule fluorescent sensors that selectively respond to the presence of the ion. The library of fluorescent zinc(II) sensors spans the entire visible spectrum and contains molecules with zinc(II) binding affinities ranging multiple orders of magnitude, however, controlling the localization and activity of these sensors still remains a challenge. Many strategies have been developed to direct zinc(II) sensors to almost every organelle within a cell through various methods, ranging from small molecules to proteins. Employing these tactics enable opportunities for new discoveries in zinc biology.

The goal of our research was to develop new methods for visualizing zinc(II) ions in complex biological systems using fluorescence microscopy. Selective targeting can be achieved by conjugating well-characterized small molecule sensors, such as Zinpyr-1 (ZP1), to peptide constructs or derivatizing them with functionally rich protecting groups. Previous studies have employed enzymes as a method of activity control in fluorescent molecules, demonstrating that functional group conversions are a viable strategy to cleave protecting groups. Our laboratory sought out to protect the zinc(II) binding sites on well-characterized fluorescent sensors with small molecules that are removable with specific enzymes. Sensors can only be activated in the cells containing an unmasking enzyme, allowing for cellular localization as opposed to the subcellular localization achieved through previous strategies. Our group uses organic synthesis and characterization techniques to develop such zinc sensors with the hopes of conducting in vivo imaging experiments with cultured cells.

Deprotection of Pro-ZP1 and Zinc(II) Coordination

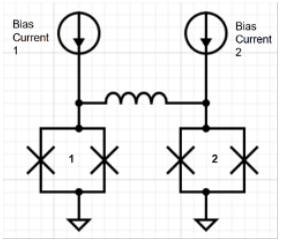


Research Fellows: **Flynn McGrath (2026)** **Concentration: Physics**
Will Rye (2026) **Concentration: Physics**
Faculty Mentor: **Ken Segall** **Department: Physics and Astronomy**
Title of Project: **Investigation of a SQUID-based Analog Multiplier Chip**
Funding Source: **Mind, Brain, and Behavior Scholars Award; Justus '43 and Jayne Schlichting Student Research Fund**

Project Summary:

The goal of this project is the understanding of a SQUID-based chip that should function as an analog multiplier that takes two current signals as inputs and outputs a signal proportional to the product of the input signals. Such a multiplier would be useful for the purpose of building superconducting neuromorphic computers because the multipliers could be used to weight the input signals of artificial neurons. The weighting of signals within a neural network is vital to the network's ability to perform computations, so any circuit component that weights signals would be among the common components in the network – more numerous, even, than the artificial neurons themselves. Therefore, it is important for the multiplier circuit to be well understood before being implemented in a neural network.

Figure 1 depicts a simplified circuit diagram of the multiplier. The input currents are applied to the chip through mutual inductances, so that the magnetic flux through SQUID 1 is proportional to the sum of the input currents, and the flux through SQUID 2 is proportional to the difference of the input currents. The voltage response of a SQUID to magnetic flux is periodic, such that the voltage is approximately proportional to the square of the flux for fluxes close to either integer multiples of the flux quantum or half-integer multiples of the flux quantum. The operation of the multiplier relies on those quadratic relationships, so that the chip should theoretically work for small inputs. This summer, we sought to determine the multiplier's input range, as well as how well the chip multiplies within that range. We also sought to figure out how to deal with the problem of trapped flux in the circuit. The multiplier chip has extra input lines that allow the user to add magnetic flux to each SQUID. Therefore, if the user knows the amount of flux trapped in each SQUID, they can remove that flux using the addflux inputs. This summer, we figured out a measurement procedure that allowed us to infer the amount of flux trapped in each SQUID, and then remove that flux using the addflux lines. Once we determined the way to back out the trapped flux in the multiplier, we could make measurements telling us the operating range of the multiplier. Figure 2 shows the results of one of those measurements. We found that the multiplier seemed to work best and have the largest range when operated with one of the input fluxes close to half of a flux quantum and the other input flux close to zero. More questions still need to be answered to improve our understanding of the chip, including questions about how the values of inductances, resistances, and bias currents in the circuit influence its behavior.



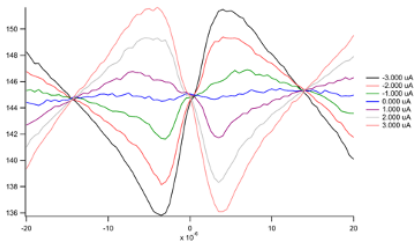


Figure 1 (left): A simplified diagram of the multiplier circuit.
Figure 2 (right): A graph of experimental data showing the output of the multiplier as a function of the two input currents. The x-axis is the input X current (A); the legend shows the input Y current (μA) of each curve in the graph; and the y-axis shows the switching current (μA) of the readout SQUID, which is a proxy for the current through the middle inductor.

Research Fellow: Zemira Meade (2026) **Concentrations:** Neuroscience; Africana and Latin American Studies

Faculty Mentor: Julie Dudrick **Department:** Upstate Institute

Title of Project: Giving a "Hand Up," not a "Handout": Helping Madison County Residents Achieve Self-Sufficiency

Funding Source: Upstate Institute

Project Summary:

The Community Action Partnership for Madison County (CAP) was established in 1986 to address persistent poverty in Madison County. CAP offers eight programs, including Women, Infant, and Children (WIC), Temporary Services, Early Head Start, and Housing. Poverty remains prevalent: as of 2023, one in ten residents lives in poverty, with the highest rates in the southern regions except Hamilton. The primary root causes are a lack of access to preschool education, employment opportunities, healthcare, childcare, and affordable housing. CAP uses its 2025-2028 Community Needs Assessment to examine how community feedback aligns with the Community Service Block Grant Domains and existing services, aiming to mitigate poverty risk factors.

Every Community Action Agency is required to curate a Community Needs Assessment (CNA) every three years. This report highlights the social and economic demographics of the residents. It highlights both the strengths and the most pressing needs of the community. The CNA planning began in June 2024. From June to February 2025, the CAP workgroup reviewed the previous assessment and planned the methods of public engagement (surveys and focus groups). The data collection period was from March to May. The surveys were launched, the focus groups were held, and the data were collected and analyzed. From June to July, there was the drafting and reviewing of the report, followed by CAP's presentation of the CNA to the CAP Board for approval. Of the three surveys launched, the Community Survey received 98 responses from residents of Madison County. The Community Partner Survey and the Board Member, Staff, and Volunteer survey each received 31 responses. Nine focus groups were conducted throughout the county, with a total of 39 participants. Data analysis for the focus groups involved manual coding using the Community Service Block Grant (CSBG) domains. The domains are measures to underscore which areas need the most attention.

The results indicated that housing was the most pressing issue. Rent, utilities, and house repair costs are too high, according to nearly half of the respondents. Many stated there is an overall lack of affordable housing and a visible increase in homelessness. About 24% of occupied housing has at least one substandard condition. Moreover, the median household value increased by $ 45,000 from 2018 to 2023. Twenty-three percent of residents are cost-burdened, meaning they spend more than 30% of their income on housing expenses, and eleven percent are severely cost-burdened, spending more than 50% of their income. Aside from housing, a lack of employment and access to healthcare are prominent issues. Madison County has large employers, such as Colgate. However, there is a lack of local jobs with a livable wage and benefits. Forty-two percent of residents are not in the labor force. The Community Survey showed that those with an income of $30,000 or less stated their top needs were dental care, food assistance, and healthcare. This is not only a geographic issue, but also a financial one. Almost half of the respondents stated that they or someone they know had to choose between buying food and paying bills. Twenty-two percent of low-income residents have limited access to food.

These statistics exemplify the importance of CAP services. Too many low-income Madison County residents are barely making ends meet, prioritizing one essential aspect of living over another. Now that the CNA has been completed, CAP can plan implementation strategies to address these issues. Then, they can spread awareness of this situation to those who have the status and the financial authority to continue funding all eight of their programs. CAP prides itself on helping low-income residents achieve self-sufficiency. This assessment plays a pivotal role in CAP continuing its mission.

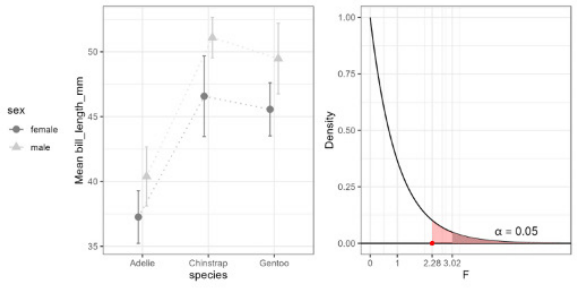
Research Fellows: **Danny Molyneux (2026)** — **Concentration: Applied Math**
Max Warriner (2027) — **Concentration: Applied Math**
Faculty Mentor: **Will Cipolli** — **Department: Mathematics**
Title of Project: **Data Science Collaboratory Project**
Funding Source: **Division of Natural Sciences and Mathematics**

Project Summary:

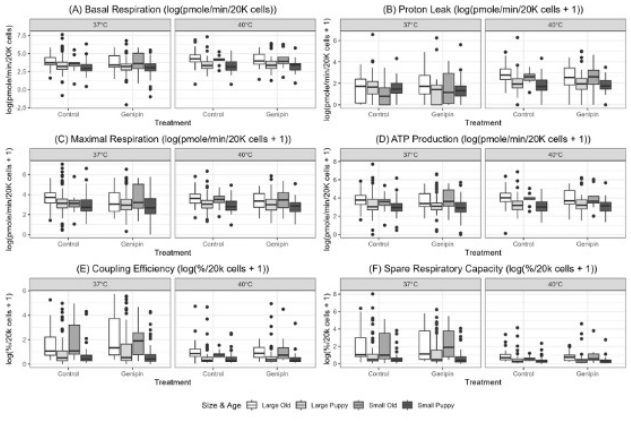
We continued the process of integrating the Data Science Collaboratory as a valued service on campus that's available to students and faculty to provide personalized consultation on enumerable things involving data and statistics. We hope that in the future there will be a constant stream of students and faculty using the services of the desk throughout the school year and summer months.
We also continued developing statistical apps available on the DSC's website at shiny.colgate.edu. These apps are the collective work of over 15 Colgate students and Prof. Will Cipolli over many years. These apps are used in educational settings such as introductory statistics courses at Colgate as well as a growing list of other colleges. They serve as an alternative to doing statistical analysis in coding software and aim to provide comprehensive results as a web experience.

This summer marked the release of version 2.0 of all existing apps as well as brand new apps, such as Robust Regression, Mixed Effects Regression, and Two-Way ANOVA. We specifically focused on the user experience of the apps by providing expanded feedback with helpful messages regarding the procedures of the apps. We also streamlined the computation of analysis so that the apps run as smoothly and quickly as possible.

To occasion the development of the Mixed Effects Regression App, we collaborated with Prof. Ana Jimenez, providing analysis of her data that involved a mixed effects model, with the primary research providing guidance into the development of the new app. We hope that the apps continue to broaden their scope to be useful for even more future research projects at Colgate.



Interaction Analysis from the Two Way ANOVA App



Faceted Boxplots of Mitochondrial Function in Dogs

Research Fellow: Jack Mullen (2026) **Concentration:** Environmental Geography
Faculty Mentors: Adam Burnett **Department:** Geography
Peter Klepeis **Department:** Geography
Title of Project: Shared histories and contemporary influences of First-Nations people of Eastern North America and Western Australia
Funding Source: Division of Social Sciences
Project Summary:

This summer my main responsibility was hosting a cohort of Indigenous Australian students from Curtin University during their two-week stay at Colgate. I had a secondary responsibility for the weeks surrounding the visit where I also created an annotated bibliography for use by Geography department professors in teaching Australian cultural differences and preparing students to attend the Australia study group. The specific topic of my annotated bibliography settled on researching the practice of cultural burns and other Indigenous usages of wildfire both in Australia and the United States.

When the Australians were here I lived in the accommodations with them to ensure a smooth adjustment to life at Colgate and assisted with the daily activities we had planned. The trip was focused on a comparison of indigeneity between people from Australia and Upstate New York, as well as intertwined with investigations into the local geography, geology, and colonial history. Admittedly, one of the largest takeaways from the visit was the Australians' negative reaction to how Native Americans are treated in the U.S. and the discussions around intercultural navigation and respect were truly meaningful and personal to each individual in the group. Interpersonal dialogues led by the ALANA center, hikes and sense of place exercises with Colgate's Outdoor Education, a variety of museum visits, and days spent on the Oneida and Onondaga Reservations are just a few of the activities during their two-week stay with the reservation visits being some of the highlights. Food sovereignty was repeatedly emphasized by our Native American hosts as a way of recontextualizing their power and finding a new way of life for their culture in a colonized world. It is difficult to put into words a summary of the feelings exchanged, but what was apparent was that preconceptions, defensive strategies, and interpersonal barriers quickly vanished. Being welcomed onto the reservations and fully engaged with the Indigenous style of discussions and teaching was as much a learning opportunity for me as it was for the Australians, and the respect, patience, and round table discussion style challenged me to reevaluate western goals, values, and discussion styles.

Throughout the other weeks, I focused my annotated bibliography's subject down further into specific sources and examples comparing the usage of prescribed fires in Australia and the United States. Prescribed fires are intentionally set fires, usually with some purpose behind them to clear our underbrush or improve soil fertility. Years of western fire suppression practices have actually intensified recent wildfires and made life in these fire prone environments more dangerous by allowing a buildup of fuel. That being said, recent efforts have been made to include Indigenous perspectives and fuel reduction practices in the form of prescribed burns. My annotated bibliography includes examples of successful prescribed burns and other examples of cooperation between western firefighting initiatives and Indigenous voices. I also looked at a comparison between U.S. (Californian) and Australian land management laws which could encourage or discourage preventative action against wildfires, specifically using prescribed burns to clear fuel. Here I found that Australia has a much more communal responsibility when it comes to preventing wildfires, while Californian laws often slow or discourage caring for one's private property in a responsible manner.

This summer, I learned about the value of prescribed fires, took a look at Australian and Californian environmental/property laws, compiled a list of prescribed fire success stories, and on top of all that, I also was able to connect with a vibrant group of exchange students for the two weeks of their stay.

Research Fellow: **Reem Numan (2027)** **Concentration: Music**

Faculty Mentor: **Michelle Bigenho** **Departments: Sociology and Anthropology; Africana and Latin American Studies**

Title of Project: **Blerd(ing) Out: Black Syncretism with Anime and other Japanese Pop Culture**

Funding Source: **Walter Broughton '63 Research Fund**

Project Summary:

This summer I researched how Black nerds, or Blerds, uniquely integrate anime and other Japanese pop culture (JPC) into Black culture. Growing up with anime and video games such as Naruto and Kingdom Hearts, alongside hip-hop lyrics referencing anime, and watching The Boondocks, an anime-inspired Black animated sitcom, I experienced how JPC intertwined with everyday Black life. This led me to ask: why and how have Blerds syncretized JPC with Black culture? This project combined literature from Anthropology, Film & Media Studies, Black Studies, Fandom Studies, and Hip-Hop Studies with ethnographic fieldwork and 30 semi-structured qualitative interviews. From May 30 – June 1, 2025, I attended DreamCon, the largest Black-owned anime convention in the U.S., in my hometown of Houston, TX. At this majority-Black attended anime convention, I conducted participant observation of cosplay, merchandise, and panels topics, and compared my findings to previous anime conventions I have attended that were catered towards a general audience.

An emerging theme in my research was how Blerds reckon with a lack of Black representation. At DreamCon, many Black cosplayers styled their hair in afros, locs, and braids absent in original character designs, affirming identity through reimagined cosplay. In my interviews, I looked into the phenomenon of "Black-coded" characters— fictional characters not explicitly Black but read as such by Black audiences. When asked about this phenomenon, over 90% cited Piccolo from Dragon Ball Z, whose dark green skin, outsider backstory, and deep masculine voice led many to view him as an older Black man. Some even read his turban as a durag, a hair accessory common amongst Black communities. Such findings demonstrate how Blerds create representation when it is absent in the media they consume. Interviews also revealed generational connections. Black parents' love of martial arts films like Enter the Dragon drew their children to Dragon Ball Z, a martial arts-inspired anime, which in turn led them to other anime like Naruto, Bleach, etc. I also looked into hip-hop's relationship with anime. Since the 90s, Dragon Ball Z and other anime have appeared in countless rap lyrics, with artists like Childish Gambino and Megan Thee Stallion using anime characters as symbols of strength, perseverance, and underdog triumphs. For many hip-hop artists, such as RZA from Wu-Tang Clan, anime heroes mirrored Black struggles against marginalization in America.

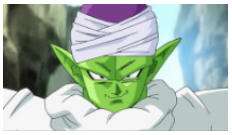


Figure 1. Piccolo from the anime Dragon Ball Z is an example of a Black-coded character

Figure 2. DreamCon attendee (right) cosplaying as *Howl* from the anime *Howl's Moving Castle* with an afro

My research framework drew on Sophie Hansal and Marianne Gunderson's "fannish methodology," which frames my positionality as an ethnographer researching a fandom I am a part of. I balance my insider perspective as a Blerd by using personal connections to interpret fandom while situating it within broader literature and scholarly analysis. My research shows that Blerds are not passive consumers, but cultural producers who transform anime, manga, and games through the lens of Black identity, history, and lived experience. These are preliminary findings, and I plan to expand my research into a trade press book accessible to both academic and non-academic audiences. I also hope to study abroad in Japan and research a reverse cross-cultural diffusion: how Black music shapes Japanese pop and video game music.

Research Fellow: Zachary O'Donnell (2027) **Concentrations: Environmental Studies; Psychological Science**

Faculty Mentor: Julie Dudrick **Department: Upstate Institute**

Title of Project: Potato Leafhopper Abundance in Central New York.

Funding Source: Upstate Institute

Project Summary:

This summer I studied pest populations in alfalfa fields across Central New York (CNY), alongside Cornell Cooperative Extension's CNY Field Crop Specialist. Cornell Cooperative Extension (CCE) aims to bridge the gap between New York State communities and the resources of higher education and research. Specifically the team I worked on, the CNY Dairy, Livestock, and Field Crop team (CNYDLFC), carries out CCE's missions by doing on farm research, providing farmers with agricultural trainings, and conducting on site farm consultations.

The specific project I worked on this summer was keeping track of Potato leafhopper (PLH) abundance across about 30 different alfalfa sites throughout the 8 counties the CNYDLFC services. PLH are the number one pest of alfalfa. We aimed to study the relationship between the number of PLH present and the amount of in-field biodiversity. We measured in-field biodiversity by estimating the amount of biomass that was alfalfa, compared to other grasses, in a square yard. Each week the field crop team would sample each site and record percentage biomass that was alfalfa, alfalfa height, number of alfalfa stems, number of PLH across 30 sweeps, and the presence of any natural enemies of PLH (ladybugs, spiders, damsel bugs, hoverflies, lacewings). Using this data we correlated the averages of PLH per sweep and percentage of biomass that was alfalfa. There was a slight positive correlation between in-field percentage of alfalfa and PLH per sweep at sites in Madison County. This means that as the percentage of alfalfa in a field went up, so did the abundance of PLH.

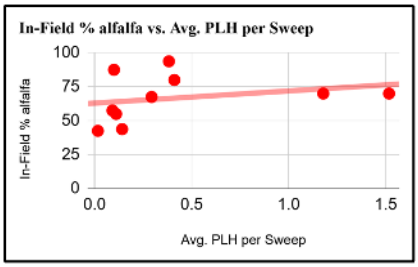


Figure 1. A graph illustrating the relationship between PLH abundance and percentage of alfalfa biomass.

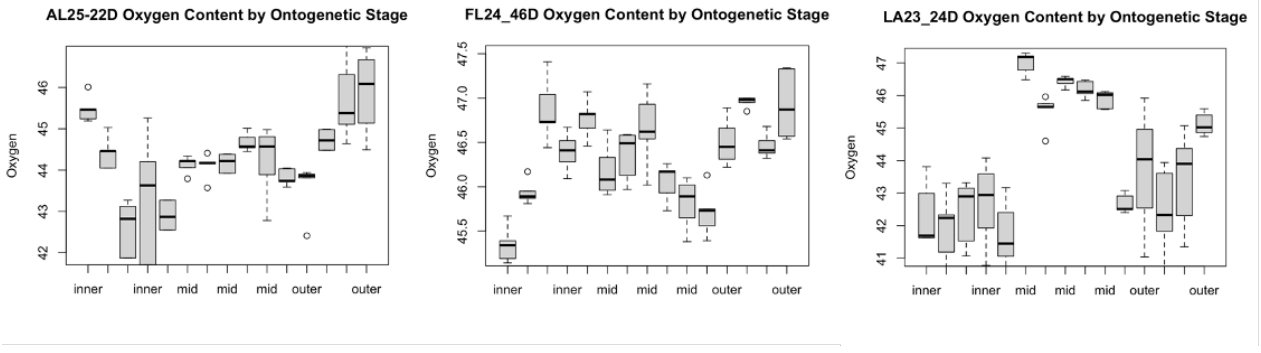
Within the same project, I utilized the tools of GIS to understand how land use surrounding a site could impact the presence of PLH and their natural enemies. Within a quarter mile radius of each alfalfa site in Madison County I digitized residential, agricultural, and forested areas. Using this data I aimed to find any relationships between different types of surrounding land and abundance of PLH and their natural enemies. I found that the strongest relationship was a negative correlation between percentage of forested land surrounding alfalfa sites and abundance of natural enemies of PLH. This meant that as the percentage of forest land around alfalfa sites went up, the average amount of natural enemies went down. We concluded that this showed that the natural predators were not emerging from heavily forested areas, and instead were likely coming from the open agricultural land surrounding alfalfa fields. This also provides another strong reason for farmers not to overly rely on insecticides to manage their pest populations since the pest's natural enemies might be harmed by insecticides sprayed on the open agricultural land.

Research Fellow: **Christopher Olivares (2028)** **Concentration:** **Undeclared**
Faculty Mentor: **Paul Harnik** **Department:** **Earth and Environmental Geosciences**
Title of Project: **Corbulid Biomineralization and Environmental Variation Within the Gulf of Mexico**
Funding Source: **Bob Linsley/James McLelland Fund**
Project Summary:

Ongoing natural and man-driven environmental shifts have altered species distributions along the Gulf of Mexico. Certain species have become more abundant, while other species have become rare or gone locally extinct. Comparing the living fauna with preserved remains of historical populations can help reconstruct an environment's history and anticipate future conditions. Bivalves play vital roles aside from contributing to water quality. As their shells can be preserved for millennia, a population's filter feeding habits also record environmental change within the elemental compositions of their biomineralized shells.

To investigate chemical variation in shell composition, we examined two abundant bivalve species (*C. dietziana* and *C. swiftiana*) from the coastal regions of the Gulf of Mexico, off the shores from Louisiana, Alabama, and Florida. Cross-sectioned specimens from batch IDs LA23_24D (Louisiana), AL23_24D (Alabama), and FL24_46D (Florida), were analyzed from larval to adult stages through Energy-dispersive X-Ray Spectroscopy (EDS), a scanning electron microscopy (SEM) based technique. Elemental data of the shell's composition revealed a trend: oxygen content increased with growth towards the middle of the shell before sharply dipping, rebounding drastically to levels that surpass prior growth. It is difficult to confidently assert whether these results are applicable to Corbulidae as a whole, yet they indicate that *C. dietziana* and *C. swiftiana* undergo certain levels of morphological and chemical changes throughout life. That in mind, the plotted specimen LA23_24D does deviate from the precedent established by Alabama and Florida. Here, central oxygen content drastically spikes and dives between its larval and latest growth, the data possibility being a genuine biological anomaly, though likely a result of user error. Regardless of this difference, the trend persists by regional oxygen concentrations and is theorized to be seen across multiple environments.

Should future research support this trend, EDS-based analysis of oxygen content integrated within bivalves may be a viable method in mapping an environment's history and predicting the future results should climate change persist. Human activity in tandem with climate change actively impacts our vulnerable waters along with its inhabitants. In understanding the causes and effects of global actions, the trajectories of habitats and a species can better be understood and protected which in turn curves the mitigation needed to address distribution and loss. While bivalves *C. dietziana* and *C. swiftiana* are only two bivalve species within the Gulf of Mexico, the data and roles they play are invaluable in the greater understanding of aquatic systems and offer valuable insight into aquatic system dynamics worldwide.

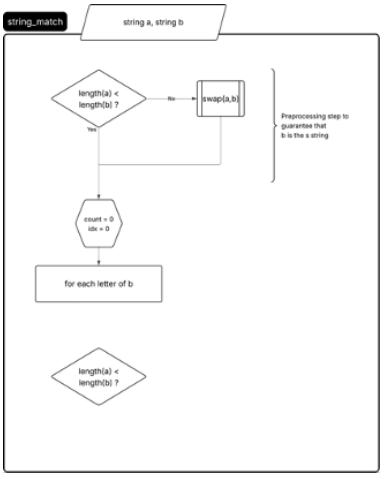


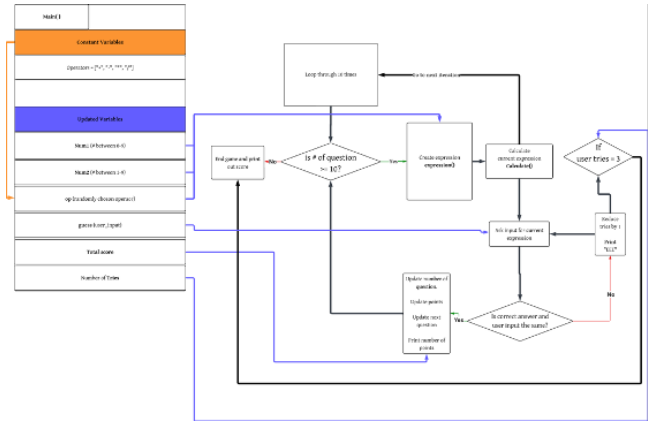
Research Fellow: Tobi Onabanjo (2028) **Concentration:** Undeclared
Faculty Mentor: Elodie Fourquet **Department:** Computer Science
Title of Project: Scaffolding Diagrams
Funding Source: Holden Endowment Fund
Project Summary:

Computer science is full of abstract ideas that can feel overwhelming to beginners. Loops, conditions, and problem decomposition all demand heavy cognitive effort when they are explained only in text. In this research, I worked with Professor Fourquet to think and assemble various ideas in computer science to form a methodology that students can use to strengthen their critical thinking and problem-solving skills. We identified common difficulties students face when approaching programming tasks—whether it is knowing where to start, handling constraints, or managing errors. We studied research papers related to these problems to gather insights and extend this scholarship. From this, we developed a methodology around the use of flowcharts, which we call "scaffolding diagrams," exploring how flowcharts make problem-solving in computer science more visual, structured, and manageable for students.

I started my research not only solving codingbat problems but also creating the flowcharts for each problem solved. I worked with two main examples: a simple string-matching task and a simulation game called Little Professor. In the string-matching problem, I found that preprocessing became a key constraint. By restricting comparisons to the shorter string, I avoided out-of-range errors. This step showed how constraints can be designed up front to make later logic safer and simpler.

On the other hand, the Little Professor game showed how flowcharts can capture the bigger picture of a simulation. Using a bottom-up approach, I mapped functions like calculate() and expression(), which revealed explicit rules (four operators, integer division) and implicit rules (no division by zero). Then, with a top-down flowchart, I organized the game loop: ten questions, three attempts per question, score tracking, and an end condition. Together, these diagrams turned an abstract program into a structured and predictable system as shown below. The second example showed how preprocessing can act as a constraint. In the string-matching problem, I prevented errors by making sure the shorter string was always chosen before looping. What could have been a messy detail instead became something regulated. Together, both examples show that flowcharts are not just visualization. They help break problems down, handle complexity early, and make program logic easier to follow. They also reveal how constraints—those built into the problem and those created—make programs safer and more predictable.





Research Fellow: **Ethan Ouyang (2027)** **Concentration:** **Neuroscience**
Faculty Mentor: **Wan-chun Liu** **Department:** **Psychological and Brain Sciences**
Title of Project: **Developing Computational Models for Quantifying Co-Song Gestures in Zebra Finches**
Funding Source: **Division of Natural Sciences and Mathematics**
Project Summary:

This summer I mainly focused on developing computational models in order to quantify co-song gestures in zebra finches to help determine if there was some correlation between degree of movement and complexity of the syllable the movement occurred on. Co-song gestures are the head movements that zebra finches make when singing their songs. As adults, they tend to display more robust, lateral and pure rotational movements opposed to juveniles who produce more random movements. Previously, our lab observed that the birds tended to gesture more frequently on the more complex syllable of their motif or song. However, since our observations were purely visual, movements were arbitrary and often introduced inconsistencies among people who were attempting to quantify these gestures. Additionally, previous quantifications have been based purely on frequency of movement and not degree of movement.

I utilized an open source tracking software called Deeplabcut to generate 2d coordinates for key points. The first approach was a single camera, uncalibrated set-up to estimate 2d head pose for our zebra finches. In this method approach, I tracked key points forming the beak: crown of the beak and the left and right base corners of the beak. This model was a very simple approach using horizontal and vertical displacements as proxies for yaw and pitch as 2d imaging can't fully capture 3d Euler values. While this method allowed us to categorize different degrees of movement, this method was only effective in adult birds that showed movements dominated by robust rotation and not overly confounded by translation.

In the second approach, I attempted a 3d reconstruction of the beak from a single, calibrated camera setup. This was a mathematical approach based in analytical projective geometry and basic computer vision. In order to attempt to recover depth from a 2d image, a 3d canonical model of the beak was constructed using measured lengths from zebra finches. After generating a 3d canonical model of the beak (crown, base corners, and tip were all tracked and used) in a real world coordinate system, a Perspective n Point (PnP) method was used to map the 3d points to the 2d image points generated from Deeplabcut in order to get a close approximation of a 3d reconstruction. However, the shortcoming with this method was that often in gesture movements key points are often occluded meaning that PnP will fail due to not having enough point correspondence. However, this method has created a foundation for the current approach that I am currently working on.

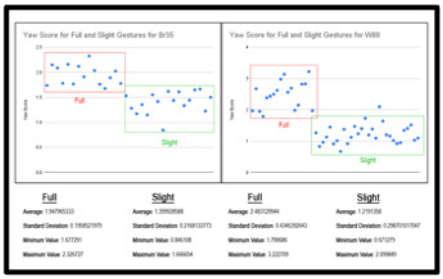


Figure 1. The first model is able to distingui between full and slight co-song gestures.

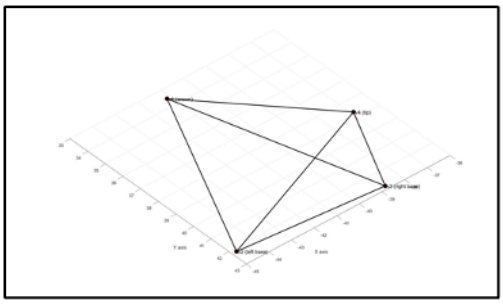


Figure 2. 3d reconstruction of zebra finch Y537 beak via PnP

Research Fellow: Robert Ozerdem (2026) **Concentration:** Chemistry

Faculty Mentor: Gongfang Hu **Department:** Chemistry

Title of Project: Using DFT to Examine an Improved Aldol reaction

Funding Source: Justus '43 and Jayne Schlichting Student Research Fund

Project Summary:

Transition metal catalysis has been a major point of innovation in the making of small organic molecules for decades now. Whether in furthering research or innovating the synthetic process of making pharmaceutical drugs, exploring new catalysts to make processes more efficient is exceedingly important. Many transition metals have been extensively studied by now, but we aim to study bimetallic systems and explore their catalytic properties. We recently discovered that a Bismuth-Palladium bimetallic catalyst that we have been using for a couple of years is particularly good at a specific type of reaction that can make a functional group called an oxazoline that is common in small molecule chemistry and pharmaceutical drugs. This is a great discovery, but we also wanted to figure out how this reaction cycle works, as we cannot see what is happening to our molecules as they are reacting. If we can find a way to understand our catalytic cycle, we can not only understand how our own catalyst works, but also aid other scientists in making new catalytic discoveries in similar systems.

Density functional theory (DFT) is one of the methods we used to help us understand how our catalytic system works. DFT is a method of computational chemistry that uses a non-real system of non-interacting electrons to calculate energies of molecules, and it corrects for this non-real system through an exchange-correlation functional. Calculating these energies can allow us to understand what our catalytic cycle looks like, and can also help us determine what our transition states look like for certain steps. Some of the more intricate things we look to determine through DFT are how the counterion affects the catalytic abilities of the bismuth-palladium system, as we have received different yields depending on the counterion chosen. We have seen that chloride has given us the best yields, but ions like acetonitrile and triflate have given lower yields of our product. We also aim to determine the position of our chloride ion during each step of the process, as we have noted that the position of the chloride relative to the complex can significantly affect the energy of the system. We have determined a couple of transition states for our proposed catalytic cycle already, specifically for the nucleophilic addition and cyclization steps (figure 1), and have also mapped out a rough energy diagram for our reaction (figure 2).

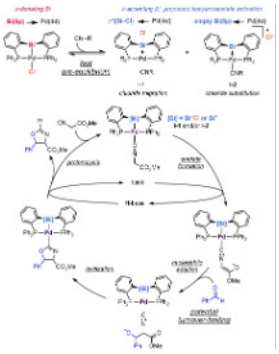


Figure 1: Proposed Catalytic Cycle.

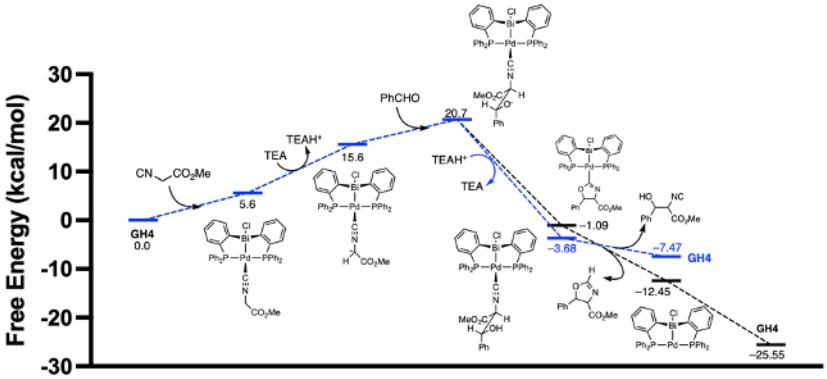


Figure 2: Energy diagram for our catalytic cycle.

Research Fellow: **Juhyun Park (2028)** **Concentration:** **Undeclared**
Faculty Mentor: **Wan-chun Liu** **Department:** **Psychological and Brain Sciences**
Title of Project: **Studying zebra finches' song-entangled gestures**
Funding Source: **Division of Natural Sciences and Mathematics**
Project Summary:

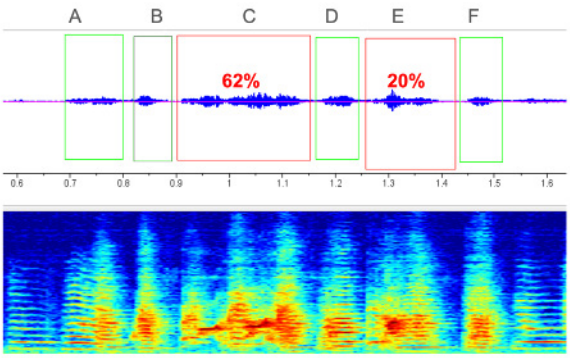
People often move their hands and arms when speaking to others. Gestures during speech are not random motions; they help communicate or emphasize a certain point. Similarly, zebra finches (songbirds) have co-song gestures. These co-song gestures may help emphasize a male zebra finch's ability to produce a complex syllable to impress females during courtship.

Zebra finches develop individualistic songs from each other. A soundfile with a zebra finch's song was put into Raven Lite so we could quantify that specific song. To quantify, we have to determine where a song starts and ends by looking at the spectrogram for repeating patterns. A segment of the song before it repeats again is called a motif and each motif is composed of syllables. We used the alphabet starting from A to mark each syllable. Each zebra finch can have a different number of syllables in their song compared to other zebra finches.

We then used Boris to code for lateral head movements. By comparing a zebra finch's song waveform with a video that was taken at the same time as the song soundfile, we were able to see the syllables in which the zebra finch had lateral head movements. When they sing, body movements can be observed; in this project, we focused on zebra finches' lateral head movements when singing. The head movements were accounted for when the zebra finches turned their heads laterally 45 degrees or more. For each zebra finch, we collected at least 50 motifs with lateral head movements.

After coding, we used SAP to organize at least 50 motifs using soundfiles. We marked each syllable for 50 motifs and exported the data of analyzed acoustics of each syllable into a google sheet to help visualize the data.

Lastly, we ran the data from Boris into Matlab to visually see the statistics of when the zebra finch moved his head. Each zebra finch we tested (eleven) moved his head significantly more on a certain syllable compared to other syllables. In conclusion, the syllable(s) with the most lateral head movements are the most complex syllable in the motif. The syllable is often visually longer and wider than the other syllables. More lateral head movements on a certain syllable seem to indicate the zebra finches' intended emphasis on the complex syllable in order to showcase their ability to produce complex notes.



The image is a motif quantification of a male zebra finch. This is one motif composed of six syllables: A, B, C, D, E, F. From both the waveform (above) and spectrogram (below), the syllable C seems to be the most complex. This zebra finch had 62% of lateral head movements on the syllable C.

Research Fellow: Olivia Pascione (2026) **Concentrations:** Psychological Science; Political Science

Faculty Mentor: Fred Chernoff **Department:** Political Science

Title of Project: Freedom vs. Security: Reconciling Civil Liberties and Nuclear Strategies

Funding Source: The Kraynak Institute for the Study of Freedom and Western Traditions (James Madison Fellow)

Project Summary:

What happens when the destiny of a democracy is dependent on decisions that appear so essentially undemocratic? This project explores a basic paradox of the nuclear age: liberal democracies, founded on checks and balances, open debate, and civil liberties, have put unprecedented destructive power in the hands of a single executive. The existence of nuclear weapons creates a perpetual trade-off between liberty and security—one that grows more painful as emerging technology, authoritarian rivals, and international problems transform the nuclear landscape.

For the non-expert, the stakes are straightforward. Nuclear weapons have transformed how democracies govern themselves. In the United States, the president can order a nuclear strike without consulting Congress, courts, or the public—a concentration of power unimaginable in almost any other context. While this authority offers the promise of speed and deterrence in moments of crisis, it short-circuits the very machinery of accountability that gives democracy its legitimacy. The question, then, is urgent: can democracies preserve freedom while defending themselves against threats to their very existence?
To accomplish this, my research tracks the paradox along three axes: theory, history, and contemporary practice. First, political theorists from Hobbes and Locke to Shklar and Agamben demonstrate that the nuclear state has created a permanent "exception" in which executive power overshadows normal democratic politics. Second, Cold War case studies—e.g., Truman's solitary decision to bomb Hiroshima, the 1980s anti-nuclear movements, and court cases regarding secrecy—illustrate both the dangers of concentrated power and the persistence of democratic dissent. Finally, the twenty-first century presents new dilemmas: Trump's "madman theory" of nuclear deterrence, Biden's AI-driven modernization of U.S. nuclear forces, and recent crises such as the Iran bombing all underscore how nuclear authority intersects with public trust, civil–military relations, and legitimacy in real time.

Set in global perspective, the liberal dilemma is even clearer. In oppressive regimes like Russia, China, and North Korea, centralized nuclear authority reinforces repression and shields rulers from accountability. By contrast, NATO democracies experiment—spottily—with consultation and oversight. Yet even in open societies, new technologies like cyber vulnerabilities and AI-powered early warning systems accelerate decision-making to a rhythm that strains democratic deliberation.

The record attests to two verities: survival without freedom is pointless, and freedom without survival is precarious. Democracies cannot fall into either abyss. Instead, they must create institutions that safeguard both, from strengthening Congressional oversight of first-use decisions to embedding international agreements and deepening civic participation. History shows that publics, activists, and courts can push back against secrecy and unfettered power; the future demands that these brakes be embedded more profoundly in nuclear governance.

This project argues that the paradox of democracy in the nuclear age is not irresolvable. Liberal democracies must resist the temptation to survive at all costs. If they can show that freedom and survival need not be traded against one another, they will not only maintain their own legitimacy but also provide a model for a political way forward in an era of permanent existential threat.

Research Fellow: **Havya Peddineni (2026)** **Concentration: Biochemistry**
Faculty Mentor: **Stephanie Sanders** **Department: Chemistry**
Title of Project: **Role of Concentration and Solvent on Aggregation-induced Emission of Tetraphenylethylene**
Funding Source: **Miller-Cochran Fund**
Project Summary:

Fluorescence is the emission of photons after a molecule is excited. Typical fluorophores experience aggregation-induced quenching, which refers to the decrease in fluorescence intensity due to new non-radiative relaxation pathways that are accessible in the aggregated state. Tetraphenylethylene (TPE) is a nonpolar compound that exhibits weak fluorescence in solution. However, the fluorescence intensity increases when it forms aggregates, which is known as aggregation-induced emission (AIE). The goal of my research was to investigate the AIE properties of TPE in solution by varying the concentration of TPE and the water: tetrahydrofuran (H2O:THF) solvent ratio.

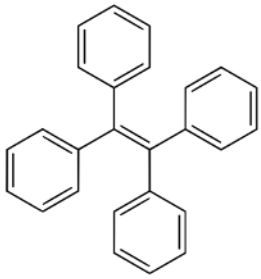


Figure 1: Structure of tetraphenylethylene

As expected, the absorbance of TPE increases with increasing concentration. However, concentrations of TPE higher than 61 µM exhibited less fluorescence because of inner filter effects. This occurs due to the reabsorption of emitted light by nearby molecules. At low concentrations or more organic solvent, the sharper features between 350 nm and 400 nm are indicative of vibronic coupling. Based on the concentration studies, we determined that concentrations of 5 µM and 50 µM TPE exhibit unique fluorescence emission spectra and are in the regime independent of inner filter effects. Therefore, they were the concentrations chosen for detailed study of the TPE's photophysical properties.

Using the concentrations of 5 µM and 50 µM, further investigations into the solvent ratio effect of fluorescence were performed. Increasing the percentage of water in the solvent causes a dramatic increase in fluorescence emission and less prominent vibronic coupling. This can be attributed to the aggregation of TPE due to the polarity of the solvent. Measurements to characterize the size of the aggregates with dynamic light scattering and vibrational modes with Fourier-transform infrared spectroscopy are underway to improve our understanding of the photophysics of TPE in solution.

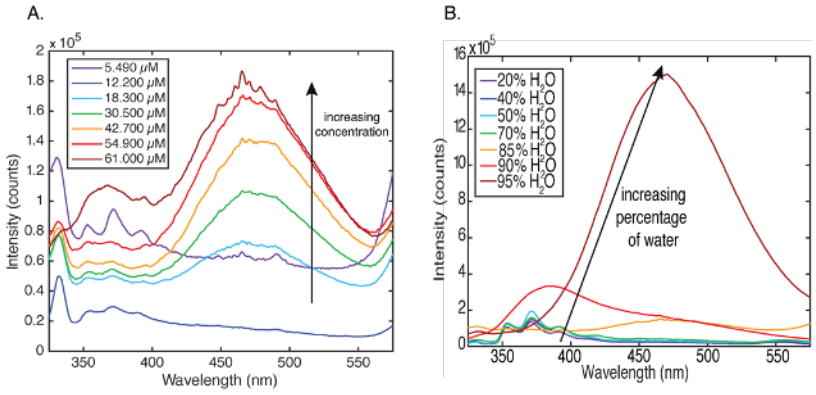


Figure 2: A. Fluorescence emission spectra of TPE, excited at 300 nm, in 90% H_2O:10%THF for various concentrations. B. Fluorescence emission spectra of TPE, excited at 300 nm, as percentage of water in solvent increases for 50 µM solutions.

Research Fellow: Olivia Pearre (2027) **Concentration:** Chemistry
Faculty Mentor: Gongfang Hu **Department:** Chemistry
Title of Project: Influence of Pnictogens (Bi, Sb, and P) in Catalyzing an Aldol Reaction
Funding Source: Warren Anderson Fund
Project Summary:

We previously synthesized two pincer-shaped catalysts containing bismuth, which was bonded to one of two metals: palladium or nickel. Both the $BiPd^{Cl}$ and $BiNi^{Cl}$ catalysts were tested for their efficiency in catalyzing an aldol reaction between benzaldehyde and isocyanoacetate. As shown by a 1H NMR, the $BiNi^{Cl}$ had a yield of 46% and the $BiPd^{Cl}$ had a yield of 98%. Based on these results, we asked how catalysis could be affected depending on the pnictogen, or group 15 element, used. Our goal was to develop four new catalysts, all with the same structure as the $BiPd^{Cl}$ and $BiNi^{Cl}$, however just varying the pnictogen. The pnictogens of interest were antimony (Sb) and phosphorus (P). By following the same catalyst structure, we could study how the pnictogen would speed up, slow down, or have no effect on catalysis compared to the BiM^{Cl} catalysts.

To synthesize the PMCl catalysts, PCl3 and nBuLi were added to a cold solution of (2-bromophenyl)diphenylphosphine in diethyl ether and allowed to stir overnight, and after work-up the resulting white solid was mixed with $LiAlH_4$ and then $(cod)PdCl_2$ or $Ni(dme)^{Cl2}$ to produce $PPd^{Cl}$and PNi^{Cl}, respectively. However, despite the color change observed after adding the metal precursors, P31CPD NMR shows that no reaction took place. Our first question for future work is how the NMR shows there has been no change, yet we observe a change, which will lead us to correctly synthesizing the phosphorus catalysts. We can then answer how the efficiency of the PNi^{Cl} and PPd^{Cl} compare to the antimony and bismuth catalysts. To synthesize the SbM^{Cl} catalysts, a very similar procedure was followed using Sb^{Cl3}, and the resulting residue was combined with $Pd(PPh_3)_4$ or $Ni(cod)_2$ to produce $SbPd^{Cl}$ and $SbNi^{Cl}$, respectively. The $SbPd^{Cl}$ was a dark orange color, whereas the $SbNi^{Cl}$ was a dark blue/purple. Both antimony catalyst crystal structures were compared, and it was seen that their geometries differed: the nickel in $SbNi^{Cl}$ adopted a distorted square planar geometry, whereas the palladium in $SbPd^{Cl}$ adopted a square planar geometry. Thus, the pnictogen identity influences the geometries and shape of the catalyst itself. Both of the antimony catalysts were tested for their efficiency in the aldol reaction, using the same reaction conditions at the bismuth catalysts: 1.5 mol% catalyst, 10 mol% triethylamine, and stirring at room temperature for one hour. It was found that the $SbPd^{Cl}$ had a yield of 79%, and the $SbNi^{Cl}$ had a much lower yield of 10%. Thus, both the $BiPd^{Cl}$ and $BiNi^{Cl}$ were more efficient than the corresponding $SbPd^{Cl}$ and $SbNi^{Cl}$, so changing the pnictogen does influence the catalysts' efficiency. However, our next question for future research asks: Why does the pnictogen actually affect catalysis?

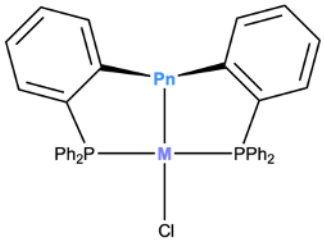


Figure 1: General structure of our catalyst.

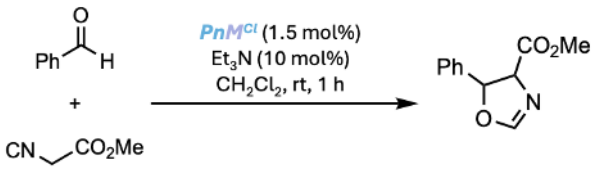


Figure 2: Conditions for the reaction between benzaldehyde and isocyanoacetate.

Research Fellow: **Abigail Pierce (2026)** **Concentration:** **Peace and Conflict Studies**
Faculty Mentor: **Lakshmi Luthra** **Department:** **Art**
Title of Project: **Illuminated in Heat**
Funding Source: **Division of Arts and Humanities**
Project Summary:

Unrestrained, the body becomes a site of corporeal seduction. Seeping out of every pore, sensitizing each nerve ending, the hierarchy of erotic zones is transcended. Through the act of multiple exposures, the body is transformed into spontaneous aesthetic undulations. This enveloping movement of the image allows the viewer to explore these familiar forms of the body in an unfamiliar way. One that rejects valuing the female body based on the cultural script of a large-breasted, lean, penile orifice. Photography has played a significant role in the dissemination of these scripts, acting as a mechanism of cultural reproduction. Yet, the same medium that is used to control perspective offers a unique space to reimagine reality. Photography can put time and space into flux, rippling the field of view, and, here, triplicating the body through multiple exposures. This method requires complete darkness interrupted only by a controlled flash, triggered when the body feels ready to be seen. The visually oriented process of assessment and correction of the photographed body is therefore suspended, instead emphasizing tactile awareness in coordination with the camera. As a result, the viewing of the photograph becomes an opportunity for reflection on how the body feels when it is released from the critique of sight; reexamining rather than perpetuating existing scripts. Once released, an erotic current flows through the body, accentuating what is touched by light, enlivening its erotic magnetism, and redefining what can be considered an erotic image.

Silver Gelatin Prints, eight 11x14 in, six 8x10 in, 2025

Research Fellow: Eliza Potter (2026) **Concentration: History**
Faculty Mentor: Julie Dudrick **Department: Upstate Institute**
Title of Project: Peterboro, New York Earned Itself a Place on the Network to Freedom
Funding Source: Upstate Institute
Project Summary:

My summer research was conducted through the National Abolition Hall of Fame (NAHOF), located within the quaint hamlet of Peterboro, New York. This nonprofit organization preserves, honors, and shares the stories of 19th-century American abolitionists. NAHOF's mission builds off the legacy of Gerrit Smith, a lifelong Peterboro resident who was a cornerstone of the 19th century abolition movement. Born into unspeakable amounts of wealth due to his fathers land business, Gerrit Smith decided to put his riches to an honorable use. Gerrit saw his fortune as a gift bestowed to him that should be used to further the greater good of the world around him. With this in mind, Smith dedicated his life to aiding others, mainly via reform movements such as abolitionism, women's suffrage, and temperance. It is estimated that over the course of his lifetime, Gerrit Smith gave away the equivalent of $1 billion in today's dollars.

The cause that Gerrit dedicated the majority of his mind and wealth towards was the abolition movement. Into his grand Peterboro home, Smith welcomed endless powerful abolitionists, including Frederick Douglass, Harriet Tubman, John Brown, and Sojourner Truth. Here, they would exchange ideas and act as an inclusive and supportive community, for the majority of the country condemned them as extremist fanatics. Additionally, in 1835, Peterboro hosted the inaugural meeting of the New York State Anti-Slavery Society due to Gerrit Smith's swift thinking and generosity. The collaboration achieved by these brilliant minds all within tiny Peterboro laid the foundation for the 2004 formation of NAHOF. NAHOF is located in the Smithfield Community Center (SCC), the same building where the 1835 inaugural meeting was held. The first half of my summer was mainly spent developing this knowledge on Peterboro, Gerrit Smith, the SCC, and the abolition movement as a whole.

During the rest of my time at NAHOF, I conducted research necessary to earn the SCC a spot on the National Parks Service's Network to Freedom due to its crucial role in the abolition of slavery. This involved combing through town, building, and individual records for evidence of antislavery work or presence of freedom seekers within the SCC. Peterboro has an extremely well recorded history, which presented me with lots of papers, books, and other archival materials to sift through. I also held discussions with regional representatives, local historians, and other important figures who hold vital ties to SCC and Peterboro. As I delved deeper and deeper into my work this summer, my superior–Dot Wilsey–and I considered the possibility of continuing this application work into the fall semester. My clear admiration for NAHOF and Dot, and my attachment to the history of Peterboro resulted in this being an obvious yes. Therefore, I will extend the writing of my application to the Network to Freedom into the fall as I continue to discuss and study the historical relevancy of this building.

Research Fellows: Cecilia Purkiss (2027)
Kira Sullivan (2028)
Faculty Mentor: Megan Abbas

Concentrations: Religion; Environmental Studies
Concentration: Undeclared
Department: Religion

Title of Project: Religion and U.S. Foreign Policy in Cold War Indonesia

Funding Source: J. Curtiss Taylor '54 Endowed Student Research Fund; Division of Arts and Humanities

Project Summary:

As part of the on-going research for a new book, this summer fellowship invites students to examine the intersection between religion and U.S. foreign policy in Indonesia. Overall, the book project investigates how American governmental institutions like the State Department, the CIA, and the United States Agency for International Development (USAID) and major non-governmental organizations like the Rockefeller, Ford, and Asia Foundations worked to mold Indonesian Muslims into useful, anti-communist allies during the Cold War. Summer 2025 research will focus on American relationships with Muslim political parties during the turbulent and violent 1960s. Students will work closely with the professor - and one another - to organize, take on notes, and begin to analyze thousands of archival documents from both US governmental agencies and private foundations. While students are not expected to have any experience with archival research, interest in the history of U.S. foreign policy, the Cold War, modern Islamic politics, and/or Indonesia is required. This is a great opportunity to get hands-on experience with historical research in religion, MIST, or Asian studies.

This research project examined the intersection of religion and U.S. foreign policy in Cold War-era Indonesia, focusing specifically on the relationship between the US and Indonesian Muslim political parties during the 1960s. To conduct our research, we first familiarized ourselves with the historical context and key institutions involved, which laid the foundation for addressing specific research questions. We then organized and analyzed archival documents, writing concise summaries after each reading to capture key points. A major focus was determining whether the Indonesian militia group Nahdlatul Ulama had connections to the U.S. Throughout the summer, we worked to understand how the U.S. sought to influence Indonesia's stance against communism and the direct role it played. Our research also included a visit to the National Archives in Washington, D.C., to further explore relevant documents.

We concluded our research by creating a comprehensive timeline of all our findings related to the NU, which allowed us to visualize the broader political shifts in Indonesia during the Cold War and gain insight into the extent of U.S. involvement in shaping Indonesian politics at the time. By 1954, the NU started to gain popularity as a Muslim political party. Political figures from the NU rose to power and directly worked with the Deputy Prime Minister. US ambassadors met directly with NU's members, taking note of political figures' views, and reporting back their findings to the Secretary State of Washington. In the 1960s, the NU was a significant force, actively participating in the political landscape and directly opposed the Indonesian Communist Party (PKI). The NU was wary of the PKI's growing influence and membership, especially as President Sukarno seemed to increasingly favor the PKI. This period was marked by political polarization, culminating in the 1965-66 mass killings where NU members and the military persecuted suspected communists. After a military coup in 1967, General Suharto became president. Under his leadership, the NU's power began to diminish, and its influence over other parties slowly dwindled. Reasons for this trend were: 1) increasing concerns from political figures that NU had been accepting bribes under Subchan (NU's 3rd chairman), and 2) Suharto was not in favor of keeping NU as a main party of power, and began to support other organizations to counterweight NU's power.

Research Fellow: **Jordan Quimby (2027)** **Concentration:** **Molecular Biology**

Faculty Mentor: **Jason Meyers** **Departments:** **Biology; Neuroscience**

Title of Project: **The End of the Line: Investigating Terminal Sensory Organ Regeneration in Zebrafish**

Funding Source: **Michael J. Wolk ’60 Heart Foundation**

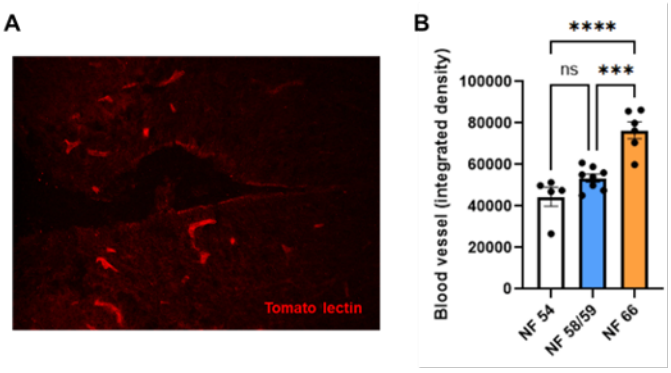
Project Summary:

The posterior lateral line (pLL) of zebrafish contains mechanosensory organs known as neuromasts, each consisting of hair cells that can regenerate after damage. While neuromasts along the pLL have been shown to regenerate following injury, it remains unclear whether terminal cluster neuromasts at the end of the pLL regenerate in the same way. To investigate this, we used photoablation and caudal fin amputation to eliminate terminal cluster neuromasts in zebrafish larvae at 3 days post-fertilization (dpf). Confocal microscopy was used to track regeneration over time. My results show that terminal cluster neuromasts exhibit partial regeneration within 3 days after photablation, and robust regeneration approximately 15 days following caudal fin amputation, though outcomes varied between fish. Imaging at 42 days post-fertilization (dpf) revealed new neuromasts developing distally, along with the formation of mantle/interneuromastic-like cells. These findings suggest that terminal cluster neuromasts are capable of regeneration, potentially through distinct cellular mechanisms involving coordinated cell migration. Further studies are needed to determine whether regenerated hair cells fully restore sensory function and how regeneration at the terminal cluster compares to non-terminal pLL neuromasts.

Research Fellow: Oscar Quintanilla (2028) **Concentration:** Neuroscience
Faculty Mentor: Anzela Niraula **Department:** Psychological and Brain Sciences
Title of Project: Microglia in Transition: Remodeling of Brain Circuits and Vasculature During Xenopus laevis Metamorphosis
Funding Source: Division of Natural Sciences and Mathematics
Project Summary:

Metamorphosis, a process by which a tadpole transforms into a frog, is characterized by significant changes. For example, a tadpole uses its tail for movement, but the tail is resorbed in the frog that uses limbs. Metamorphosis is also marked by rapid growth, gut remodeling, brain circuit remodeling, and cell turnover. Microglia are the resident immune cells of the brain, critical for waste clearance and remodeling of synapses. However, the role of microglia in brain remodeling during metamorphosis is unknown. Therefore, we first examined the changes in the number of microglia in the tadpole brain across the three developmental stages of metamorphosis. We also examined microglial association with vasculature during this phase. The three important stages of metamorphosis are chosen due to each unique characteristic the tadpole undergoes. Investigating these specific stages will provide us with a better understanding of the role of microglia in brain development and pathology. This, in turn, can aid in the treatment of human neurodegenerative diseases and brain injury, like brain hematomas.

The Xenopus laevis is the African clawed frog–Xenopus means “strange foot” and laevis means “smooth”. These frogs undergo a developmental process of metamorphosis, where remodeling of the brain and the periphery transforms from a single tadpole into a froglet while undergoing changes like limb growth, gut remodeling, cell turnover, and brain circuit remodeling. Microglia, the resident macrophages of the brain, play a role in phagocytosing debris, neuronal particles, and apoptotic cells, which allows for synaptic rewiring and brain circuit remodeling. The role of microglia during metamorphosis is unknown. We conducted immunohistochemistry (IHC) and transcriptional analysis in Xenopus laevis brains to examine the number of microglia across metamorphic stages: NF 54, NF 58/59, and NF 66. During the early stages (NF 54) of pre-metamorphosis, the tadpole is passively growing in size and grows barbels on its head. In stages 58/59 during pro-metamorphosis, the tadpole visually starts erupting forelimb buds and hindlimb claws, respectively. Stage 66, known as the metamorphic climax, gives rise to a froglet with a fully resorbed tail no longer visible from the ventral side. We further tested whether microglia are involved in the development of the blood vessels across the three stages of metamorphosis. Our results support the model that microglia cell turnover occurs in the optic tectum, a major site of sensory circuit remodeling, and the ventricular zone, a proliferative region of the brain. In addition, our results also suggest that there is a growth in blood vessel development, but the question remains whether microglia have an association with this process.



(A) Blood vessels labeled with Tomato Lectin (red) near the ventricular zone of an NF 58/59 brain. (B) Average integrated density of Tomato Lectin across the metamorphic stages. Data were analyzed using one-way ANOVA with Tukey’s test for multiple comparisons (*** $p<0.001$, **** $p<0.0001$, ns = not significant).

Research Fellow: **Elijah Ramirez (2026)** **Concentration:** **Biology**
Faculty Mentor: **Eddie Watkins** **Department:** **Biology**
Title of Project: **Comparative Ecophysiology of Sun and Shade Grown Individuals of E. hyemale and E. variegatum**
Funding Source: **Division of Natural Sciences and Mathematics**
Project Summary:

During my summer at Colgate, I worked with Professor Watkins on a research project focused on members of Equisetum, commonly known as horsetails. Horsetails are a prominent group of plants that populate our local forest floors and open fields, yet are heavily underrepresented in the literature. Horsetails are characterized by their lack of traditional leaves, instead relying on either a long single stem or branched stems for structure and photosynthesis. This unique physiology makes it difficult to work with when many commonly used tools and techniques for research are developed with traditional leaves in mind. After spending time in the field observing the availability and distribution of local species, we decided to focus on *E. hyemale* and *E. variegatum*. These two were selected because they are non-branching, which made them easier to work with, and because we were intrigued by the visually distinct variation within members of the same species growing in sun and shade environments. Sun grown hyemale, for example, were consistently shorter than their shade grown counterparts. This shaped our research question as we sought to describe the underlying mechanisms driving variations between species and between individuals grown in different conditions.

Rather than conducting this study in the field, we retrieved them from a few locations and introduced them to our greenhouse here at Colgate. To replicate their environments, we built two structures. One was a frame with multiple light strips at the top set on a timer to be on during the day and off at night to replicate high-light conditions. The other frame carried a 70% light reduction cloth, which plants were placed under to simulate low-light conditions. After growing and adjusting to their new environment for at least ten days, a Licor 6400 device was used to gather plant parameters and construct light response curves and A-Ci curves. While we are still in the process of analyzing data, current results are trending towards a sun vs shade dimorphism consistent with what is seen in other plant species in the literature.

Research Fellow: **Eloise Sampson (2026)** **Concentrations:** **Studio Arts; Educational Studies**
Faculty Mentor: **Meg Gardner** **Department:** **Educational Studies**
Title of Project: **Art in Place: Art within a place-based framework in science education**
Funding Source: **Division of Social Sciences**
Project Summary:

My research project this summer explored the way art can be a tool within the place-based framework when applied to science education. Given my study was introduced in July 2025, my work this summer was preliminary research and literature review as preparation to enact the study in the fall. The goal and outcome of the study is to build a lesson plan for elementary students that centers the interdisciplinary approach, bringing art into place-based science education to improve science literacy and encourage curiosity in the natural world.

Place-based education is an educational framework that counters standardized science curriculums by centering the local environment, culture, and communities in an area. Place can be considered through the lens of a location's physical geography and its living world, in addition to the identity, emotions, experiences, and histories a place holds for someone. In order to honor our inherent connection to place, place-based education specifically within science learning, centers the local environment. This framework fosters a greater connection to the subject matter because students can directly apply their lived experience and prior knowledge to what is being taught.

Existing literature, while limited, demonstrates how art has been incorporated into place-based science education. By bringing art into place-based education, independent exploration, curiosity, and critical thinking become second nature. Art can be used as a tool to allow visualizing abstract concepts, making the invisible, visible. It also helps students avoid cramming and memorizing strategies. Finally, it helps teachers informally assess students.

After assessing the existing literature on art in place-based learning, I've found there has yet to be much research done WITH the students themselves. I'm interested in working directly with the children to understand how they experience place-based education and its relationship to the arts. After the research has been conducted, I plan to apply the findings to develop a primary school science place-based arts curriculum.

Research Fellow: **Rafael Sanchez Lazaro (2026)** **Concentration:** **Physics**

Faculty Mentor: **Cosmin Ilie** **Department:** **Physics and Astronomy**

Title of Project: **Determining the Geometry of the Dark Matter Halo at the Center of our Galaxy**

Funding Source: **Justus ’43 and Jayne Schlichting Student Research Fund**

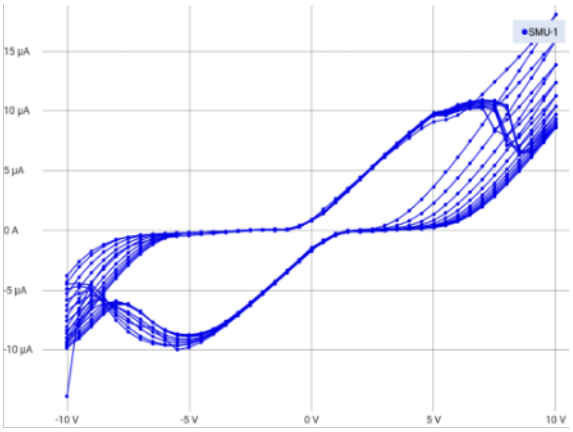
Project Summary:

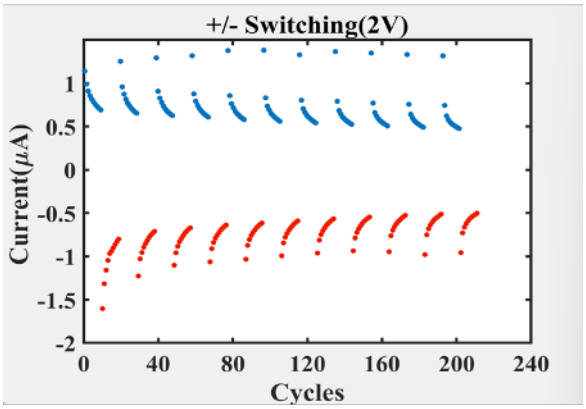
In my summer research project under Professor Illie, we investigate the impact of an ultra-light-dark-matter halo on the orbit of the star S2 orbiting the supermassive black hole Sgr A* at the center of the Milky Way. We will assume a Navarro-Frenk-White (NFW) dark-matter density profile surrounding Sgr A*, and derive the leader-order modifications to the Schwarzschild solution of Einstein’s field equations by solving the TOV equations. Using a combination of analytic derivations and computational modeling with SageMath, we explore how these changes to the metric alter the orbital characteristics of S2, such as orbital period, precession, and distance, relative to observed orbits from the GRAVITY collaboration. We aim to constrain halo parameters to determine the upper limit on the amount of dark matter contained within S2’s orbit and determine its geometry. Future work will extend this analysis to adiabatically compressed halo profiles, enabling more accurate constraints on the dark-matter density.

Research Fellow: Andrew Savage (2026) **Concentrations:** Computer Science; Physics
Faculty Mentor: Ramesh Adhikari **Department:** Physics and Astronomy
Title of Project: Characterization of Pristine Leaf Memristive Devices
Funding Source: National Science Foundation Grant
Project Summary:

As electronics have become more and more prevalent in society, concerns about their environmental impact need to be addressed more seriously. In addition to this, interest in biological materials for use in electronics is growing as well due to their low cost, availability, and biodegradability, as well as their biocompatibility for use in biological systems. We focused specifically on the creation of memristive devices made using pristine leaves as they fit the perfect niche of being simple and easy to acquire and dispose of and having an extremely complex structure allowing ion flow that we can exploit.

Memristors themselves are a novel electrical component that is being researched for its uses in both data storage as well as neuromorphic computing. Given that it is still in the early stages of development compared to other electrical components such as transistors or resistors, only being first made in 2008, there is an opportunity to make them sustainable from the outset. On top of this biological materials may have some advantages over their semiconductor counterparts due to the immense complexity inherent in the cells of the material, which would have to be built from the ground up to achieve in semiconductors.
Instead of trying to alter the structure of the leaf in order to produce certain behavior, we instead took the approach of using a raw untreated leaf as our entire device and after characterizing its behavior, we could choose the best application for our device. This involved testing the current response of the leaf under various different voltages and conditions. We found from this testing that our leaf device could work as an artificial neuron for possible neuromorphic computing purposes.





The top graph shows the general memristive behavior of our leaf device. We can show two different current values at each voltage depending on the direction of voltage change, i.e. going from low to high or high to low. We can then use this to define an On and Off state as the current at 5V which we can control by going to 10V or -10V first. We can also see a habituation-like behavior demonstrated as the peak current values at 10V fall as more and more cycles happen. We use this to model similar behavior in neurons, where they produce lower responses to repeated stimuli as they get habituated to them. On the bottom graph we've shown that we can control and reset this habituation behavior by pausing or applying a negative stimulus which reverts the device back to its un habituated state.

Research Fellow: Jack Schaeffer (2026) **Concentration: Applied Math**
Faculty Mentor: Julie Dudrick **Department: Upstate Institute**
Title of Project: Expanding the Story: Phase II of the Oneida Ltd. Oral History Project
Funding Source: Upstate Institute
Project Summary:

This summer, I carried out a project with the Oneida Community Mansion House (OCMH), a National Historic Landmark dedicated to preserving both the history of the Oneida Community and the legacy of Oneida Ltd. My fellowship primarily focused on expanding OCMH's oral history project and contributing to the exhibit More Than a Silverware Company. Since the oral history initiative began in 2020, OCMH has collected dozens of interviews with former employees and community members connected to Oneida Ltd. My role was to listen to nearly 50 hours of these interviews, identify stories that best highlighted the company's culture and impact, and edit them into short-form clips. These clips were then made accessible to the public through OCMH's online exhibit app, providing new avenues for visitors to engage with the lived history of Oneida Ltd.

In addition to editing existing interviews, I also worked on expanding the collection of archival materials related to Oneida Ltd. I accompanied OCMH staff to Syracuse University's Special Collections, where I documented a series of interviews from 1961 that focused on Oneida Ltd., Kenwood, and Sherrill. Incorporating these materials into OCMH's holdings helped strengthen the Mansion House's historical record and ensured that future researchers will have access to a broader range of perspectives. This phase of the project deepened my understanding of oral history methodology, particularly in how archival sources can complement and contextualize contemporary interviews.

Once the oral history project was complete, I shifted to collections work under the guidance of OCMH's staff. I learned to use collections management software, catalog artifacts, and process newly received donations, which ranged from company newspapers and letters to household objects connected to the Mansion House. Handling these artifacts gave me a tangible sense of the daily lives and legacy of the Oneida Community and its successors. I came to see the extent of OCMH's collections as both a resource for historians and a reflection of the Mansion House's longstanding role as a cultural and community landmark.

This fellowship provided me with valuable research skills and professional experience in both oral history and collections management. In just ten weeks, I gained a deeper understanding of the history of the Oneida Community, the development of Oneida Ltd., and the ongoing work required to preserve and interpret this history for the public. My time at the Mansion House also emphasized the importance of connecting academic study with community-based preservation efforts. As a history minor, this experience reinforced my interest in public history and museum work, and I look forward to carrying what I have learned into future academic and professional opportunities.

Research Fellow: **Penelope Schenkel (2028)** **Concentration:** **Undeclared**
Faculty Mentor: **Anthony Chianese** **Department:** **Chemistry**
Title of Project: **Kinetics of Ruthenium-catalyzed Hydrodehalogenation Reactions**
Funding Source: **National Science Foundation Grant**
Project Summary:

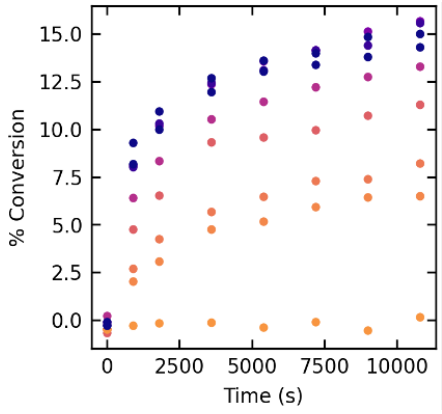
Understanding the kinetics of a chemical reaction can provide insight into the mechanisms by which a reaction operates and help to predict the relationship between the rate of reaction and other relevant factors, including substrate concentration, catalyst concentration, etc. This project aims to increase our understanding of the reaction kinetics that occur when using Milstein's catalyst. Catalysts are substances that assist in other chemical reactions, such as through hydrogenation and dehydrogenation (the addition and removal of a hydrogen from a molecule, respectively).

In 2017, Nobel laureate Dr. Robert Grubbs published a paper illustrating the use of Milstein's catalyst, a ruthenium-PNN pincer complex, in hydrodehalogenation reactions using isopropanol as a solvent in combination with a base. The stable precursor of Milstein's catalyst, a hydridochloride complex with the formula (PNN)RuHCl(CO), was used to catalyze the reaction. After replicating Grubbs' reaction using 1-bromodecane as a substrate with sodium tert-butoxide as a base at Colgate, further kinetic experiments were performed to understand the mechanisms of this reaction.

For kinetic experiments, gas chromatography was used to assess substrate conversion and product yield over time; tetradecane was used as an internal standard. Initial trials used 1-bromodecane as a substrate to mimic Grubbs. However, numerous side reactions limited yield and made understanding kinetics difficult. 1-bromo-4-tert-butylbenzene was used as a substrate for further reactions as it provided a cleaner reaction to study. Sodium isopropoxide was used as a base. Kinetic experiments were performed at 30, 50, and 70° C using 1-bromo-4-tert-butylbenzene, and currently indicate that the reaction is first order in terms of base, substrate, and catalyst after the first hour of reaction. There is an apparent burst phase in the first hour of the reaction before substrate conversion slows to follow first order kinetics. Spike experiments were performed to understand this burst phase, where catalyst was added both at the beginning and in the middle of the reaction; there was not a second burst once the second dose of catalyst was added.

When the hydridochloride precatalyst interacts with base, it becomes an alkoxide. NMR was used to visualize the different forms of catalyst present in a reaction. Future experiments will examine which forms of the catalyst are present at different temperatures and where these catalysts are located on proton and phosphorous NMR spectra. Future experiments will also focus on understanding the burst phase at the beginning of the reaction as well as solidifying our understanding of the rate law for this reaction.

Figure 1: Substrate conversion at 50° C with increasing catalyst loadings



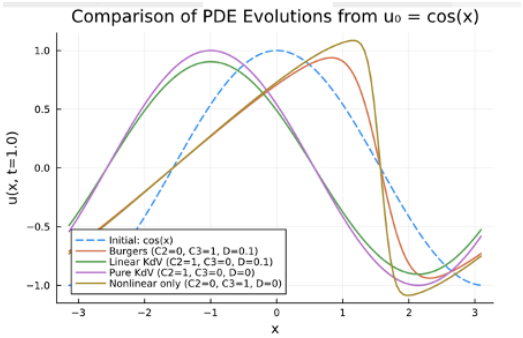
Research Fellows: Olivia Schlegel (2027) — **Concentration:** Applied Math
Yuchen Zhao (2026) — **Concentrations:** Economics; Applied Math
Faculty Mentor: Nick Moore — **Department:** Mathematics
Title of Project: Numerical sampling and simulation of rogue water waves
Funding Source: Office of Naval Research Grant; Division of Natural Sciences and Mathematics

Project Summary:

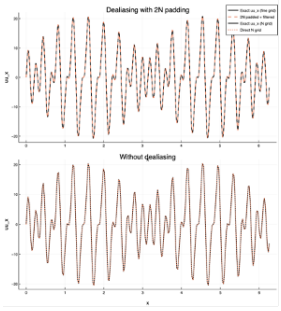
Rogue waves are an unpredictable phenomenon in which large ocean waves appear suddenly, even in seemingly calm waters. They can pose serious threats to ships at sea due to their magnitude and unpredictable nature. Although they seem to arise randomly, their formation may be influenced by underlying physical mechanisms. In our research we attempted to better understand rogue waves by solving the Korteweg–de Vries (KdV) equation. The KdV equation is a nonlinear partial differential equation (PDE) that models wave phenomena. Through solving this equation, we can better understand rogue wave activity and gain insight into the propagation of nonlinear wave structures and explore potential factors that contribute to the emergence of rogue waves.

The specific form of the KdV equation we used included a diffusion term: ut+ Duxx+ C2uxxx + C3uux = 0, where D, C2, and C3 are all parameters. In order to solve this equation for a chosen initial u0 we created a routine in the Julia programming language. We began by applying Fourier series expansions, expressing the solution as u(x,t) = ∑_k (u_k)ˆ(t) e^ikx on [0,2π) and approximated the nonlinear term uux similarly as uux = ∑_k (v_k)ˆ(t) e^ikx. Once all terms in the KdV equation were represented in spectral form, we used the Linear Propagator Method, which solves the PDE using the integrating factor technique combined with the RK2 (midpoint) method. This gives us an update equation for uˆ_k^((n+1)), which then allows us to time step using a pseduo-spectral method. Within each time step we transform the current uˆ_k to physical space using built in Julia function ifft, compute u·ux, and then transform the result back to spectral space using fft. We can time step this as many times as needed to see how the wave function will evolve over time.

We also add dealiasing to reduce the error that arises when computing nonlinear terms in spectral methods. Nonlinear operations can generate high-frequency components, and these components may be misrepresented as lower frequencies in the solution. In order to fix this problem, we introduce the dealiasing algorithm. First, we double the number of grid points in the physical domain, which increases the resolution and ensures that the nonlinear product is computed more accurately. Then, we apply an exponential filter to the Fourier coefficients of the nonlinear term to dampen high-frequency modes and reduce aliasing. The filter is defined as ρ(k) = exp (−α (|k|/N)^m), where α = 36, m = 36. By applying dealiasing, we achieved around a 20% decrease in the L2 error, and also a smaller decrease in the relative errors of the conserved quantities: energy, momentum, and Hamiltonian.



This graph shows how a wave can evolve differently over time according to different parameter values.



This graph compares the L2 errors for the function uu_x = sin(x) + sin(16x) before and after dealiasing.

Research Fellow: **Kathryn Schluter (2026)** **Concentration:** **Biology**
Faculty Mentor: **Rebecca Metzler** **Department:** **Physics and Astronomy**
Title of Project: **Ocean Acidification and its Effect on Crab Microstructures**
Funding Source: **Division of Natural Sciences and Mathematics**
Project Summary:

Climate change has resulted in the world's ocean temperatures rising. Along with rising temperatures, oceans are becoming more acidic due to an excess of carbon dioxide within the atmosphere, which these bodies of water are then absorbing. Calcium carbonate is an important component of the shells of crabs, but when too much carbon dioxide is absorbed by water, its carbonate form does not get used for the calcium carbonate form that is needed for the crabs and instead takes on an acidic form. My research aims to understand just how ocean acidification is altering the microstructures within different parts of crabs shells so that we can predict the ways future crab populations will be affected by climate change as well as come up with solutions that address ways in which we can mitigate warming waters impact on shell microstructures.

This summer, we examined the carapace, claw, and legs of female and male snow crabs as well as the claw of a blue crab using the SEM and EDS. From imaging, structural variation was noted in each of the samples, as well as differences within different parts of individual samples. EDS showed different levels of calcium, oxygen, magnesium, carbon, and traces of other elements throughout each of the samples (Fig 1. & Fig. 2). With this data, we plan to create graphs that depict the overall amount of each element detected so that we can explore how these levels are expected to look under current conditions, allowing us to compare to measurements made on crabs grown in higher temperature or lower pH.
This data will be a starting point for my senior research tutorial this fall where we will look at the carapace, legs, and claws of green crabs in comparison to the snow and blue crabs. Green crabs are an invasive species in the US, and they are slowly starting to take over areas where blue crabs and snow crabs typically reside. Given that this crab species is invasive, it makes me curious whether the microstructures of these specific crabs gives them an advantage that allows them to thrive in warming and increasingly acidic waters that other species suffer in. By conducting this research, we are able to gain a better understanding as to how human environmental impacts are affecting certain marine organisms, as well as how shell microstructure may give invasive species an advantage in warming waters.

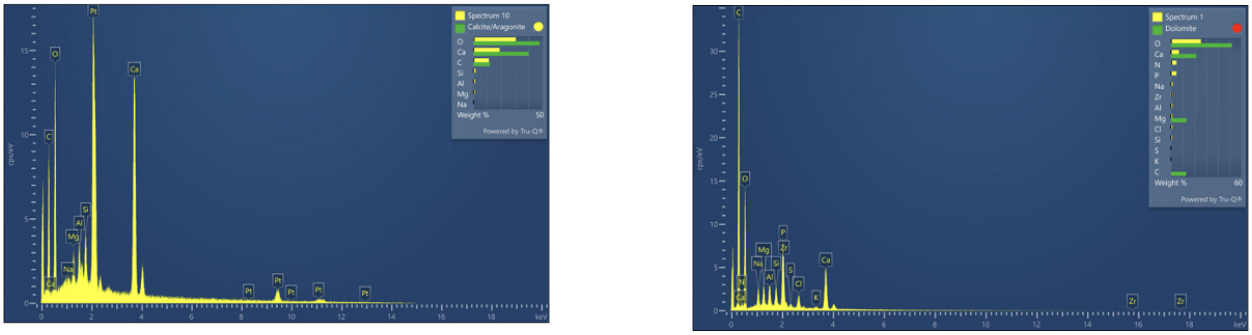


Figure 1: BlueCrabClaw_BOX2B_PIC1_BOTTOM (spectrum 10; left); SnowCrabMaleLeg_BOX2C_PIC1_TOP (spectrum 1; right)

Research Fellow: **Leigha Schultze (2026)** **Concentrations:** **Environmental Studies; Political Science**

Faculty Mentor: **Julie Dudrick** **Department:** **Upstate Institute**

Title of Project: **Employing Community-Building Strategies to Enhance Regional Support Networks within the Adirondacks**

Funding Source: **Upstate Institute**

Project Summary:

This summer, I had the privilege of working with two nonprofit organizations through my fellowship with the Upstate Institute, the Adirondack Community Foundation (ACF) and the Adirondack Diversity Initiative (ADI). ACF provides financial resources, partnerships, and organizational assistance to nonprofits, schools, medical facilities, and more across the Adirondack region. ADI empowers local communities to become agents of change by offering educational materials that promote inclusivity. Both organizations recognize that building resilience from the ground-up by cultivating support networks that unite and uplift communities is essential to making the Adirondacks an accessible place where all can thrive.

During the week, I worked at ACF's office in Lake Placid with the Grants and Programs team on a project focused on evaluating the impact of ACF grants and granting strategies within local communities. I started by reading through the follow-up reports submitted by grantees at the end of the 2024 fiscal year, looking through these reports to identify the most common challenges grantees faced and evaluate whether they were able to meet or exceed their goals established through their initial grant applications. In reading these reports, I identified various nonprofits to meet with for further exploration of their successes and struggles. Through these interviews, I sought to uncover the personal stories and outcomes behind the accomplishments and quantifiable outputs grantees produced in the past year. Using this information, I wrote impact stories that highlighted each nonprofit and spotlighted some of the accomplishments and impacts they were most proud of. My goal with these stories is that they serve as a form of PR for external audiences to encourage their sustained support of the ACF mission. By the end of the summer, I shifted my focus to broader trends in ACF 3-year grant data, exploring changes in granting over time and what priority areas were receiving more or less funding. Analyzing this data provided new insights into grantmaking strategies and areas, whether categorical or geographical, that could use additional financial or relational support in the future.

I was fortunate to spend the latter portion of my week and weekends out of the office, and on the trails with ADI. For this research project, I was stationed at various trailheads in the High Peaks wilderness and collected data both actively and passively. The passive data was largely in relation to social and geographical demographics of visitors using the trailheads, whereas the active data was collected via surveys that asked visitors about their prior experience on the trails, where they acquired information for their hikes, individual motivations for using the trailheads, and their perceptions of welcoming in the wilderness space. Primarily, ADI was looking to see if there was a noticeable difference in the degree to which people of all races, classes, religions, genders, sexualities, ages, and disabilities are perceived to be safe and included in the Adirondack wilderness. The data I gathered this summer, which will supplement an ongoing 3-year study, will be sent to the New York Department of Environmental Conservation in hopes that they can revise the language of their wilderness Visitor Use Management framework to be more inclusive of people across all demographics.

ACF and ADI recognize that empowering community actors is a vital first step toward affecting real change, and this belief is reflected in their work to uplift communities through funding and education. This summer experience has taught me that spending time, money, and effort building up communities in the Adirondacks is a worthy investment because it is in these communities that progress is felt most acutely. It has shown that grassroots movements and nonprofit work can create far greater ripples throughout communities than one might anticipate, and has renewed a longer-term interest in working in the nonprofit sector.

Research Fellow: Eli Senzel (2026) **Concentrations:** English; Political Science

Faculty Mentor: Annie Benn **Department:** Political Science

Title of Project: Congressional Oversight of the Bureaucracy

Funding Source: Division of Social Sciences

Project Summary:

An underdiscussed aspect of policy in the US government is the bureaucracy. Federal agencies conduct a significant amount of rulemaking, much of which is conducted under the authority of congressional statutes that authorize their actions. However, does Congress have control over bureaucrats beyond statutes, or do agencies hold the cards? This research project, through studies of congressional hearings and their policy outcomes, as well as comments on proposed agency rules and their subsequent final rules, seeks to determine the impact Congress, as well as the President and lobbyists, have on agency action, findings that could inform interbranch relations in the contemporary political era.

During this project, I have written several literature reviews that support ongoing research projects. First, I prepared a general overview of congressional oversight, focusing on tactics such as the aforementioned comments and hearings, as well as statute specification and timing, deck-stacking, fire alarms, limitation riders, and many more. Here, I expanded on existing literature, which places a great deal of focus on whether oversight is taking place, but far less on whether it is effective. This literature review looked at oversight comprehensively, and I noted that, on balance, Congress can restrict bureaucratic action, though it often fails to conduct oversight effectively, only using its most effective tactics sparingly.

Another literature review focused on the external influence of the bureaucracy. I studied comments on proposed rulemaking, in addition to pre-policy lobbying, which constitutes a much less visible portion of business and interest group influence. These papers were very interesting, as I argue that existing articles, which tended to focus on either interest groups or businesses, neglected the fact that, for the most part, federal agencies prioritize unity and volume over all else, leaving business and interest group lobbyists without an institutional advantage in influencing rulemaking. However, this does not translate into pre-comment lobbying, a field in which more powerful groups have a better chance of influencing agency policies before they are made. This conclusion synthesizes the existing empirical literature on the topic and provides insight into the practice of bureaucratic lobbying, which I will continue to study with an ongoing paper in the fall. A final literature review dealt with the concept of attacks on administrative capacity by the President, a subject that has a growing role in today's political climate. In the articles I studied here, I noted the negative relationship between bureaucratic capacity and Presidential unilateralism, an understanding that may inform present bureaucratic developments. Through these three literature reviews, I gained a greater understanding of bureaucratic politics and how oversight can occur from several perspectives.

Another aspect of my research was studying congressional hearings and their outcomes. My case studies of ten hearings regarding bureaucratic actions provided great insight into legislative attempts to oversee agency outcomes and influence the executive branch. These hearings covered topics such as regulatory Executive Orders, proposed rulemakings, and agency guidelines. With this focus, I also studied a database of congressional hearings from the last half-century and determined how legislators refer to Executive Orders in their testimony and whether their focus tends to be substantive or procedural. In conducting these case studies, I looked for hearings that met distinct conditions, mainly action or inaction following the hearing by the agency, whether any changes came before or after changes in the President's party, and whether the hearing was politically salient. To determine hearing effectiveness, I studied government documents to see whether agencies were responsive to the changes suggested by Congress in the hearing, using these findings to determine whether the selected hearing, and oversight in general, was successful. With my focus on literature reviews and case studies, I have gained a comprehensive understanding of the congressional oversight process, determined areas where it has more success, and seen how bureaucratic action has developed over time, especially in its attempts to be overseen by Congress, the President, and lobbyists.

Research Fellow: **Ashley Shanahan (2027)** **Concentration:** **Neuroscience**
Faculty Mentor: **Anzela Niraula** **Department:** **Psychological and Brain Sciences**
Title of Project: **Exploring the microglia response to demyelination and remyelination in mice**
Funding Source: **Division of Natural Sciences and Mathematics**
Project Summary:

Multiple Sclerosis (MS) is a demyelinating disease of the nervous system, characterized by loss of myelin and death of neurons. Cuprizone is a copper chelator that when given to mice depletes oligodendrocytes, leading to myelin loss, particularly in areas of the brain that are high in myelin content, such as the corpus callosum. Cuprizone withdrawal leads to remyelination and oligodendrocyte renewal. The course of demyelination and remyelination that is induced with cuprizone in mice without disrupting the blood-brain barrier makes cuprizone a strong model for understanding the development of MS. Microglia are critical for the brain's response to cuprizone-induced demyelination, as microglia are the resident macrophages of the brain. It is not yet understood what microglia are responding to during cuprizone-induced demyelination or withdrawal from cuprizone. Using mice and cell culture experiments, we sought to characterize the microglial phagocytic response, the recruitment of peripheral immune cells, and the direct effects of cuprizone on microglia.

To examine the acute and chronic cuprizone response, mice were placed on either a one week or four week cuprizone diet respectively. To examine microglial dynamics during remyelination, a third group of mice was given a cuprizone diet for four weeks followed by one week of vehicle diet. We hypothesized that microglia are engulfing myelin during demyelination in response to cuprizone. Immunohistochemistry was done on brain sections containing corpus callosum. We labeled for myelin basic protein (MBP) and Iba-1, which is a marker for microglia. We imaged the sections using a confocal microscope and did a quantitative analysis of the images for colocalization of MBP and Iba-1, which is indicative of microglia engulfing myelin. It was found that there was a significant increase in colocalization of MBP and Iba-1 at all time points when compared to vehicle, including in mice that were withdrawn from cuprizone for a week. This indicates that during both demyelination and remyelination stages, microglia are engulfing myelin.

To further understand changes in microglia activation, mouse brain sections from the various time courses will be analyzed for the presence of peripheral immune cells and vascular markers. That analysis will indicate if microglia are promoting the transport of peripheral immune cells into the brain in order to respond to cuprizone-induced demyelination and subsequent remyelination. Cell culture experiments with BV-2 cells, which are a microglial cell line, will also be used to understand gene expression changes in microglia in response to cuprizone and withdrawal, particularly focusing on how cuprizone may directly affect microglia, particularly microglia metabolism.

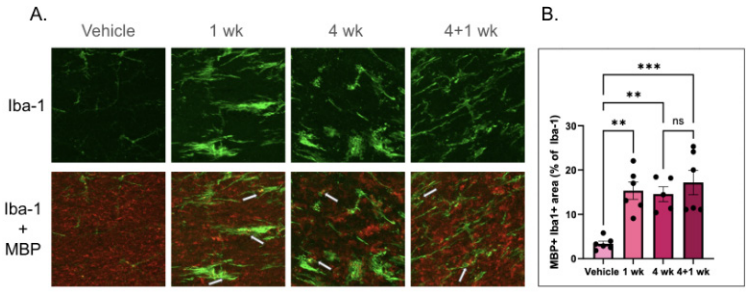


Figure 1: Iba-1 and myelin basic protein (MBP) imaging and analysis in the corpus callosum. (A) Representative confocal images and (B) quantification of Iba-1 (green) and MBP (red) from the rostral corpus callosum sections of mice treated with cuprizone for the indicated durations. White arrows indicate microglial colocalization with myelin. Asterisks indicate significant difference: **p<0.001, ***p<0.0001, ns = not significant.

Research Fellows: **Kathryn Shearer (2027)** **Concentration:** **Political Science**
Catherine Whang (2026) **Concentration:** **Political Science**
Faculty Mentor: **Danielle Lupton** **Departments:** **Political Science; International Relations**

Title of Project: **Threat Construction During Crises: How Leaders Justify Coercion**

Funding Source: **Stickles Fund**

Project Summary:

This summer, I researched the use of coercive threats in international crises. Coercive threat can be a useful tool to leaders during international crises in order to achieve certain goals, whether it be to deter another power from striking or demand that invading troops retreat. I used International Crisis Behaviors Events (ICBe) to collect data for our research. The dataset covers 475 international crises from 1918 to 2015. These crises spanned from relatively small conflicts to full-scale wars. Within the dataset are details on the crises, including the states involved, background information, and the actions taken by each state. These specifics were demonstrated through both mapping and tables. Of the crises in the dataset, I specifically researched the crises that involved a demand, threat, ultimatum, or show of force between states. Once I narrowed down the dataset to follow this criteria, I did extensive research on each of these crises to determine the nature of each of the threats.

Coercive threats can vary from crisis to crisis. They may be general statements, or define specific consequences. The demands can be stated directly by the state leader, or other areas of the government. The threat can be made publicly or privately. These details, including the exact wording that is used for the threat, can be crucial to determine the efficacy of the threat. These were some examples of features that I researched in order to ascertain if the threat was deemed "successful." I used scholarly articles and primary documents to analyze the individual coercive threats. While it was difficult in some cases to find direct statements of the threats, there were often many primary sources reporting on the threats after they were made. We found that coercive threats can be effective depending upon the circumstances surrounding the threats, as well as the delivery of the threat itself. My research particularly focused on how the threats were justified. The justification of a threat can greatly contribute to determining both the efficacy of the threat and the perception of the threat by both the targeted state and other involved states. While the research did not yield results in the traditional sense, I am interested to see how the research we did will be used in the future.

Research Fellow: **Jenavieve Sherwood (2026)** **Concentrations:** **Spanish; Molecular Biology**

Faculty Mentor: **Engda Hagos** **Department:** **Biology**

Title of Project: **Investigating the Role of Krüppel-like Factor Four (KLF4) in Cancer Metabolism**

Funding Source: **Michael J. Wolk '60 Heart Foundation**

Project Summary:

Krüppel-like factor 4 (KLF4) has been widely studied as an effective tumor suppressor gene in colorectal cancer cells. It has been linked to genomic stability, as cells lacking Klf4 have higher levels of DNA damage, such as chromosomal aberrations. Furthermore, it has been implicated as a hallmark of colorectal cancers, one of the most common cancers worldwide. Our recent findings indicated that in the absence of Klf4, damage to mitochondria may facilitate a shift toward glycolytic metabolism, an indicator of the Warburg effect, wherein cancer cells stay in glycolysis regardless of oxygen levels. A byproduct of the Warburg effect also builds up lactate within the cell, acidifying the tumor microenvironment and making it ultimately more favorable for cancerous cells to thrive. Additionally, cancer cells overuse fatty acid metabolism, where higher levels of fatty acid oxidation are observed. However, the role of Klf4 in fatty acid metabolism as a method of maintaining genomic integrity remains to be elucidated. This study seeks to address the role of Klf4 in fatty acid metabolism in mouse embryonic fibroblasts (MEFs). In order to determine the role of KLF4 in cancer metabolism, we compared cells expressing KLF4 (MEFs +/+) and lacking KLF4 (MEFs -/-). Oil Red O staining was conducted to investigate lipid droplet levels when cells were treated with 2DG, a drug that inhibits glycolysis. In addition, MEFs were deprived of glucose for 24hrs. When Klf4-null cells were under metabolic stress, they exhibited the highest amounts of lipid droplets. It was found that Klf4-null MEFs had the highest number of lipid droplets when under 0% glucose for 24hrs (Fig. 1). This indicates some sort of relationship between regulation of fatty acid oxidation and the presence of KLF4, especially when the cells are facing metabolic stress. Figure 2 displays fluorescent imaging after cells were treated with 2DG. Consistent with previous findings, the highest lipid droplet production was in the KLF4 null cells treated with the highest 2DG concentration. This indicates some sort of relationship once again, as cells are unable to utilize the Warburg pathway if 2DG halts glycolysis and switches to lipid metabolism. Similar to the glucose starvation stain (Fig. 1) we see that under more metabolic or glycolytic stress, there is higher lipid droplet production. Further studies will investigate other metabolic stress conditions and levels of fatty acid metabolic protein expression measured by western blotting.

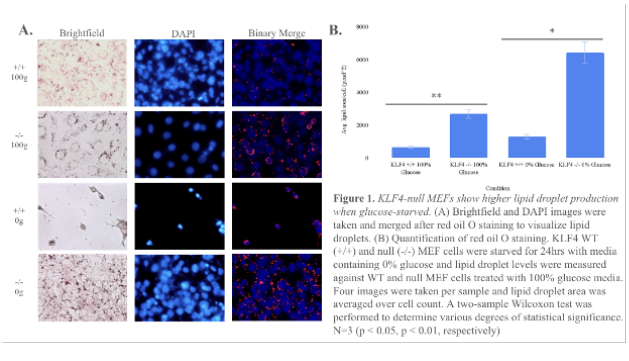


Figure 1. *KLF4-null MEFs show higher lipid droplet production when glucose-starved.* (A) Brightfield and DAPI images were taken and merged after red oil O staining to visualize lipid droplets. (B) Quantification of red oil O staining. KLF4 WT (+/+) and null (-/-) MEF cells were starved for 24hrs with media containing 0% glucose and lipid droplet levels were measured against WT and null MEF cells treated with 100% glucose media. Four images were taken per sample and lipid droplet area was averaged over cell count. A two-sample Wilcoxon test was performed to determine various degrees of statistical significance. N=3 ($p < 0.05$, $p < 0.01$, respectively)

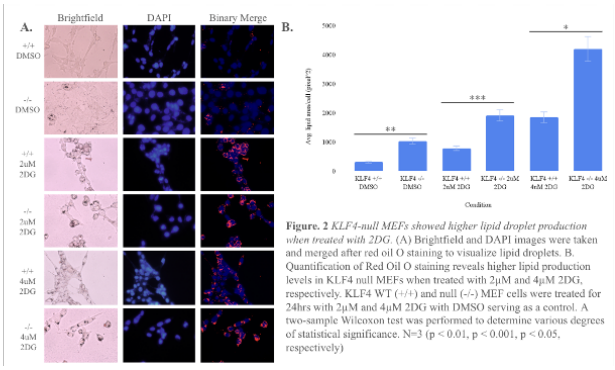


Figure. 2 *KLF4-null MEFs showed higher lipid droplet production when treated with 2DG.* (A) Brightfield and DAPI images were taken and merged after red oil O staining to visualize lipid droplets. B. Quantification of Red Oil O staining reveals higher lipid production levels in KLF4 null MEFs when treated with 2μM and 4μM 2DG, respectively. KLF4 WT (+/+) and null (-/-) MEF cells were treated for 24hrs with 2μM and 4μM 2DG with DMSO serving as a control. A two-sample Wilcoxon test was performed to determine various degrees of statistical significance. N=3 ($p < 0.01$, $p < 0.001$, $p < 0.05$, respectively)

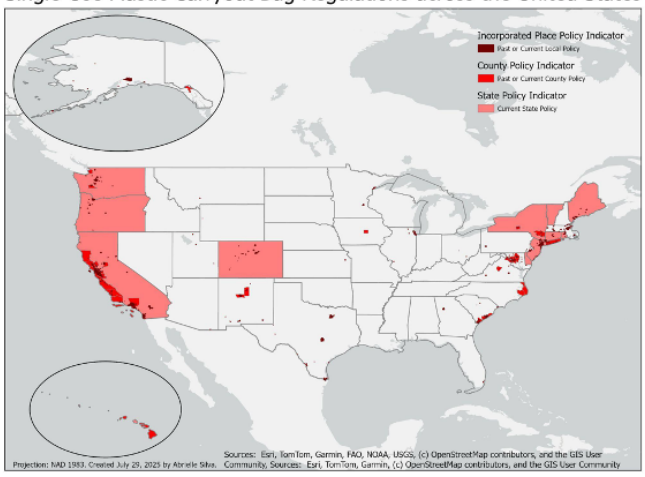
Research Fellow: Abrielle Silva (2026) **Concentration:** Environmental Economics
Faculty Mentor: Isla Globus-Harris **Departments:** Economics; Environmental Studies
Title of Project: National-Level Analysis of Single-Use Plastic Bag Regulations
Funding Source: Walter Broughton '63 Research Fund
Project Summary:

The objective of my research was to identify the regulation of single-use plastic bags (SUPB) across all levels of governing power across the United States. Looking at states, counties, and incorporated places, I engaged in extensive data collection efforts of which governments have implemented SUPB policies; for those with a policy, I identified the policy name, municipal code section and adopting ordinance or resolution, date of adoption, date of enforcement, type of policy, complementary paper or reusable bag policies, and other policy details. Exploring the adoption of these policies can provide insights into how SUPB regulation, and similar environmental policies, will progress across the United States.

My dataset was initially based on the Californians Against Waste National List of Local Plastic Bag Ordinances.[1] Along with lacking specific details for many regulations, the list omits various policies. I carefully researched all regulations provided and exhaustively searched for any missing policies. The dataset I created is as complete as possible, supported by local municipal codes, public ordinance archives, government websites, and reliable local news organizations.

By identifying past and current SUPB regulations, I was able to examine the geographic distribution of where these policies have been adopted. Environmental policies are often modelled after neighboring communities policies, and SUPB policies are not an exception. The geographic distribution of these policies across the nation show clusters where policies are more commonly adopted. Notably, there are denser clusters of county- and local-level policies within states that currently have a state-wide policy, suggesting that the abundance of policies within the state predicts the adoption of state-level SUPB regulation. Further supporting this evidence is the high amount of lower level policies in Massachusetts, which is currently in the midst of adopting a state ban on single-use plastic carryout bags.

Single-Use Plastic Carryout Bag Regulations across the United States



This research and data collection will lay the framework for my honors thesis project this year. I plan to examine the characteristics that predict local adoption of SUPB regulations, analyzing economic and political predictors and outcomes.

[1] List of national bans. (n.d.). Californians Against Waste. Retrieved February 28, 2025, from https://www.cawrecycles.org/list-of-national-bans.

Research Fellow: **Emma Slupik (2026)** **Concentration:** **Neuroscience**
Faculty Mentor: **Wan-chun Liu** **Department:** **Psychological and Brain Sciences**
Title of Project: **Defining Syllable Complexity in Zebra Finch Birds**
Funding Source: **Division of Natural Sciences and Mathematics**
Project Summary:

Previous research in this lab has identified song-entangled beat gestures in zebra finch birds. These lateral gestures appear to mirror beat gestures in humans through their alignment with song rhythm; preliminary results indicate that a zebra finch's co-song beat gestures are more likely to occur when they produce a song syllable of longer duration, which are visually identified as more complex. However, what makes a syllable complex? While other studies have attempted to classify zebra finch syllables into groups using acoustic features, weak species-wide clustering tendency was observed and complexity was not clearly defined. This study investigates a new methodology for operationally defining syllable complexity by quantifying significant transitions in acoustic features during syllable production.

Using SAP software, we analyzed sound files for 10 sound features at each timepoint within a syllable interval (22 adult male zebra finches, 114 syllables total). We created a program in MATLAB to identify the local maxima and minima of each sound feature within a syllable, and count the transitions between these points which were practically significant based on an experimentally set threshold (> 1 SD of all values collected for that feature amongst the population of birds).

Obtained via discriminant function analysis, total transition counts predicted the timing of co-song gestures; syllables identified as more complex through higher transition counts of song features were more likely to be gestured during. Additionally, transition counts are stronger predictors of co-song gesture timing than the mean or variance values for any acoustic feature. Total transitions (r =.846), AM transitions (r =.796), FM transitions (r =.774), and amplitude transitions (r =.690) of a syllable were the most influential transition components in determining whether a bird gestured on the syllable. By filtering out minute variations ("noise") within a sound feature using a threshold value, our transition program may more accurately predict syllable complexity than variance values of the same acoustic features. Future research should determine the most biologically significant threshold value. Operationally defining syllable complexity will be instrumental in future research uncovering the function of song-entangled beat gestures.

Research Fellow: Shep Sorenson (2027) **Concentration:** Molecular Biology
Faculty Mentor: Jen Greenwich **Department:** Biology
Title of Project: Investigating the Interaction Between PruR and DcpA in Agrobacterium tumefaciens
Funding Source: Division of Natural Sciences and Mathematics

Project Summary:

Agrobacterium tumefaciens is a common soil microbe that is responsible for crown gall disease in plants. Agrobacterium tumefaciens is a valuable model system for bacteria, as most of its proteins share similarities with proteins in other types of bacteria. The majority of bacteria, including Agrobacterium tumefaciens, possess the ability to form biofilms. A biofilm is a sessile colony of bacteria that is anchored to either a biotic or an abiotic surface. Biofilms are highly resistant to antibiotics and are one of the leading causes of hospital infections. DcpA and PruR are two proteins in Agrobacterium tumefaciens that, when interacting, regulate biofilm growth. The ultimate goal of my project is to discover the specific locations of interaction between the proteins PruR and DcpA.

DcpA and PruR regulate biofilm growth through the amount of the secondary messenger cyclic di-GMP present. Cyclic di-GMP triggers the synthesis of polysaccharides, such as cellulose and the unipolar polysaccharide (UPP), both of which contribute to biofilm formation. DcpA is a dual-function protein that can both create and break down cyclic di-GMP, therefore controlling biofilm growth. DcpA only breaks down cyclic di-GMP when it is interacting with PruR. To find the specific points of interaction between DcpA and PruR, random mutants in the pruR gene were generated and screened for interrupted interaction using biofilm assays. Biofilm assays are performed by placing a coverslip in a well inoculated with bacteria and given 48 hours to incubate. Then the OD600 is measured from the culture left in the well after removal of the coverslip, and the A600 of crystal violet from the removed coverslip, solubilized in acetic acid, is also measured. The ratio CV/OD was used to normalize the biofilm in comparison to the growth for quantification.

From the screening of potential *pruR* mutants, four mutants were identified as interrupting the regulation of biofilm formation. These mutants are pictured in Fig. 1; they include A1, C1, E2, and F1. The proposed reason for the elevated biofilms in this case is that in the mutants, PruR is unable to properly bind to DcpA, so cyclic di-GMP cannot be broken down. If cyclic di-GMP isn't able to be broken down, then it will continuously cause the synthesis of the previously mentioned polysaccharides and, therefore, elevate biofilm levels.

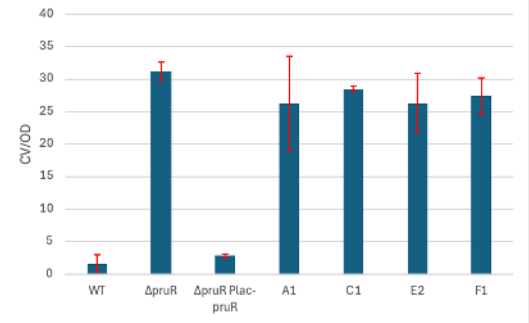


Figure 1. Random mutant biofilm assay. The A600 of crystal violet was divided by the OD600 from the culture left in well after coverslip removal. All random mutants display elevated biofilm formation compared to the wild type.

The next step for my research project is to dive deeper into the mutants by performing Western blotting to see if PruR and DcpA are interacting. I will then sequence the mutants to see exactly which amino acid residue is mutated. Once specific amino acid residues have been identified as possible binding sites, I will use the crystal structure of PruR to further look into those possibilities and finalize where exactly PruR and DcpA interact.

Research Fellow: Yaroslav Spytskyi (2028) **Concentration:** Chemistry
Faculty Mentor: Anthony Chianese **Department:** Chemistry
Title of Project: Ru-catalyzed Hydrodehalogenation
Funding Source: Warren Anderson Fund
Project Summary:

The Chianese lab specializes in studying reactions catalyzed by transition metal complexes. My work this summer focused on studying hydrodehalogenation of organohalides using Milstein's catalyst. Hydrodehalogenation reaction removes a halogen, chlorine, bromine, or iodine from an organic molecule and replaces it with a hydrogen atom. Other scientists published work studying similar reactions, but used an alcohol as a source of hydrogen. Our reaction uses hydrogen gas for the same purpose which promotes atom efficiency and sustainability. There are no reports of hydrodehalogenation with hydrogen gas and Milstein's catalyst, so I began the study of the new reaction this summer.

The first step was to find working reaction conditions. I successfully adapted the reaction conditions from scientific literature to the specific requirements of our reaction. A blueprint for my reaction consisted of 4 reagents: catalyst, base, hydrogen source, and solvent. The right reagents would result in successful hydrodehalogenation of a wide scope of organohalides. I knew what catalyst and hydrogen source I would use, so I had to find the answer for two other variables.

Once I had my hypothesis, I had to perform a positive control of my reaction. Since Milstein's catalyst reacts with oxygen in the air, all reactions had to be set up in an inert atmosphere in an Argon-filled glovebox. The reaction vials were then transferred to a reactor, pressurized with hydrogen gas, and heated at a certain temperature overnight.

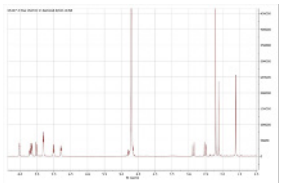
After running a first successful hydrodehalogenation of bromodecane, I began optimizing my reaction conditions by meticulously changing the concentration and ratio of the reagents to fine tune the reaction to produce the highest yield. I used gas chromatography (GC) to calculate the analytical yield and conversion for reactions with internal standard. I wrote a custom python script to quickly and efficiently analyze raw data produced by GC instrument. As a result of optimization, I developed a set of reaction conditions which produced 100% conversion and >90% yield of bromodecane.

Next, I focused on exploring the scope of the reaction to find its limitations. I used various organohalides as reactants and studied their reactions by calculating analytical and isolated yield. Based on the properties of a given product, I performed manual or automated column chromatography with CombiFlash machine to isolate the product, which was then identified via proton and carbon NMR. During the first phase of exploration, I worked with 8 different organic compounds. My data showed 4 compounds with yield equal to or above 90%, 2 with the yield greater than 80%, and 2 with the yield equal to or greater than 60%.

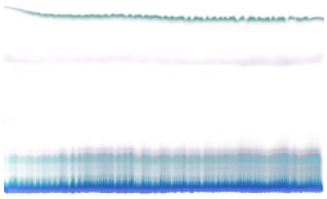
The future steps for my project include finishing the scope exploration and starting a kinetic study of the reaction mechanism.

Research Fellow: **Sabrina Srabani (2027)** **Concentration:** **Molecular Biology**
Faculty Mentor: **Dimitar Shopov** **Department:** **Chemistry**
Title of Project: **Synthesis and Characterization of Iridium Oxo Dimers for Water Oxidation Catalysis**
Funding Source: **Division of Natural Sciences and Mathematics**
Project Summary:

Our project is focused on making and studying iridium oxo dimers, with the long-term goal of testing whether they can produce oxygen through water oxidation. This reaction (turning H_2O into O_2) is a part of artificial photosynthesis, which could enable renewable fuel production. We begin with the synthesis of iridium precursors: Iridium COD chloride by reacting ammonium hexachloroiridate (IV), cyclooctadiene (COD), isopropanol, and water (79% yield). The iridium cod chloride is then reacted with our M-di-pyalk ligand (we have synthesized previously) and potassium tert-butoxide + solvent in a glove box (under Argon), and then run under CO to coordinate a total of 4 CO atoms on the symmetric compound known as dipyalk Ir2(CO)4. Purifying this compound is difficult, requiring up to 5-7 rounds of recrystallization and solvent precipitation (DCM and hexane). Figure 1 shows the NMR spectrum of the oxo dimer after oxidation:



Once isolated, we test oxidants such as sodium periodate, permanganate, and hydrogen peroxide under different conditions (varying molarity & equivalency) to generate the oxo dimers. While the reactions yield a mixture of products, one major product could be isolated and identified. Our most successful oxidation has been with sodium periodate. The oxidation with peroxide or permanganate decomposes with time. We also prepared a half-metalated species, HdipyalkIr(CO)2, which, upon oxidation with sodium periodate, forms many oxo dimer species that can be separated by thin-layer chromatography (TLC). Isolating and crystallizing these species is part of ongoing work. Figure 2 shows our separation attempts:



The next step is to determine whether these oxo dimers can act as good water oxidation catalysts.

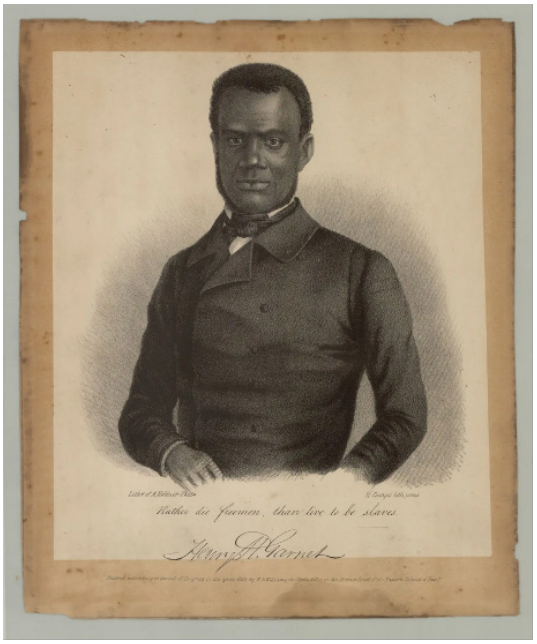
Research Fellows: **Alec Stein (2027)** **Concentration: History**
Brendan Werries (2027) **Concentration: History**
Faculty Mentor: **Graham Hodges** **Departments: History; Africana and Latin American Studies**

Title of Project: **Henry Highland Garnet Research/Underground Railroad**
Funding Source: **Division of Social Sciences**
Project Summary:

This summer we assisted Professor Graham Hodges in editing and gathering sources for his book on Henry Highland Garnet, a nineteenth century abolitionist who resided in upstate New York and worked with many local and nationally prominent advocates for the abolition of slavery. Professor Hodges was in the final stages of writing his first draft of his book that argued for the underappreciated value of his life's work.

We first began by reading through the entirety of the draft. After this point we discussed with Professor Hodges about our and his own thoughts on the draft, including broader organizational critiques as well as our opinions on more minute paragraphs. For the next several weeks we went through the draft again at a much slower pace, stopping to verify every citation as well as ensuring that each source was utilized to its fullest. During this time we also worked to find new sources on our own, and look into any sources that Professor Hodges sent over for further review.

After we completed these initial edits and they were reviewed and implemented by Professor Hodges, we were directed to look into more supplementary sources that were sometimes harder to find, or more tangential in hopes of finding a proverbial "needle in a haystack". With a lot of time put into this during the latter half of our summer, we turned up many new leads that we hope will provide strong value to any subsequent drafts.



1. Lithograph of Henry Highland Garnet

Research Fellows: JD Suarez (2027) — **Concentration:** Environmental Biology
Joy Tang (2026) — **Concentrations:** Biology; Sociology
Faculty Mentor: Tim McCay — **Departments:** Biology; Environmental Studies
Title of Project: Assessing and Mitigating the Impact of Invasive Earthworms on Small Vegetable and Nursery Farms: An Integrated Research and Education Approach
Funding Source: Division of Natural Sciences and Mathematics

Project Summary:

Jumping worms (JW) are earthworms belonging to the family Megascolecidae. Jumping worms originated from Asia, and have become a concerning invasive species in Northeast America. These jumping worms are noticeably different from the Lumbricae species that are native to America due to their snake-like thrashing behavior, milky white clitellum, and their ability to change soil structure to resemble loose coffee grounds. The presence of these jumping worms greatly concerns gardeners due to their ability to cause erosion in the top layer of soil. With their annual life cycle, jumping worms are very abundant in the late summer. There are three prevalent species (Amynthas agrestis, Amynthas tokioensis, and Metaphire hilgendorfi), and they typically co-exist. The presence of one species signals that the other two are likely present as well. The motivation behind this project stems from the expressed concerns of gardeners and farmers about how jumping worms can impact crop abundance, soil health, and soil organic matter.

Figure depicting the three species of jumping worms (from left to right, Amynthas tokioensis, Amynthas agrestis, Metaphire hildendorfi)

This project is largely in the beginning stages of development. Our work this summer consisted of reaching out to farmers, recruiting farms, developing a survey instrument, and making site visits to determine invasion status and administer the survey. We searched for farms that were less than 50 acres and their properties were physically surveyed for jumping worms. These farmers were also asked to fill out a survey that aimed to find out more information about their farm, opinions on jumping worms, their approach to farming, as well as any efforts they have taken to control the presence of jumping worms should they have any. Site visits were conducted from July 20 to August 15. We were able to sample 11 farms and discuss with farmers their concerns about the presence of jumping worms on their land. Out of the 11 farmers, 5 of them had jumping worms on their property. These farmers all expressed concern over the presence of jumping worms on their property, most of them asked if there were ways to mitigate their impact and reproduction.

Later stages of this project will focus on helping the farmers adapt innovative jumping worm control techniques. Farmers will also be provided with resources to help with jumping worm identification and knowledge. Farmer's understanding of jumping worm ecology will hopefully be enhanced through research trials and webinars.

Research Fellow: **Sophie Sujo (2027)** **Concentration:** **Environmental Studies**

Faculty Mentor: **Julie Dudrick** **Department:** **Upstate Institute**

Title of Project: **Direct Seeding Methodologies for Riparian Restoration in the Ausable Watershed: Innovating Native Plant Restoration with Low-Input, Climate-Adapted Methods**

Funding Source: **Upstate Institute**

Project Summary:

A legacy of logging, damming, road construction, and channel straightening has destabilized streambanks across the Adirondacks. These changes impair rivers' natural ability to flow and manage sediment. This not only worsens flooding hazards and water quality, but threatens infrastructure and sensitive riparian habitats. Riparian habitats are the woody, vegetated zones that anchor riverbanks and support biodiversity.

The Ausable Conservation Nursery (ACN), a program launched in 2024 by the Ausable Freshwater Center (AFC), a 501(c)3 non-profit, addresses these issues throughout the Ausable River watershed. The nursery cultivates hardy, hyperlocal native riparian tree and shrub species- such as paper birch, red maple, shrub willow, and quaking aspen- using wild-collected seeds and cuttings. ACN's commitment to collecting hyperlocal seeds and cuttings from the region is vital to the success of their restoration projects. "Plant provenance," which is the specific geographic origin of where a plant or its seeds were collected, determines how a particular plant population will develop the genetic adaptations necessary to accommodate local environmental conditions. Over time, plants of the same species from different areas may develop unique genetic traits that allow them to thrive in localized conditions like soil types, elevations, temperature variations, and pest pressures. At AFC, cultivating plants from the correct provenance helps assure the genetic integrity of their plant stock- they are elevation hardy and acclimated to the harsh Adirondack winters. After a lengthy process of propagating cuttings, cultivating wild seeds, and placing saplings in a production field, large and competitive plant stocks are transplanted by AFC staff along degraded streambanks. This fortifies and anchors soils, slowing erosion and reconnecting fragmented habitats.

Considering the traditional method of cultivating and transplanting greenhouse stocks is quite time, labor, and cost intensive, AFC recently opened up a conversation about a direct seeding approach. With a direct seeding method, native seeds are broadcast directly onto streambanks. This reduces time and labor, and can offer a cost-effective, scalable alternative. Direct-sown species also develop stronger, undisturbed root systems, increasing their resilience and eliminating the risk of transplant shock for larger plant stocks. I conducted an informal germination trial on two restoration sites on the East Branch Ausable River to evaluate which native species and substrates yielded the best results under a direct seeding approach. I compared seed germination across eight transects using a variety of native plant species- shrub willow, red maple, paper birch, and a custom ACN seed mix- across different soil media treatments of peat moss, vermiculite, and sand. My preliminary findings demonstrate that paper birch seeds paired with peat moss had the highest germination rate. This is a promising species-media combination and could inform scaling direct seeding in future AFC projects. However, while direct seeding reduces labor and cost, further monitoring is required to assess whether seedlings can establish robustly enough to replace larger, more competitive transplanted nursery stock.

Research Fellow: Sara Tabibian (2026) **Concentration:** Environmental Geography

Faculty Mentor: Julie Dudrick **Department:** Upstate Institute

Title of Project: How Do Transportation Barriers Impact Refugees' Resettlement and Employment Outcomes?

Funding Source: Upstate Institute

Project Summary:

Utica, New York, has experienced remarkable revitalization through refugee resettlement, with resettled refugees now comprising 22% of the city's population and significantly contributing to the growth of the local economy. However, transportation access remains a critical barrier limiting refugee integration and community integration. This study explores how transit inadequacies impact refugees' resettlement and employment outcomes.

This mixed methods research employed surveys, internal and external interviews, and spatial mapping to comprehensively assess refugee transportation needs. Eleven structured interviews were conducted with the Center staff and stakeholders including Centro (Utica's bus system), Herkimer-Oneida Counties Transportation Council (HOCTC). A survey was created and administered to 62 students that enrolled in The Center's ESL programs, collecting qualitative and quantitative on refugee mobility barriers and transportation patterns and experiences. Geographic mapping visualized employment and education centers as well as grocery store locations in relation to transit coverage.

The research revealed significant structural barriers limiting refugee movement in Utica. Most refugees do not use public transit for employment due to inadequate route coverage. Centro buses operate approximately once per hour with service gaps, limited Saturday schedules, and no service on Sundays. No reliable public transit exists for critical services like naturalization appointments in Syracuse. Centro faces ongoing driver shortages and competition from higher paying employment opportunities. Survey respondents identified three primary transit needs: increased bus frequency, bus stops located closer to residential areas, and comprehensive language support including clearer information on system navigation. Employment destinations extend as far as Fonda (55 miles), well beyond current transit service areas.

Four key intervention strategies were developed to address identified barriers: (1) multilingual signage and information systems incorporation refugee community languages, with QR codes providing audio instructions for non-literate users; (3) Enhanced transit education through hands-on classes teaching bus navigation, fare payment, and mobile app usage; (3) Implementation of microtransit services modeled after Rome, NY's successful on-demand program, coupled with route simplification and increased frequency; (4) Workforce development initiatives training refugees as Centro drivers and mechanics to address staffing shortages while improving cultural competency within the transit system.

Research findings informed a comprehensive recommendation report delivered to The Center's grant writer for funding applications. Results were shared with the HOCTC and Centro leadership to guide policy discussions and service improvements. This community-based research demonstrates how transportation equity investments can simultaneously support refugee integration outcomes and broader urban economic development goals, with increased ridership driving further transit infrastructure investment and system robustness.

Research Fellow: **Andrew Tatela (2027)** **Concentration: Physics**

Faculty Mentor: **Ramesh Adhikari** **Department: Physics and Astronomy**

Title of Project: **Leaf-Based Electronic Components**

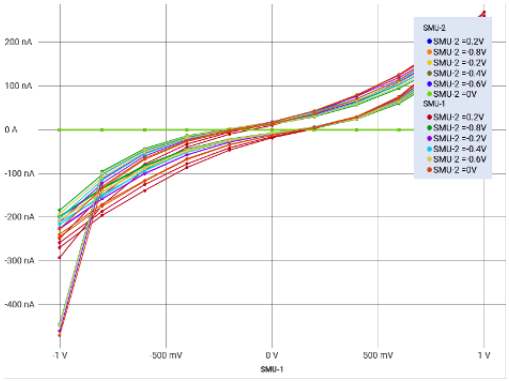
Funding Source: **National Science Foundation Grant; Division of Natural Sciences and Mathematics**

Project Summary:

The goal of my research is to fabricate viable electronic components from organic materials. In theory, such components would be more biocompatible and disposable than current offerings, which are important aspects for progress in medical implants and environmentally friendly devices. I worked to create an organic electrochemical transistor (OECT) and a water-resistant leaf-based capacitor. I spent time testing ways to augment a leaf's conductivity and water resistance as well as fabricating ionic gels to serve as electrolytes in the construction of transistors and capacitors. I produced one example of an OECT with the desired I/V curve.

My summer research was devoted to working with leaf-based electronics. Mainly, I attempted to create an organic electrochemical transistor (OECT.) A transistor is a common electronic component that regulates an electric current with a smaller gate voltage (or current,) allowing it to be used as a switch. I also worked with similar materials and methods to make a capacitor, another common electronic component used for energy storage.

For a transistor, I started with the drain-source channel, where the main current flows. I tested different leaves' ability to retain PEDOT:PSS, a conducting polymer, with a method called vacuum infiltration. This involved putting a leaf in a syringe with PEDOT and pulling the plunger to create a vacuum that the PEDOT can fill. I would then create a voltage between two points in the leaf and have a computer measure the current flowing between them. Eventually, I switched to the Louisiana iris leaf, which has channels wide enough to simply inject with PEDOT. Once I conducted a test that produced a linear relationship between voltage and current, I then needed an electrolyte. When the gate voltage is supplied, it pushes the ions in the electrolyte to the drain-source channel, which regulates the flow of current. After finding that salt water evaporated too quickly, I transitioned to using ionic gels. After many attempts, I was able to create one example of a transistor-like I/V curve where no current leaks through the gate electrode, which was a common problem I encountered. To improve upon this, I need to work on making the drain-source more conductive and make the curve straighter, like a resistor.



(Graph shows the current in the drain-source channel in response to applied voltage. The different colors are the current responses for different gate voltages and the straight line is the current through the gate.) I also worked on creating a capacitor with PEDOT treated oak leaves as the double plates and ionic gel as the dielectric. Capacitors are another common electronic component that store and release charge. One goal I had was to treat the leaves such that they absorbed the PEDOT rather than it rolling off, which I achieved by bathing them in sodium hydroxide, then sodium chlorite. I was able to produce a device with some capacitive properties, and in the future I would work on making the dielectric as thin as possible while not letting the leaves touch to enhance this property.

Research Fellow: **Maksim Tesovic (2027)** **Concentration:** **Neuroscience**
Faculty Mentor: **Anzela Niraula** **Department:** **Psychological and Brain Sciences**
Title of Project: **Sickness at the Cellular Level: How Macrophages Mediate Brain-Body Communication in Response to Viral Immune Challenges in Mice**
Funding Source: **Division of Natural Sciences and Mathematics**
Project Summary:

Our body combats infections with a set of familiar symptoms, including fatigue, fever, and a decreased appetite, when pathogens cannot be contained by a localized immune response. To generate such robust changes in our bodily functions, our immune system turns to the brain to induce sickness. Specifically, our lab was interested in investigating the role of perivascular macrophages (PVMs) and microglia, resident macrophages in the brain, during infections. Current research exploring the function of immune cells at the borders of our brain is limited, and existing studies have primarily examined PVMs in a model of bacterial infection in mice via lipopolysaccharide injections.

To examine how physiological symptoms originate during a viral infection, we administered mice with Poly I:C, a synthetic segment of double-stranded RNA associated with mimicking viral infections. We then observed physiological and behavioral differences and quantified cellular changes at the brain's borders by using immunohistochemistry to label PVMs and microglia in the medial preoptic area (fever regulation), periaqueductal gray (pain and anxiety-associated behaviors), arcuate nucleus (manages appetite control), and hippocampus (memory and learning).

Our summer project divided mice into two Poly I:C groups that would either undergo tissue collection 24 hours post-injection (hpi) or 48hpi and a vehicle group. Prior to tissue collection, physiological and behavioral measurements were recorded at several points in time to better assess the progression of sickness and recovery in our mice. We observed significant decreases in food intake and body weight when comparing Poly I:C mice to vehicle mice at both 24hpi and 48 hpi. However, 48-hour Poly I:C mice significantly increased their food intake on the second day post-injection compared to the first 24 hours, but still consumed less food than vehicle mice on average, indicating recovery from the initial infection. Additionally, 48-hour Poly I:C mice had recovered their body weights on the second day post-injection when compared to the body weight lost on the first day, returning to levels comparable to vehicle mice. In the future, we hope to examine changes in PVM and microglia activation profiles to understand the mechanisms underlying sickness and recovery

Research Fellows: Nathaly Tlaseca Verde (2026) — **Concentration:** Geography
Luke Wang (2027) — **Concentrations:** Environmental Geography; International Relations

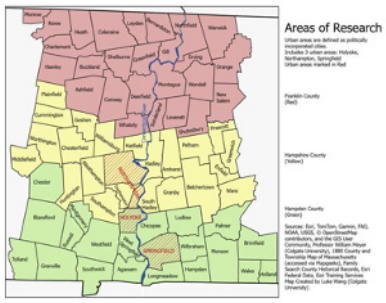
Faculty Mentor: William Meyer — **Department:** Geography

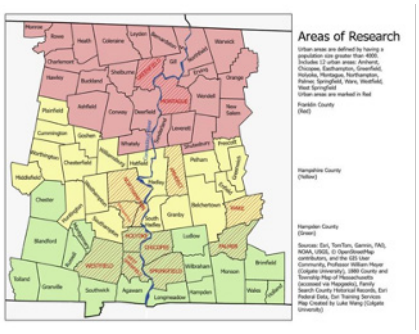
Title of Project: Urban and Rural Accident Risk in 1880s Massachusetts

Funding Source: Division of Social Sciences

Project Summary:

Urban growth in the United States during the nineteenth and early twentieth centuries has often been hypothesized as having increased accidental death or injury, on the grounds that higher densities of people and their activities expose people to more risk. Research has shown, however, that the late twentieth- and early twenty-first-century pattern in the United States is the opposite, with the risks of accidental death or injury lower in cities than in rural areas. To explore the earlier pattern further, we studied accidental deaths in the three western Massachusetts counties of Franklin, Hampshire and Hampden during the years 1882-1888, centered on the state census year of 1885. Massachusetts was the first state (in 1841) to establish a detailed system of death reporting, one that soon became highly reliable. We collected data from its records on all cases of three forms of accidental death (drownings, railroad accidents, and non-railroad injuries, such as falls, fractures, and concussions), the ones likely to have varied systematically between urban and rural settings. In addition, we used digitized contemporary newspapers to investigate deaths that were vaguely or ambiguously classified in the official records. We also collected and analyzed data on suicides, both to examine their own urban/rural patterns and because some such deaths, especially by drowning, may have been declared accidental given the social stigma of the time. We calculated crude urban and rural death rates for accidents and suicides overall and for the three subcategories separately. Localities in the study area were defined as urban if they had a population of 4000 or higher in 1885 or were politically incorporated as cities during the study period. Especially when corrected for differences in population structure and accidental death across age groups, the results do not strongly indicate either an urban advantage or a penalty, but they do suggest that different kinds of accidents differed considerably in incidence by age group and locality. A larger dataset would permit more trustworthy and expanded calculations, which should also compare results based on place of residence (used here) versus place of death. If such research confirms our tentative findings, several conclusions would follow: that the present-day pattern of an urban advantage in accident safety did not hold true at this time; that suicide did not follow the widely assumed nineteenth-century pattern of an urban penalty; and that the category of "accident" may be more varied and heterogeneous than usually recognized.





Research Fellow: **Jacqueline Tong (2027)** **Concentration:** **Applied Math**

Faculty Mentor: **Shu Gu** **Department:** **Mathematics**

Title of Project: **How doctors spend service times with patients with varying degree of severity: An approach using deep learning**

Funding Source: **Division of Natural Sciences and Mathematics**

Project Summary:

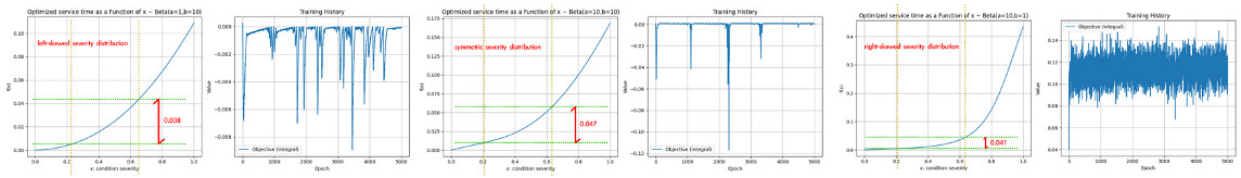
It's not rare to witness hospitals, especially the outpatient services located in central areas in the cities like New York and Shanghai, that are crammed with patients in waiting lines. Added to this untimely treatment is the unsatisfying care sessions experiences by the patients. Normally, patients with severe conditions need more care time than patients with relatively mild conditions. So, with some discretions about service times and varying service needs on patients' side, doctors need to allocate their limited service capacity to patients with varying conditions for the sake of an efficient service delivery. In this research, I aim to find the treatment time corresponding to patients with varying degrees of severity in order to maximize service value.

Essentially, I am trying to solve for the treatment times as a function of patients' severity of condition, i.e.: x measures the patients' severity over (0,1), and t(x) denotes the service time as a function of x. And it is important to model the service value over service time, and the overall waiting time of the system. To this end, my mathematical model is as follows:

$$\int_0^1 v(t(x))f(x)dx - cW$$

Where v(t) is a concavely increasing function describing how the service value gains over time; f(x) is the probability density function(pdf) of patients' severity spanning over (0,1); W represents the overall waiting time, i.e. $W=T/(1-T)$; and $T=\int_0^1 t(x)f(x)dx$.

As shown above, we are doing maximization over a functional space, which becomes easily intractable, for generic functions v(.). I use a newly-learned approach to tackle with it, namely, artificial neural network(ANN) thanks to the widely known Universal Approximation Theorem. I managed using Pytorch code to calculate the optimal service time as a function of x. My choice of ANN is "FunctionSpaceOptimizer(hidden_layers=[64, 64, 64])" (that is 3 hidden layers with 64 neurons each layer). And the integral is conducted via Monte Carlo simulation. The computation results are shown below (with a left-skewed, symmetric, right-skewed Beta distribution, respectively).



Research Fellow: Cal Tortolani (2026) **Concentration:** Environmental Studies

Faculty Mentor: Priscilla Van Wynsberghe **Department:** Biology

Title of Project: Environmentalism in the US and Australia: The Role of Constitutional Foundations, Free Enterprise, and Individual Freedom in Shaping and Implementing Environmental Policies

Funding Source: The Kraynak Institute for the Study of Freedom and Western Traditions (James Madison Fellow)

Project Summary:

Annual global carbon dioxide emissions have risen dramatically since the early decades of the 20th century. Increasing the prevalence of carbon dioxide and other greenhouse gases in Earth's atmosphere traps heat and warms the planet. As a result, sea level rise and extreme weather events have become more frequent and severe. If the nations with the most political influence, economic stability, and significant contributions to global greenhouse gas emissions take a leading role in establishing environmental policy, it will go a long way toward minimizing the harmful outcomes of climate change. As leaders of the developed world and major contributors to annual greenhouse gas emissions, the United States and Australia have the capacity to establish such policies. However, despite their geopolitical control, these two nations have struggled to establish and maintain meaningful long-term environmental policies. This paper observes the role that the electoral cycle, the economy, and individual freedom have in the implementation of environmental policy in the United States and Australia.

The changing environmental stances of the presidential and prime ministerial administrations of the last 25 years demonstrated how each country's process of democratically electing a new leader every three or four years can present significant challenges to the health of long-term legislation like environmental policies. For example, the Paris Agreement went through numerous approvals and withdrawals as President Obama joined the agreement in 2015, President Trump withdrew from it in 2017, President Biden rejoined it in 2021, and President Trump rewithdrew from it in 2025. This pattern, which impacted many environmental policies in the U.S. and Australia, shortened the lifespan of these policies and prevented them from achieving meaningful environmental improvements.

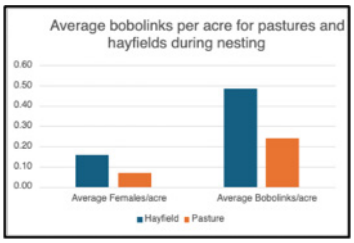
The economic implications of environmental policies help explain why people and corporations might oppose environmental policies. Fighting climate change requires a sizable transition from fossil fuels to renewable sources of energy. This process can take away from the jobs and profitability provided by the fossil fuel industry while also requiring a massive infrastructural overhaul in each country. Despite these setbacks, switching to renewables can stimulate a net increase in jobs, lower energy prices, and reduce countries' subsidy spending by trillions of dollars. With these possible economic benefits in mind, it is plausible that political ecology and the power relations between fossil fuel corporations and high-ranking governmental officials are preventing political support for environmental policy.

Lastly, the role of freedom in the history and culture of the United States and Australia influences public opinion on environmental legislation. In the United States, policies that impede individual decision-making and promote governmental intervention receive heavy public criticism. Much of this is due to the pervasiveness of individualism within the country, as citizens disagree with rulings that threaten their freedom and autonomy. Freedom appeared to be less of a driving force for public opposition to environmental policy in Australia. However, Australians still prefer voluntary policies that do not restrict their daily lifestyle choices.
These findings suggest that the democratic election cycle, the economy, and individual freedom all play a notable role in environmental policy support and implementation in the United States and Australia. Other factors, like the uneven distribution of costs and benefits, and the intangibility of climate achievements, inherently add to policy struggles. For successful environmental policies to be adopted, it is crucial that the roles of democratic political terms, the economy, and individual freedom in influencing policy implementation are recognized alongside the severe impacts of climate change.

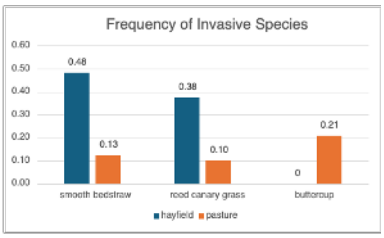
Research Fellow: **Naomi Valentine (2027)** **Concentration:** **Biology**
Faculty Mentor: **Julie Dudrick** **Department:** **Upstate Institute**
Title of Project: **Managing Fields for Grassland Birds in the Champlain Valley**
Funding Source: **Upstate Institute**
Project Summary:

The goal of this study was to explore how different land management practices, specifically grazing and haying, may affect grassland habitat quality and bird populations in the Champlain Valley of New York. To do this, I measured the difference in vegetation composition, invasive species frequency, and bobolink abundance between grazed and hayed fields.

I surveyed vegetation on 5 pastures and 5 hayfields on seven properties in the Champlain Valley. The total area sampled was around 200 acres, with an even split between hayfield and pasture. Using ArcGIS Pro, I created a polygon feature defining the boundary of each field. I used aerial imagery to select 6 evenly spaced points centrally located within the boundaries. Each point marked the start of a square where I would collect 4 samples. Sampling was conducted by placing a 1m² quadrant and observing the vegetation cover from above in order to estimate the percent cover of grasses, forbs, and bare ground. I noted any presence of relevant invasive species, including smooth bedstraw, reed canary grass, wild parsnip, spotted knapweed, and buttercup. To count the number of birds, I walked transects across each pasture and hayfield that I sampled vegetation in. The transects were about 100m apart, measured by 70 steps. I recorded the number of male, female, and juvenile bobolinks counted in each transect, and avoided recounting birds that flew between transects. I took notes on nesting behavior such as chasing, circling, agitated calls, and carrying nesting material or food.



Average females per acre and bobolinks per acre for pastures and hayfields. Counts were conducted in mid to late June.



Average frequency of smooth bedstraw, reed canary grass, and buttercup in pastures and hayfields from presence/absence samples (n=120)

The vegetation numbers were mostly inconclusive and insignificant, showing that there are explanatory variables like, grazing timing and management history, that weren't covered in this study. Except for buttercup, invasive species were much more abundant in hayfields than in pastures. This may suggest that grazing helps to control the growth of invasive species, providing higher quality nesting habitat for grassland birds. Surprisingly, bobolinks seemed to prefer hayfields over pastures. More birds per acre and more females per acre were observed in hayfields, although the sample size is too small to confirm significance. There was more of an increase in birds between visits in pastures than in hayfields, indicating the difference reflects initial settlement rather than nest success. This could be a result of vegetation structure and composition that wasn't captured in this study, or disturbance between visits on pastured land. Controlling for field openness could also possibly explain why bobolinks were more abundant in hayfields, as I felt the pastures I sampled were more irregularly shaped than the hayfields. Overall, my project contributed to Mass Audubon's work by collecting preliminary data of bobolinks in pastures and narrowing the research focus for a future summer fellow. I recommended that a future intern explore the extent that different grazing strategies are compatible with nesting grassland birds by comparing initial bobolink territories and nesting success between different stocking density and grazing timing of pastured land.

Research Fellow: **Pablo Vivas Rivera (2026)** **Concentration:** **Molecular Biology**

Faculty Mentor: **Damhnait McHugh** **Department:** **Biology**

Title of Project: **Building the genetic roadmap of *Prosellodrilus amplisetosus*, an invasive earthworm species in Ireland**

Funding Source: **Division of Natural Sciences and Mathematics**

Project Summary:

Prosellodrilus amplisetosus is a soil-eating earthworm species that typically inhabits the Southwestern and Northwestern regions of France and Spain respectively. These small worms have recently been found in Ireland, yet there is little known about the introduction of the species into this region. Climate change can accelerate the adaptation of invasive species into new territories. Ireland has seen a 0.8°F increase per decade over the last forty years, which could be facilitating the movement of the species. Previous studies have shown that *P. amplisetosus* can access older deposits of Carbon in the soil more efficiently than others. This has caused growing concerns over the possible displacement of the native biodiversity.

In this project, we used DNA extraction, polymerase chain reaction (PCR), and genomic analysis to begin revealing the species' history. Samples were collected by Dr. Damhnait McHugh at different locations in Ireland for comparison with samples from the native range. Many of the worms collected were juveniles, which made morphologically identifying them difficult, because they had not developed the characteristic markers of earthworm species. Tissue samples were cut from the worms and the QiAmp DNA extraction kit was used. Gel electrophoresis, Nanodrop analysis, and Qubit were all used to assess the quality of the extractions. PCR was performed to verify that the samples amplify the Cytochrome Oxidase 1 gene fragment used as a species-specific DNA barcode. Another gel electrophoresis revealed that the amplification had been successful, and allowed sequencing of the barcode. Building the genetic roadmap for the introduction of *P. amplisetosus* is a complex project; however this work helped lay the foundation for future barcoding and genetic mapping.

Research Fellow: Luca Williams (2026) **Concentrations:** Computer Science; Political Science
Faculty Mentor: Annie Benn **Department:** Political Science
Title of Project: Regulations.gov Data Project
Funding Source: Division of Social Sciences
Project Summary:

As a research assistant for Professor Benn's work this summer, the work I did consisted heavily of aggregating data and creating pipelines from the regulations.gov API. The website, regulations.gov, is managed by the eRulemaking Program Management Office and is intended to provide the public with information on the process of federal regulations and other related documents. In addition to this, it gives members of the public the opportunity to easily comment on federal regulations during the rulemaking process, which is where bureaucratic agencies draft and create regulations that implement legislation. This process is interesting to us because agencies are granted differing amounts of discretion and scope when creating regulations, so it is relevant to understand how much power bureaucrats have in relation to other influential actors. This source of data was relevant to Professor Benn's research as it relates to the process of rulemaking and the different influences that can affect whether rules are changed or not, and how they are implemented.

The first part of this project began with the task of getting all the comment data from the regulations.gov API. I developed and tested Python scripts that would make a call to the API, collect the metadata of a comment, and then save that data while navigating the pagination limits of the API to gather data on over 22 million comments. This method also extends to data on dockets and documents as well and this data will have multiple purposes in the future. This project made use of the Colgate Supercomputer to keep the scripts running and collecting data.

While metadata from regulations.gov was being collected, the second part of the project was to determine the affiliation of the commenters. The affiliation relates to what organization or group the commenter represents and is a key point of data to answer questions about which kinds of actors influence the bureaucratic process. With the number of comments that we wanted to evaluate, the evaluations need to be automated in some way. To do this, we made use of OpenAI's large-language models, similar to the ones ChatGPT is based on. The main goal of this pipeline was to have these LLMs look at the pulled data associated with each comment and determine the organization or group that the commenter represented, if any. The regulations.gov website has no consistent formatting for comments, as each one is agency-specific, so the available data would vary greatly between and even within agencies. This inconsistency meant that all metadata pertaining to a comment would be needed to make the most accurate evaluation possible. The script first gathers all of the relevant metadata from a comment, then builds a prompt around it to run through an OpenAI model, and then stores the result.

To get the best results possible, we created accuracy tests, comparing the model's results against hand-coded results. In addition to this, we fine-tuned the models with a couple of hundred examples to enhance the performance and make it as accurate as possible for when we put it into production on the larger dataset. The work that was done this summer to gather this data and set up data pipelines will be useful for a research project that we will be working on during the academic year.

This project was a great learning experience in that it gave me hands-on experience working with data. It was a self-guided project where I was given a goal to collect the data, followed by research on how to accomplish that. It involved learning how to use and parse the API, how to handle missing or inconsistent data, and learning how to create data pipelines. It was a great experience to build technical skills to apply to a non-technical domain.

Research Fellow: **Matheson Williams (2027)** **Concentrations:** **Economics; Environmental Geography**

Faculty Mentor: **Julie Dudrick** **Department:** **Upstate Institute**

Title of Project: **Hamilton - A Climate Smart Community (CSC)**

Funding Source: **Upstate Institute**

Project Summary:

In 2009, New York state established a program for local municipalities to become "Climate Smart Communities." The Climate Smart Communities (CSC) program was designed to help build resilience while implementing climate change mitigation practices. Municipalities could become a part of this program by completing numerous actions to acquire certification, and both the Town and Village of Hamilton became bronze certified in 2020. However, communities must submit for recertification every five years to maintain their status as a CSC. This process includes submitting various actions and documentation of "pledge elements" to accumulate a minimum of 120 points while also completing at least three priority actions.

This summer, I was tasked with completing this recertification process for both the Town and Village of Hamilton. In order to achieve this goal, I first began by attending meetings with Hamilton's Climate Smart Community Task Force. This task force is made up of a combination of government officials and community leaders to discuss potential events and actions that should take place to maintain Hamilton's CSC certification. Subsequently, using the NY CSC website, I created spreadsheets for both Town and Village with all potential actions, which I then ranked on priority and feasibility. This spreadsheet served as a roadmap for actions and needed documentation for both myself and the municipalities. Next, I worked in the Town and Village offices to begin collecting the necessary data and resources to demonstrate completion of CSC actions. This was done by reading meeting minutes, memos, and resolutions while also having meetings with officials to supplement the remaining material. This data and documentation was put into the spreadsheets and CSC portal to maintain a collection of information. I then worked with the municipalities to complete any actions that were unfinished or could be completed by creating summaries, taking photos of infrastructure, and updating websites. Lastly, I uploaded all the necessary documents and information needed to receive credit for actions completed, while also leaving a guide for future recertification and a collection of all spreadsheets and documents used.

By the end of my project, I officially gathered enough documentation to apply for recertification as bronze certified CSC's. Through numerous community events, municipal resolutions, and partnerships the Town and Village have demonstrated their commitment to be a CSC. Specifically, the Village has submitted enough actions to receive up to 161 points and the Town has submitted enough for 157 points. This is well beyond the required 120 points, as both municipalities have gone above and beyond in their efforts to mitigate climate change and help build a resilient community.

Research Fellow: Logan Wilson (2026) **Concentrations:** Middle Eastern and Islamic Studies; History

Faculty Mentor: Noor-Aiman Khan **Department:** History

Title of Project: Immigrants at Work: Uncovering Arab Americans Place in the Michigan Auto Industry and Labor Movement

Funding Source: Division of Social Sciences

Project Summary:

Academic literature on Arab Americans has steadily increased in recent years and decades, most often focusing on their position within American society and politics, particularly following the attacks of 9/11 and in the context of increased paranoia and xenophobia felt amongst many Americans. However, these analyses often ignore Arab Americans' centuries-long history in the United States. This project seeks to break from traditional understandings of Arab Americans by analysing their history as workers, specifically their role in the Southeast Michigans auto industry and union movement. Of particular interest to this research was how the auto industry provided community members with stable employment and played a major part in turning the Detroit Area into one of the largest Arab American communities in the United States. Also of interest is Arab Americans' role within the larger auto industry and its accompanying union movement, particularly in terms of their complicated relationship with the United Auto Workers (UAW).

Through analysing Arab Americans' experience in the auto industry, this research stands in contrast to other academic literature by centering Arab Americans' experience as workers and identifying the common experiences they share with other workers, be they immigrant or natural born American workers. This project also works to highlight the diversity of workers within both the auto industry and the union movement. Arab American workers often proved themselves to be loyal union members while at the same time showing a willingness to stand up the union establishment. This is most notable with the rise of Arab Workers Caucus (AWC) in the late 1960s and 1970s, with Arab workers striking to protest against UAW investments in the Israeli trade union the Histandrut as well as against racism and discrimination both within the UAW and at their work places. More often than not however, Arab workers saw the positives of working with the UAW and fought for greater unionization throughout its history, with many prominent UAW leaders themselves being Arab American, most notably former UAW President Stephen Yokich. Many Arab workers used the lessons they learned from their time as union activists with the UAW and AWC to begin organizing within the broader Arab American community, most notably with the founding of the Arab Community Center for Economic and Social Services (ACCESS).

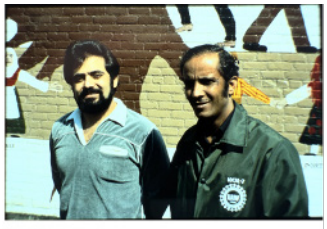


Figure 1: Photo from the 1970s of two Arab American Auto Workers and UAW Local 7 Members (Source: Walter Reuther Library)

Archival materials for this project were drawn from numerous institutions throughout Southeast Michigan, including the National Arab American Museum, the University of Michigan Bentley Historical Library, the Michigan State University Library's Special Collections, and Wayne State University's Walter P. Reuther Library. Archival materials include oral histories, pamphlets, personal documents, photos, and documents from the UAW, auto companies including Ford and Dodge, and other organizations such as the AWC and ACCESS, amongst others.

Research Fellow: Yabesi Witinya (2026) **Concentration:** Computer Science
Faculty Mentor: Joel Sommers **Department:** Computer Science
Title of Project: Geographic Footprints in the rDNS Records via N-ary Tree Structure
Funding Source: National Science Foundation Grant
Project Summary:

Research in the past has investigated different methods of identifying physical location from IP addresses for multiple reasons, including security, commercial, and browser search. Some researchers attempted to utilize active measurements like tracerouting, which is generally considered inefficient given the computation time. Other past work, such as [1]Undns, used handcrafted regexes, which is very labor- and time-intensive and prone to human error. However, recent work by [2]Microsoft researchers explores an ML approach to the problem and has proven successful in extracting and ranking geographic hints from rDNS records. In this project, we attempt to extract geographic hints from rDNS records collected by OpenINTEL via N-ary Tree representation of the synthesized patterns.

What did we attempt to do?
We tokenize every Namefill-synthesized pattern based on common separators such as dots and dashes. The tokenization of the names aims to create tokens that represent the nodes of the N-ary tree. For instance: uequam[SEQ].westfield.ma.boston.comcast.net is tokenized to [uequam[SEQ], westfield, ma, boston, comcast.net], which makes up a tree structure. To achieve tokenization, we classify each pattern—which is essentially a collection of names with common naming conventions—based on ETLD+1s such as comcast.net. We further classify the patterns by country ISO codes, which are extracted from the MaxMind database, and finally classify all patterns with the same number of tokens. At this stage, we have a complete tree, so we perform token matching against databases combining GeoNames, directional terms, UN/LOCODEs, and other recurring geographic hints we hardcoded. While the trees are very much self-explanatory, we still needed to understand the level of complexity of naming patterns deployed by different operators. We utilized the average out-degree of individual trees, classified by ETLD+1, to quantify the complexity of naming conventions based on the branching scale of the trees.

Did we get to any interesting findings?
We successfully reduced the number of synthesized patterns by 80% through classification via token matching. Furthermore, we found that about 30% of patterns embedded geographic hints from more than one dataset, for example, GeoNames and UN/LOCODE. More than 90% embedded geographic hints from at least one dataset we matched tokens against. However, our algorithm still has several limitations due to the incompleteness of the datasets we use for token matching, the lack of knowledge about in-house geographic encodings deployed by different operators (such as amazon.com), and the fact that some DNS records are not updated when the geographic location changes. Regardless of these limitations, we show it is possible to classify and summarize the naming patterns deployed by different DNS operators, which is a significant step toward extracting geographic information from rDNS records.

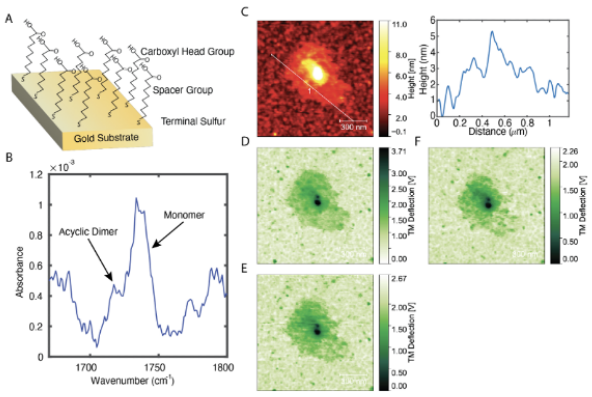
[1] Neil Spring, Ratul Mahajan, David Wetherall, and Thomas Anderson. Measuring ISP topologies with Rocketfuel.
IEEE/ACM Transactions on networking, 12(1):2–16, 2004.
[2] Ovidiu Dan, Vaibhav Parikh, and Brian D Davison. IP geolocation through reverse DNS.
ACM Transactions on Internet Technology (TOIT), 22(1):1–29, 2021.

Research Fellow: Sam Witonsky (2026) **Concentration:** Chemistry
Faculty Mentor: Eric Muller **Department:** Chemistry
Title of Project: Structure and Ordering of Self-Assembled Monolayers through Vibrational Spectroscopy
Funding Source: Division of Natural Sciences and Mathematics
Project Summary:

Self-assembled monolayers (SAMs) spontaneously form into a single molecular layer on metal or metal oxide surfaces. SAMs can control surface chemistry through functionalization of the head group, with many applications in biology, chemistry, and materials science. However, measurement and characterization of such thin films remains challenging. We seek to improve sensitivity to SAM structure through infrared scattering-scanning near-field optical microscopy (IR s-SNOM), which provides zeptomolar (near single molecule) sensitivity and information on the local chemical environment. IR s-SNOM in conjunction with atomic force microscopy (AFM) opens the possibility for the study of the defects within a monolayer.

We focus on the SAM 11-mercaptoundecanoic acid (MUA), which is widely used to control surface chemistry, yet is prone to forming disordered regions due to hydrogen bonding of the carboxylic acid head groups. We prepare SAMs by submerging a piece of gold in a solution of MUA, where self-assembly then occurs over the course of several hours. We characterize the resulting monolayers using the widely used technique of attenuated total reflection Fourier transform infrared spectroscopy (ATR-FTIR). Despite the sensitivity of ATR-FTIR vibrational spectroscopy to hydrogen bond structure (Fig. B), ATR-FTIR lacks the sensitivity to defects such as bilayers, non-crystalline monolayer regions, and pinhole defects.

We apply IR s-SNOM and AFM imaging to better understand defect formation in MUA SAMs. While large regions of the sample are well ordered, AFM images (Fig. C) show the formation of bilayer defect regions in MUA films as ~2 nm tall islands. The IR s-SNOM images (Fig. D-E) show this same bilayer region through the reduced optical signal (green region). We will next combine spatial imaging information with IR s-SNOM vibrational spectroscopy, and will be able to directly measure the chemical structure of each defect. Our results will build a fundamental understanding of defect formation in functional self-assembled monolayers.



(A) Diagram of MUA on gold. (B) ATR-FTIR spectra of .5 mM MUA on Au. (C) AFM height image and (D to E) 2nd and 3rd harmonics IR s-SNOM images of MUA monolayer around a defect.

Research Fellow: Natalie Yale (2026) **Concentration:** Religion
Faculty Mentor: Megan Abbas **Department:** Religion
Title of Project: Rehabilitating Rastafari: Religion and the State in the Jamaican 1960s
Funding Source: Division of Arts and Humanities
Project Summary:

On the one hundred twenty-first anniversary of Emancipation Day, quasi-Rastafari preacher Reverend Claudius Henry declared to his flock that October 5th, 1959 would be the day of the "Miraculous Repatriation Back Home to Africa." Commanded by God in 1957 to return to Jamaica and preach repatriation and the liberation of Africa, Henry ended a 13 year stretch in the United States and by the middle of 1959, had amassed hundreds in urban Kingston and on the Vere Plains of Clarendon who worshipped him as a prophet. When October 5th passed with no deliverance and Henry's millenarian movement began to dissolve, Henry's Jamaican-born American son Ronald and members of his Bronx-based First Africa Corps traveled to Jamaica to re-mobilize his father's following. With the broader goal of repatriation to Africa still in the background, Ronald's more immediate aim was to train a cadre of Rastafari and execute a violent overthrow of the Colonial government. Local intelligence officers, aware of potential subversive activities at the Henrys' African Reform Church at Rosalie Avenue, initiated a police raid in the early morning of April 6, 1960, where they seized more than 3,000 detonators and several other weapons. Charged with treason, Claudius Henry was in prison when, two months later, Ronald's camp in the Red Hills near Kingston was raided by the police and British Army. Ronald was eventually sentenced to death, and the Red Hills Incident, in view of the earlier raid and Claudius' 1959 Back-to-Africa fiasco prompted the rapid compilation of a report on the Rastafari. Carried out by three University professors, M. G. Smith, Roy Augier, and Rex Nettleford, The Ras Tafari Movement in Kingston, Jamaica (1960), covered the history, organization, and beliefs of the movement and articulated ten recommendations to the government to aid in the peaceful reintegration of the Rastafari into Jamaican civic life. Situating the Henry Rebellion within the longer arc of Jamaica's constitutional decolonization, this summer project serves as the initial research for a senior thesis that will figure the University report and its series of recommendations as a point of departure to examine the national and international efforts to rehabilitate the Jamaican Rastafari in the early 1960s. Specifically, the eventual thesis project will trace United States intelligence gathering and direct and indirect intervention into the tumultuous relationship between Rastafari and the Jamaican state in the first half of the 1960s. Considering the multidirectional flow of intelligence, people, and religious ideas between Jamaica, Britain, and the United States, the thesis will engage British and US intelligence gathering in order to effectively join theoretical conversations emerging from Surveillance Studies and studies of religion and US foreign policy. Furthermore, the thesis will center a religious community development organization, Operation Friendship, and the activities of a Rastafari politician, Sam Brown, in the early 1960s to investigate the larger trajectory of rehabilitation. By following the story of these actors, the project will interrogate the dialogue between the institutional articulations of religion cornerstone to rehabilitation and the self-fashioning done by agentic religious traditions forced to negotiate state-led projects of reform.

Research for Summer 2025 consisted of reading 45 books and many other relevant secondary sources written about 1960s Jamaica. Drawing on scholarship and relevant theory from religious studies, Black studies, Caribbean studies, anthropology, history, political science, and English, this research culminated in a 25 page thesis prospectus consisting of a historical introduction, three interlocking literature reviews focusing on Jamaican history, Rastafari, and religious studies, respectively, and a detailed plan for future work during the 2025–2026 academic year.

Research Fellow: David Ye (2027) **Concentration:** Chemistry

Faculty Mentor: Anthony Chianese **Department:** Chemistry

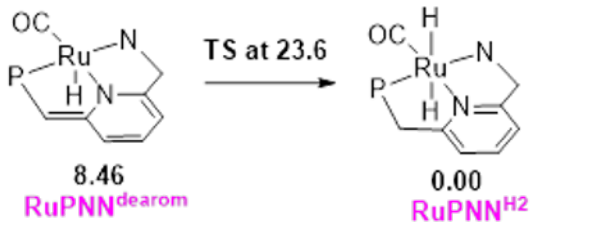
Title of Project: Identifying the Active Catalyst in Ru-PNN Complexes Catalyzed Ester Hydrogenation

Funding Source: Justus '43 and Jayne Schlichting Student Research Fund

Project Summary:

This project aimed to investigate how a precatalyst is activated to become the active catalyst that can accelerate hydrogenation and dehydrogenation reactions. Hydrogenation stands for a substrate reacting with hydrogen to form the product with the presence of catalysts, and dehydrogenation is the reverse side of it. The precatalyst, $RuPNN^{dearom}$, will release ethane after heating to become the active catalyst for ester hydrogenation (a category of hydrogenations). However, while no ethane release was observed at 55°C, the precatalyst could still be activated with the presence of alcohol. Since we already have kinetics data for this reaction, we want to provide the complete mechanism of ester hydrogenation of $RuPNN^{dearom}$ by doing DFT (density functional theory) calculations.

From recent kinetic experiments, we concluded that the ester hydrogenation of $RuPNN^{dearom}$ is first order in [$RuPNN^{dearom}$], first order in [ester], and zero order in [H2]. Alcohol is required but does not increase the rate of the reaction. Ester hydrogenation catalyzed by $RuPNN^{dearom}$ has three stages: hydrogen activation, ester hydrogenolysis, and aldehyde reduction. The catalyst firstly needs to be activated by alcohol and hydrogen to form a more stable resting state as shown in figure. 1.



*All numbers are relative free energies in kcal/mol

The resting state of the catalyst $RuPNN^{H2}$ is able to react with ester to form the intermediate aldehyde and alcohol. Then the aldehyde could also react with the resting state to form alcohol. From our kinetic data, the reaction has an overall energy barrier of 22.0 kcal/mol. However, DFT calculations from existing papers reported that the lowest energy pathway has an energy barrier above 30.0 kcal/mol. Even though DFT calculation could have errors around 3 kcal/mol, these pathways are too energetically unfavorable to be correct. Our preliminary results from DFT calculations suggest a pathway with an overall energy barrier at 27.2 kcal/mol. Future works would be done to investigate whether there is a more energy favorable pathway.

Research Fellow: **Jannah Zabadi (2026)** **Concentration: Geography**
Faculty Mentors: **Adam Burnett** **Department: Geography**
Peter Klepeis **Department: Geography**
Title of Project: **Indigenous Australian Cultural Exchange**
Funding Source: **Division of Social Sciences**
Project Summary:

Colgate University has cultivated a relationship with the Center for Aboriginal Studies at Curtin University in Perth, Western Australia. This connection is a result of the long process of repatriating pieces of art created by Aboriginal children in a mission in the 1930s. This relationship has facilitated groups of Colgate Students visiting Perth on extended study trips since 2013.

Adam Burnett and Peter Klepeis of the Geography Department emphasized the need for a reciprocal relationship. They invited a cohort of 12 students and two staff members from Curtin to participate in a two-week extended study in Central New York.

As one of the student chaperones, my primary responsibilities included answering questions about the US and our Indigenous nations, staying in the accommodations with the group, and ensuring the safety and well-being of all participants. During the action-packed session, the ALANA Cultural Center kicked off the week by engaging in Inter-Group Dialogue. We visited the Oneida and Onondaga Indigenous Nations, spent time with the Colgate Outdoor Education Team in the Adirondacks, participated in Sense of Place activities, and visited several museums. Museums, while informative, are contested spaces that have contributed to collective harm and theft from Indigenous people, as well as awareness of the issues Indigenous people face. One of our most difficult conversations was held about the purposes of museums. Additionally, while at the Onondaga Nation Farm, we had a discussion about food sovereignty as a method of resisting oppression and a way to build a future in which Indigenous communities thrive. The major takeaways relayed to us by the group were noticing the differences in how Australian Indigenous people were treated, as opposed to Native Americans. The Australians noted that they have more rights in the national government, more representation, and greater assistance programs than the reservation and sovereign governance systems established by deceptive American treaties.

Once the Australian cohort returned home, my team was tasked with creating teaching materials for the next time Colgate takes students into Noongar Country. Based on our conversations at the Museums about Indigenous artifacts and sacred knowledge, I decided to compile some information on how students should enter Indigenous communities they are not from. The primary and secondary resources I used to create this unit plan came from Noongar and Haudenosaunee texts and people. In the spirit of the Cultural Exchange program, I blended the two Indigenous cultures we were invited into. The main takeaways from these lessons include the criticality of storytelling, defining and understanding Indigenous Geography, delving into the history of the Stolen Generations, and finally focusing on how to accept invitations into these communities. I plan to continue working in the field of Indigenous Geography in the coming year while completing my senior thesis, and in the future as I pursue a PhD in Geography.

Research Fellow: Figo Zhang (2026) **Concentrations:** Chemistry; Biology

Faculty Mentor: Rick Geier **Department:** Chemistry

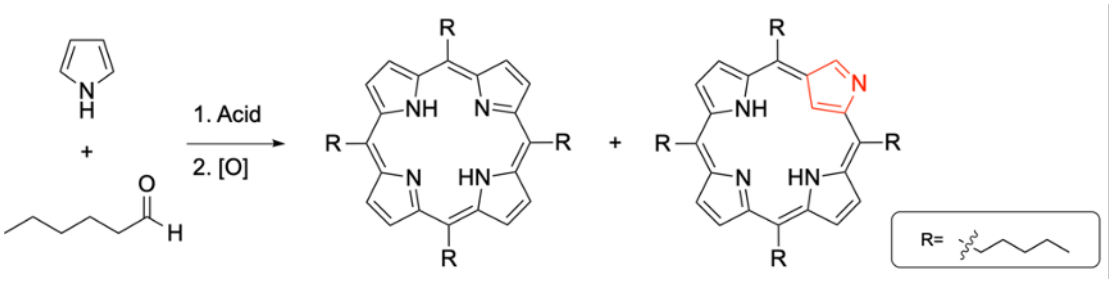
Title of Project: Synthesis of Tetrapentylporphyrin, and the Investigation of the Preparation of Tetrapentyl-N-Confused Porphyrin

Funding Source: Justus '43 and Jayne Schlichting Student Research Fund

Project Summary:

Porphyrins are important for their roles in essential biological processes. Well-known examples include heme in red blood cells and chlorophyll in plants. Porphyrins are widely studied for their various properties including metal binding and spectroscopy. N-confused porphyrins (NCPs) are isomers of porphyrin with an inverted pyrrole ring. While tetraarylporphyrins (e.g., tetraphenylporphyrin) have been commonly used in studies of porphyrin synthesis and properties, meso-alkyl substituted porphyrins have been less thoroughly studied and meso-alkyl N-confused porphyrins have not been reported.

Our research group previously identified conditions that afford tetrapentylporphyrin (TPeP) in a yield of 45% on a preparative-scale. Our group also identified conditions on an analytical scale that provided tetrapentyl-N-confused porphyrin (TPe-NCP) in a yield of 7-9%. However, attempted preparative-scale syntheses of TPe-NCP under these conditions provided isolated yields that were lower and inconsistent. Goals for this summer included preparing additional quantities of TPeP to support an ongoing collaboration, attempting the synthesis of TPe-NCP under conditions previously identified, and refining the synthesis and purification of TPe-NCP on preparative scale to improve yield and reproducibility.



This summer, we began with the preparation of TPeP (two samples of ~465 mg each) some of which have been sent to a collaborator. We then proceeded to investigate the preparation of TPe-NCP. First, we attempted a preparative-scale reaction under previously identified conditions, and we obtained a very low yield. In examining possible reasons for the low yield, we found that TPe-NCP is sensitive to light. This work was followed by a study of the effect of condensation reaction time on the yield of TPe-NCP. The reactions, purification steps, and sample transfers were done shielded from light to minimize degradation. We observed an improvement in yield and purity, and we were able to isolate a sufficient amount of the compound to support preliminary studies of its properties.

Research Fellows: **Grace Zhang (2027)** **Concentration: Biochemistry**
Haiyu Zhu (2027) **Concentration: Biochemistry**
Faculty Mentor: **Jenny Peeler** **Department: Chemistry**
Title of Project: **Influence of lysine acetylation on bacterial stress response proteins**
Funding Source: **Division of Natural Sciences and Mathematics; Justus '43 and Jayne Schlichting Student Research Fund**

Project Summary:

Lysine acetylation (AcK) is a post-translational modification where an acetyl group is added to the side chain of the amino acid lysine. This modification can alter the structure of proteins, potentially changing their functionality. Previous studies have identified many proteins containing AcK, but the functional influence of these modifications remains unknown. We studied two E. coli proteins known to be modified by AcK: YajL and FNR. Both proteins play roles in bacterial stress response. First, we successfully used genetic code expansion to express and purify homogeneous samples of both unmodified (wt) and site-specifically acetylated YajL, as well as FNR. Then, we performed kinetic assays on each version to determine their Km and Vmax values, which provide insight into how lysine acetylation influences protein activity.

YajL catalyzes the conversion of glyoxal (GO) to glycolate, preventing harmful glyoxal-induced protein modifications. The kinetic assay measures the initial velocities of YajL by tracking the rate of GO disappearance over time at different GO concentrations. A Michaelis-Menten curve was successfully made for wt YajL, along with acetylated YajL. Both versions yielded similar Vmax values, but wt YajL had a lower Km, indicating higher substrate affinity than the acetylated version. Future work will examine the kinetics of YajL with other substrates.

FNR contributes to E. coli's redox stress response by generating products that repair oxidatively damaged iron-sulfur clusters. It catalyzes electron transport from NADPH to ferredoxin (Fd), an iron-sulfur protein involved in various metabolic pathways. A coupled assay using cytochrome c as the final electron acceptor was performed. The increase in absorbance of reduced cytochrome c over time serves as an indirect measure of FNR's velocity. We confirmed that cytochrome c is successfully reduced in the assay and generated a preliminary Michaelis-Menten curve from wt FNR initial velocities across varying NADPH concentrations. Work is currently underway to optimize the protocol for more precise results and to create curves for varying Fd concentrations, as well as for acetylated FNR.

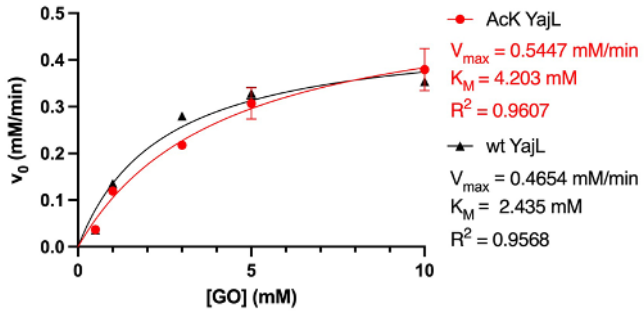


Figure 1. Michaelis-Menten curve plotting AcK and wt YajL initial velocity against various concentrations of GO

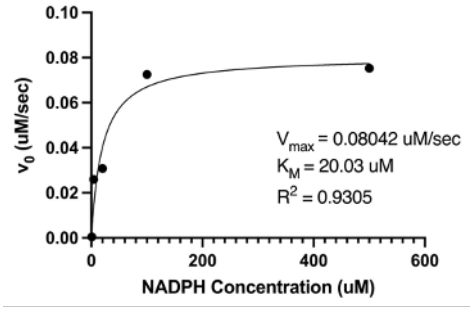


Figure 2. Michaelis-Menten curve plotting wt FNR initial velocity against various concentrations of NADPH.

Research Fellow: **Lezhi Zhang (2028)** **Concentration:** **Undeclared**
Faculty Mentor: **Stephanie Sanders** **Department:** **Chemistry**
Title of Project: **Photophysical Properties Across Phases: Aggregation-Induced Emission of Tetraphenylethylene in Acetonitrile-Water and Electronic Characteristics of Fluorophores in Thin Films**
Funding Source: **Division of Natural Sciences and Mathematics**
Project Summary:

Aggregation-induced emission (AIE) occurs when molecules that are weakly emissive in solution exhibit enhanced fluorescence upon aggregation. Understanding how photophysical properties evolve from dilute solution to aggregated or solid-state forms is crucial for optimizing AIE materials in real-world devices. Spin coating, a widely used thin-film deposition technique, creates unique molecular environments that can dramatically influence photophysical behavior through controlled aggregation and confinement effects. A common AIE molecule is tetraphenylethylene (TPE). As TPE aggregates, single bond rotation is restricted, thus increasing the radiative decay.

My goal was to investigate AIE properties of TPE in acetonitrile-water (MeCN-H2O) solutions and the electronic structure of conventional fluorophores in thin films versus in solution to explore how aggregation and solid-state confinement affect their photophysical properties.

Fluorescence emission spectra of TPE in MeCN revealed multiple peaks between 350 nm and 450 nm characteristic of vibronic coupling. At high TPE concentrations, the fluorescence intensity was diminished, attributed to inner filter effects. Notably, fluorescence intensity increased and red shifted substantially upon addition of water, with higher water concentration leading to aggregation and enhancing emission.

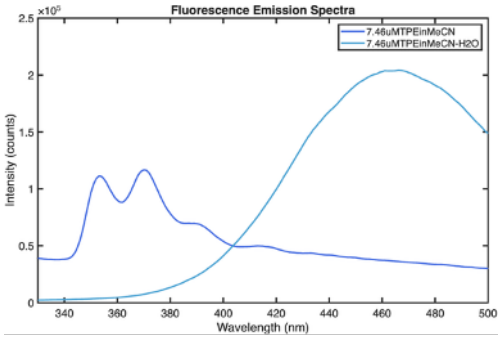


Figure 1. Fluorescence emission spectra of TPE in MeCN and 90% H2O : 10% MeCN.

Spin-coated thin films of four conventional fluorophores showed distinct solid-state photophysical behavior. Compared to solution, sulforhodamine 101 and fluorescein exhibited red-shifted absorption maxima in thin films, cresyl violet showed blue-shifted peaks in thin films, and congo red displayed negligible shift. This indicates different intermolecular interactions upon film formation. All fluorophores demonstrated significant peak broadening in the solid state, consistent with increased heterogeneity in thin films. These findings illustrate the profound influence of molecular packing and intermolecular interactions on fluorophore photophysical properties across different phases and aggregation conditions. My future research directions will focus on investigating the photophysical properties of TPE in thin films and varying MeCN-H2O ratios.

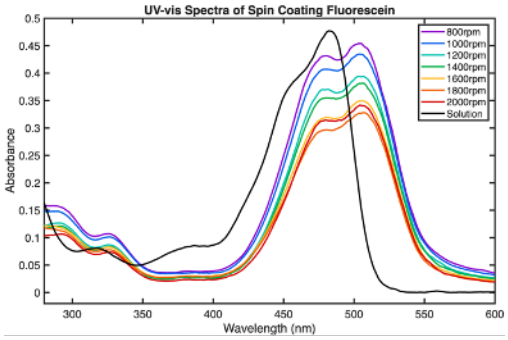


Figure 2. UV-vis absorbance spectra of spin coating fluorescein at different speeds.

Research Fellow: Melly Zhuang (2026) **Concentration:** Mathematical Economics
Faculty Mentor: Yang Song **Departments:** Economics; Asian Studies
Title of Project: Analyzing Patterns in the U.S. Charter School Laws and Their Political Context
Funding Source: Division of Social Sciences
Project Summary:

Charter schools are privately run schools that are publicly funded. According to MIT Blueprint Labs, relevant charter school laws were first established in 1991 and are now present in 45 states. Unlike traditional public schools, charter schools often pursue innovative growth and enjoy greater autonomy in areas such as curriculum design, employee certification requirements, administrative policies, and more. While proponents believe they foster competition and improve educational quality, opponents argue that they exacerbate inequities through selective admissions and risk financial mismanagement due to their autonomy. This summer, as part of a collaboration between Colgate University and MIT researchers, we began collecting state-specific law data and conducting preliminary trend analyses. The ultimate goal of this project is to identify charter school regulations most effective in improving student performance.

Data collection involved reviewing each state's charter school laws annually on state legislative websites and in the legal database Justia. Using pre-existing data collection sheets—where charter law components were categorized into 89 variables—I compiled data for seven new states. I also cross-checked three prior datasets collected by MIT students, organizing similarities and differences in Excel tables. Based on all cross-check results conducted with a peer research assistant, I calculated the match rate and conflict rate for each variable. These metrics will serve as references for future data cleaning and more accurate econometric analysis.

For the trend analysis, I examined the relationship between state political alignment and changes in the supportiveness of charter school laws over time. I hypothesized that Republican-dominated states would increasingly adopt more supportive laws, while Democrat-dominated states would either maintain current levels or shift toward more stringent policies. To test this, I selected two groups of variables representing support for innovative growth and for charter school autonomy, and conducted a Principal Component Analysis (PCA) to create a composite supportiveness index for 26 states with complete data for 2010 and 2024. The change in index values between the two years was calculated for each state and grouped by political alignment (Figure 1). The results indicate only a weak association between political context and changes in supportiveness. Notably, Republican-dominated states showed minimal change, contrary to my initial hypothesis. Potential limitations include the incomplete dataset (26 of 45 states) and unverified state-level data with possible high error rates.

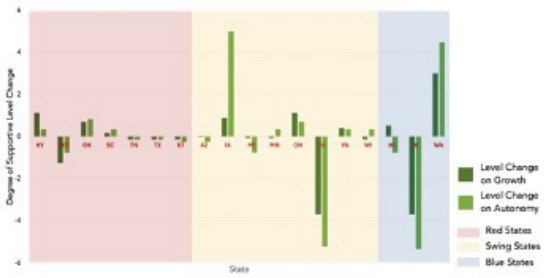


Figure 1. Supportive Level Change by State Political Context from 2010 to 2024

Research Fellows: Angie Zhu (2026) **Concentration: Applied Math**

Faculty Mentor: Bineyam Taye **Departments: Biology; Global Public and Environmental Health**

Title of Project: The impact of food insecurity on the gut microbiome of Ethiopian schoolchildren

Funding Source: Michael J. Wolk '60 Heart Foundation

Project Summary:

Food insecurity is a pressing global health concern and is linked to numerous adverse physical and mental health conditions such as diabetes mellitus, cardiovascular disease, and depression. Moreover, food insecurity is a complex, multidimensional condition experienced heterogeneously, and its various facets may exert different effects. Yet, the biological mechanisms connecting food insecurity to health remain poorly understood. To address this gap, we investigated the effects of food insecurity and its various components on the gut microbiome of Ethiopian schoolchildren ($n = 57$) and assessed food insecurity using the Household Food Insecurity Access Scale. Fecal samples were collected in the 2024 academic year, and microbial profiles were established using 16S rRNA amplicon paired-end sequencing. We observed no significant differences in alpha diversity across food security status (Kruskal–Wallis, $p > 0.4$). However, beta diversity analysis showed modest but meaningful microbiome composition shifts between food secure and food insecure individuals (PERMANOVA: Bray–Curtis $p < 0.05$; Jaccard $p < 0.10$). Further analyses of individual food insecurity components revealed that limited dietary variety, consumption of disliked foods, and reduced meal size were each associated with significant shifts in microbial community structure (PERMANOVA, all $q < 0.05$), highlighting the importance of these components. Across various approaches, *Sutterella* was consistently enriched among food-insecure participants (composite model $q = 0.11$; component-specific models $q < 0.05$). Additionally, a microbial feature based machine learning model accurately predicted the food security status of study participants (AUC = 0.81) with *Sutterella* emerging as the top predictive feature. Our findings demonstrate that food insecurity, especially specific components, is associated with disruptions in gut microbial composition. The consistent enrichment of *Sutterella* in food insecure individuals suggests potential mechanistic links between food insecurity, child health, and neuro-developmental pathways. Further studies are warranted to clarify the mechanisms involved between food insecurity and health outcomes and to develop targeted microbial intervention treatments.

Statistics

Please note the total number of participating students is the number of student projects. Students working on two different projects with different faculty are counted twice. Students with double-majors are counted twice in the Distribution of Students by Concentration table.

In addition, the total number of participating faculty is the number of faculty supervising student research projects. In the individual department counts, faculty holding joint appointments are counted twice, once for each department affiliation. Faculty in different departments jointly supervising one student research project are both counted in the Distribution of Students by Faculty Division and Department table.

Total number of participating students: **202**

Distribution of Students by Concentration (students with double majors are included twice)

Africana and Latin American Studies	1
Anthropology	1
Applied Math	9
Art and Art History	1
Astronomy/Physics	3
Biochemistry	9
Biology	17
Chemistry	11
Chinese	1
Classical Studies	2
Classics	2
Computer Science	8
Economics	7
Educational Studies	2
English	10
Environmental Biology	1
Environmental Economics	1
Environmental Geography	4
Environmental Geology	1
Environmental Studies	9
French	1
Geography	3
Geology	3
German	1
History	6
International Relations	4
Japanese	1
Mathematical Economics	1
Mathematics	2
Middle Eastern and Islamic Studies	2
Molecular Biology	15
Music	1
Native American Studies	2
Natural Sciences	1
Neuroscience	13
Peace and Conflict Studies	5
Philosophy	6
Physics	13
Political Science	16
Psychological Science	11
Religion	2
Russian and Eurasian Studies	3
Sociology	3
Spanish	1
Studio Art	2
Undeclared	28

Distribution of Students by Concentration (students with double majors are included twice)

Arts and Humanities	**31**
Art and Art History	1
Chinese	1
Classical Studies	2
Classics	2
English	10
French	1
German	1
Japanese	1
Music	1
Philosophy	6
Religion	2
Spanish	1
Studio Art	2
Natural Sciences and Mathematics	**115**
Applied Math	9
Astronomy/Physics	3
Biochemistry	9
Biology	17
Chemistry	11
Computer Science	8
Geology	3
Mathematics	2
Molecular Biology	15
Natural Sciences	1
Neuroscience	13
Physics	13
Psychological Science	11
Social Sciences	**43**
Anthropology	1
Economics	7
Educational Studies	2
Geography	3
History	6
International Relations	4
Mathematical Economics	1
Political Science	16
Sociology	3
University Studies	**29**
Africana and Latin American Studies	1
Environmental Biology	1
Environmental Economics	1
Environmental Geography	4
Environmental Geology	1
Environmental Studies	9
Middle Eastern and Islamic Studies	2
Native American Studies	2
Peace and Conflict Studies	5
Russian and Eurasian Studies	3
Undeclared	**28**

Distribution of Students by Faculty Division and Department:
(Number is greater than total number of participating students due to jointly supervised projects and joint faculty appointments)

Arts and Humanities	**22**
Art	4
Classics	3
East Asian Languages and Literatures	2
English	7
Philosophy	1
Religion	5
Natural Sciences and Mathematics	**134**
Biology	30
Chemistry	22
Computer Science	5
Earth and Environmental Geosciences	12
Mathematics	7
Neuroscience	6
Physics and Astronomy	28
Psychological and Brain Sciences	24
Social Sciences	**35**
Economics	5
Educational Studies	2
Geography	4
History	3
International Relations	4
Political Science	14
Sociology and Anthropology	3
University Studies	**24**
Africana and Latin American Studies	4
Asian Studies	2
Environmental Studies	9
Global and Environmental Public Health	3
Museum Studies	3
Native American Studies	1
Russian and Eurasian Studies	2
Other	**42**
Information Technology Services	4
Kraynak Institute for the Study of Freedom and Western Traditions	15
Lampert Institute for Civic and Global Affairs	4
Upstate Institute	19

Distribution of Students by Funding Source:

Internal	**142**
Division of the Arts and Humanities	14
Division of Natural Sciences and Mathematics	67
Division of Social Sciences	19
Division of University Studies	2
Information Technology Services	2
Kraynak Institute for the Study of Freedom and Western Traditions	15
Lampert Institute for Civic and Global Affairs	4
Upstate Institute	19
Endowed	**49**
Bob Linsley/James McLelland Fund	2
Doug Rankin ’53 Endowment-Appalachian Research	1
Doug Rankin ’53 Endowment-Geology Research	2
Hackett-Rathmell 1968 Memorial Fund	1
Holden Endowment Fund	1
J. Curtiss Taylor ’54 Endowed Student Research Fund	2
John C. Cochran Endowed Fund for Undergraduate Research	2
Justus ’43 and Jayne Schlichting Student Research Fund	13
Michael J. Wolk ’60 Heart Foundation	8
Miller-Cochran Fund	1
Mind, Brain, and Behavior Scholars Award	3
Mind, Brain, and Behavior Summer Grant	2
Norma Vergo Prize	1
Picker Interdisciplinary Science Institute	1
Sonya Lee-Chung ’85, P’21 Endowed Research Fund	1
Stickles Fund	2
Tom and Liz Brackett Endowed Fund for Diversity, Equity, and Inclusion in Computer Science	2
Walter Broughton ’63 Research Fund	2
Warren Anderson Fund	2
External	**13**
NASA Grant	2
National Institutes of Health Grant	1
National Science Foundation Grant	8
Office of Naval Research Grant	1
Organic Syntheses PUI Summer Research Grant	1

Total number of participating faculty:	**81**

Distribution of Faculty by Division and Department:
(Numbers below may be greater than total number of participating faculty due to faculty joint appointments)

Arts and Humanities	**10**
Art	2
Classics	2
East Asian Languages and Literatures	1
English	2
Philosophy	1
Religion	2
Natural Sciences and Mathematics	**48**
Biology	11
Chemistry	9
Computer Science	3
Earth and Environmental Geosciences	4
Mathematics	5
Neuroscience	2
Physics and Astronomy	7
Psychological and Brain Sciences	7
Social Sciences	**21**
Economics	4
Educational Studies	1
Geography	2
History	2
International Relations	1
Political Science	9
Sociology and Anthropology	2
University Studies	**11**
Africana and Latin American Studies	2
Asian Studies	1
Environmental Studies	3
Global and Environmental Public Health	1
Museum Studies	1
Native American Studies	1
Russian and Eurasian Studies	2
Other	**19**
Information Technology Services	1
Kraynak Institute for the Study of Freedom and Western Traditions	13
Lampert Institute for Civic and Global Affairs	4
Upstate Institute	1

Distribution of Faculty by Funding Source
(Faculty with more than one funding source are counted multiple times)

Internal	**73**
Division of the Arts and Humanities	6
Division of Natural Sciences and Mathematics	34
Division of Social Sciences	12
Division of University Studies	2
Information Technology Services	1
Kraynak Institute for the Study of Freedom and Western Traditions	13
Lampert Institute for Civic and Global Affairs	4
Upstate Institute	1
Endowed	**42**
Bob Linsley/James McLelland Fund	1
Doug Rankin ’53 Endowment-Appalachian Research	1
Doug Rankin ’53 Endowment-Geology Research	2
Hackett-Rathmell 1968 Memorial Fund	1
Holden Endowment Fund	1
J. Curtiss Taylor ’54 Endowed Student Research Fund	2
John C. Cochran Endowed Fund for Undergraduate Research	2
Justus ’43 and Jayne Schlichting Student Research Fund	11
Michael J. Wolk ’60 Heart Foundation	5
Miller-Cochran Fund	1
Mind, Brain, and Behavior Scholars Award	3
Mind, Brain, and Behavior Summer Grant	2
Norma Vergo Prize	1
Picker Interdisciplinary Science Institute	1
Sonya Lee-Chung ’85, P’21 Endowed Research Fund	1
Stickles Fund	1
Tom and Liz Brackett Endowed Fund for Diversity, Equity, and Inclusion in Computer Science	2
Walter Broughton ’63 Research Fund	2
Warren Anderson Fund	2
External	**8**
NASA Grant	1
National Institutes of Health Grant	1
National Science Foundation Grant	4
Office of Naval Research Grant	1
Organic Syntheses PUI Summer Research Grant	1

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