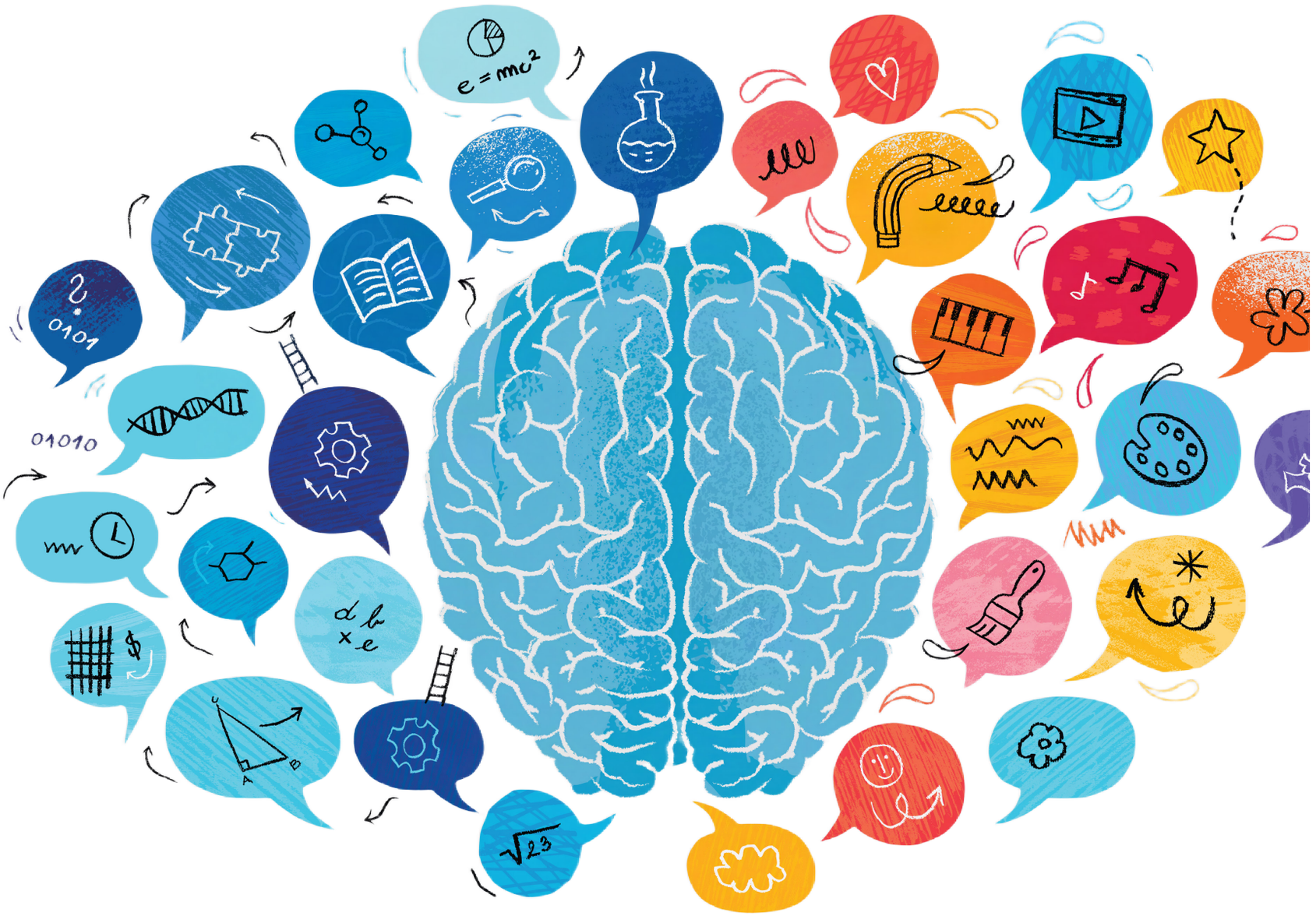
COLGATE UNIVERSITY



Summer Undergraduate Research Directory

Volume 33 | 2026

Colgate University Summer Undergraduate Research Directory

Volume 33
2026

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

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: Emma Lepkowicz 2028 (Chemistry; History)
Faculty Mentor: Elizabeth Marlow
Title of Project: *Why are the Picker Gallery's late-antique Egyptian relief sculptures beginning to deteriorate and what can be done to prevent further damage?*
Funding Source: The Kraynak Institute for the Study of Freedom and Western Traditions

Research Fellow: Rebecca Li 2028 (Art History)
Faculty Mentor: Carolyn Guile
Title of Project: *17th-Century Chinese Reinterpretations of the Jesuit Engravings Series, Evangelicae Historiae Imagines (1593)*
Funding Source: The Kraynak Institute for the Study of Freedom and Western Traditions

Research Fellow: Bennett Rowe 2026 (Classical Studies; Art History)
Faculty Mentor: Carolyn Guile
Title of Project: *The Tomb of the Unknown Soldier at Arlington National Cemetery in the period 1920-1932 asking the question, "How did Americans mourn in the wake of unimaginable tragedy?"*
Funding Source: The Kraynak Institute for the Study of Freedom and Western Traditions

Department of Classics

Research Fellow: Claire Escher 2028 (Classical Studies; Molecular Biology)
Faculty Mentor: Geoffrey Benson
Title of Project: *Dreams, Deception, and the Politics of Truth in Vergil's Aeneid*
Funding Source: The Kraynak Institute for the Study of Freedom and Western Traditions

Department of East Asian Languages and Literatures

Research Fellow: Leo Li 2027 (Philosophy)
Faculty Mentor: Jing Wang
Title of Project: *On the Importance of Joseph Needham and His Contemporaries*
Funding Source: J. Curtiss Taylor '54 Endowed Student Research Fund

Department of English and Creative Writing

Research Fellow: Karla Joseph 2027 (English)
Faculty Mentor: CJ Hauser
Title of Project: *Living Writers Fellowship*
Funding Source: J. Curtiss Taylor '54 Endowed Student Research Fund

Research Fellow: Annabel McKenna 2027 (History; English)
Faculty Mentor: CJ Hauser
Title of Project: *Living Writers Summer Fellows*
Funding Source: Division of Arts and Humanities

Research Fellow: Everett Shinn 2027 (English; Educational Studies)
Faculty Mentor: CJ Hauser
Title of Project: *Living Writers Summer Fellows*
Funding Source: Living Writers Program

Research Fellow: Keira Tran 2027 (English)
Faculty Mentor: CJ Hauser
Title of Project: *Living Writers Summer Fellows*
Funding Source: Living Writers Program

Research Fellow: Sophie Wohlstadter 2027 (English; Asian Studies)
Faculty Mentor: CJ Hauser
Title of Project: *Living Writers Summer Fellows*
Funding Source: Living Writers Program

Department of German

Research Fellow: Tyler Couture 2027 (German; Economics)
Faculty Mentor: Irina Kogan
Title of Project: *Historical Revisionism. Two Tales of Teutoburg*
Funding Source: The Kraynak Institute for the Study of Freedom and Western Traditions

Department of Philosophy

Research Fellow: Luke Lostumbo 2026 (Psychological Science)
Faculty Mentor: David Dudrick
Title of Project: *Efficiency and The Panopticon: Living Well in a Culture of Death*
Funding Source: The Kraynak Institute for the Study of Freedom and Western Traditions

Research Fellow: Hannah Zubatyy 2028 (Philosophy; Political Science)
Faculty Mentor: David Dudrick
Title of Project: *A Thomist Critique of Sartre's Moral Relativism*
Funding Source: The Kraynak Institute for the Study of Freedom and Western Traditions

Department of Romance Languages and Literatures

Research Fellow: Nicolette Fox 2027 (French)
Faculty Mentor: Katherine Brown
Title of Project: *Portraits of Anxiety: a Medical Humanities Analysis of 19th-Century Literature*
Funding Source: J. Curtiss Taylor '54 Endowed Student Research Fund

Department of Theater

Research Fellow: Juliette Boots 2028 (German)
Faculty Mentor: April Sweeney
Title of Project: *Midsummer Night's Dream*
Funding Source: Storytelling Fund; Division of Arts and Humanities

Research Fellow: Antonius Robello 2029 (Theater)
Faculty Mentor: April Sweeney
Title of Project: *A Midsummer Night's Dream*
Funding Source: Storytelling Fund; Division of Arts and Humanities

DIVISION OF NATURAL SCIENCES AND MATHEMATICS (NASC)

Department of Biology

Research Fellow: Matthew Arnold 2028 (Environmental Studies; Sociology)
Faculty Mentor: Frank Frey
Title of Project: *Pollinator Habitat Restoration*
Funding Source: Oberheim Memorial Fund

Research Fellow: Katherine Cline 2027 (Molecular Biology)
Faculty Mentor: Sarah McMillan
Title of Project: *Characterizing How Exonuclease IX Interacts with Single-Stranded DNA-Binding Protein (SSB)*
Funding Source: Michael J. Wolk '60 Heart Foundation

Research Fellow: Emily Collins 2027 (Molecular Biology)
Faculty Mentor: Krista Ingram
Title of Project: *Single- and multi-SNP haplotype analyses of the circadian-related SLC20A2 gene reveal sex-specific associations with seasonal affective disorder (SAD)*
Funding Source: Mind, Brain, and Behavior Scholars Award

Research Fellow: Veronica Cordero 2027 (Molecular Biology; Spanish)
Faculty Mentor: Engda Hagos
Title of Project: *Investigating the Role of Krüppel-like Factor Four (KLF4) in Oxidative Stress and Lipid Metabolism*
Funding Source: Michael J. Wolk '60 Heart Foundation

Research Fellow: Isabel Drexler Booth 2027 (Computer Science; Biology)
Faculty Mentor: Ahmet Ay
Title of Project: *Artificial Intelligence and Mathematical Modeling Meet Biology*
Funding Source: Michael J. Wolk '60 Heart Foundation

Research Fellow: Jia Edison 2029 (Undeclared)
Faculty Mentor: Frank Frey
Title of Project: *Counting Configurations of Points and Lines*
Funding Source: Division of Natural Sciences and Mathematics

Research Fellow: Maya Guha 2028 (Biology)
Faculty Mentor: Therese Frauendorf
Title of Project: *Sticks and Stones and Poop and Bones: Shifts in Invertebrate Diets with Wildlife Input*
Funding Source: Division of Natural Sciences and Mathematics

Research Fellow: Theo Hauptman 2027 (Biology)
Faculty Mentor: Therese Frauendorf
Title of Project: *Sticks and Stones and Poop and Bones: Shifts in Invertebrate Diets with Wildlife Input*
Funding Source: Division of Natural Sciences and Mathematics

Research Fellow: Tolu Ladapo 2028 (Molecular Biology)
Faculty Mentor: Sarah McMillan
Title of Project: *Confirming the interaction between SSB and SbcCD*
Funding Source: Division of Natural Sciences and Mathematics

Research Fellow: Seongwon Lee 2029 (Undeclared)
Faculty Mentor: Jason Meyers
Title of Project: *Zebrafish Terminal Neuromast Regeneration*
Funding Source: Division of Natural Sciences and Mathematics

Research Fellow: Michal Lukaszewski 2029 (Undeclared)
Faculty Mentor: Jason Meyers
Title of Project: *fgf3 and wnt2 in situ hybridization during Epithelial Mesenchymal Transition post Neuromast Ablation*
Funding Source: Division of Natural Sciences and Mathematics

Research Fellow: Jackson Macejko 2029 (Undeclared)
Faculty Mentor: Frank Frey
Title of Project: *Pollinator Habitat Restoration*
Funding Source: Division of Natural Sciences and Mathematics

Research Fellow: Shegufta Mehjabeen 2028 (Biology; Neuroscience)
Faculty Mentor: Krista Ingram
Title of Project: *Single- and multi-SNP haplotype analyses of the circadian-related SLC20A2 gene reveal sex-specific associations with seasonal affective disorder (SAD)*
Funding Source: Division of Natural Sciences and Mathematics

Research Fellow: Nathan Molloy 2027 (Biology)
Faculty Mentor: Sarah McMillan
Title of Project: *Characterizing SSB/ExoIX Protein Interaction*
Funding Source: Oberheim Memorial Fund

Research Fellow: Leah Nemi 2028 (Molecular Biology)
Faculty Mentor: Engda Hagos
Title of Project: *Investigating the Role of Krüppel-like Factor Four (KLF4) in Regulating Lipid Metabolism*
Funding Source: Michael J. Wolk ’60 Heart Foundation

Research Fellow: Kendall Newsome 2028 (Biology)
Faculty Mentor: Therese Frauendorf
Title of Project: *Sticks and Stones and Poop and Bones: Shifts in Invertebrate Diets with Wildlife Input*
Funding Source: Division of Natural Sciences and Mathematics

Research Fellow: Alex Osteen 2028 (Natural Sciences)
Faculty Mentor: Krista Ingram
Title of Project: *Facial Recognition and eDNA Analysis of Harbor Seal Social Networks Provides Insight into Population Dynamics of Wild Pinnipeds*
Funding Source: Division of Natural Sciences and Mathematics

Research Fellow: Malia Porter 2028 (Computer Science)
Faculty Mentor: Ahmet Ay
Title of Project: *Words, Voice, and Face: How an Explainable AI Detects Depression and PTSD*
Funding Source: Mind, Brain, and Behavior Faculty Grant

Research Fellow: Lana Rinkin 2029 (Undeclared)
Faculty Mentor: Priscilla Van Wynsberghe
Title of Project: *Exploring Lin-42 & Kin-20 Interactions in C. elegans; Molecular Analysis of Development in C. elegans*
Funding Source: Division of Natural Sciences and Mathematics

Research Fellow: Isaiah Ruffin 2028 (Molecular Biology)
Faculty Mentor: Priscilla Van Wynsberghe
Title of Project: *Exploring Lin-42 & Kin-20 Interactions in C. elegans; Molecular Analysis of Development in C. elegans*
Funding Source: Michael J. Wolk ’60 Heart Foundation

Research Fellow: Madeline Shingleton 2028 (Biology)
Faculty Mentor: Jason Meyers
Title of Project: *FGF Signaling May Be Restricted to Central Support Cell Populations During Neuromast Regeneration*
Funding Source: Michael J. Wolk ’60 Heart Foundation

Research Fellow: Shep Sorenson 2027 (Molecular Biology)
Faculty Mentor: Priscilla Van Wynsberghe
Title of Project: *Exploring Lin-42 & Kin-20 Interactions in C. elegans; Molecular Analysis of Development in C. elegans*
Funding Source: Michael J. Wolk ’60 Heart Foundation

Research Fellow: Han Xiao 2029 (Undeclared)
Faculty Mentor: Ahmet Ay
Title of Project: *Discovering Parkinson's Disease Biomarkers with Explainable AI*
Funding Source: Sonya Lee-Chung ’85, P’21 Endowed Research Fund

Research Fellow: Tony Xu 2028 (Computer Science)
Faculty Mentors: Ay Ahmet; Bineyam Taye
Title of Project: *Gut Microbiome, Diarrhea, Stunting, and Thinness in School-Age Ethiopian Children: A Cross-Sectional 16S rRNA Gene Sequencing Study*
Funding Source: Mind, Brain, and Behavior Faculty Grant

Department of Chemistry

Research Fellow: Sakhi Balaji 2029 (Undeclared)
Faculty Mentor: Jenny Peeler
Title of Project: *Influence of lysine acetylation on YajL and AdhE*
Funding Source: Michael J. Wolk ’60 Heart Foundation

Research Fellow: Meredith Black 2028 (Chemistry; Neuroscience)
Faculty Mentor: Jason Keith
Title of Project: *Applications of Density Functional Theory to Reaction Mechanisms and Spectroscopy*
Funding Source: National Science Foundation Grant; Justus ’43 and Jayne Schlichting Student Research Fund

Research Fellow: Gavin Coull 2028 (Biochemistry)
Faculty Mentor: Jacob Goldberg
Title of Project: *Enzyme-Activatable Fluorogenic Zinc Sensors*
Funding Source: Organic Syntheses PUI Summer Research Grant; Division of Natural Sciences and Mathematics

Research Fellow: Cathy Dai 2029 (Undeclared)
Faculty Mentor: Stephanie Sanders
Title of Project: *Spectroscopic Investigation of the UV-Included Photocyclization of Bis(triphenylphosphonium) tetraphenylethylene*
Funding Source: Justus ’43 and Jayne Schlichting Student Research Fund

Research Fellow: Vivian Eckert 2028 (Biochemistry)
Faculty Mentor: Dimitar Shopov
Title of Project: *High-Valent Oxo-Bridged Iridium Cluster: Evidence for Unprecedented Ir(IV) Metal-Metal Bond*
Funding Source: Division of Natural Sciences and Mathematics

Research Fellow: Audrey Holland 2027 (Biochemistry)
Faculty Mentor: Katie Smith
Title of Project: *Structural Modifications to an Established 5-HT1A Agonist for Improved SSRI Therapeutic Effects Onset Time*
Funding Source: Michael J. Wolk ’60 Heart Foundation

Research Fellow: Tori Houser 2027 (Biochemistry)
Faculty Mentor: Anthony Chianese
Title of Project: *Characterizing an Iridium Pincer Catalyst for Amide Hydrogenation*
Funding Source: National Science Foundation Grant

Research Fellow: Conner Jones 2027 (Chemistry)
Faculty Mentor: Gongfang Hu
Title of Project: *Bismuth Complexes Supported by a Rigid CCC/CNC Pincer Ligand*
Funding Source: Miller-Cochran Fund

Research Fellow: Isabel Kats-Rodgers 2027 (Chemistry)
Faculty Mentor: Eric Muller
Title of Project: *Probing the Liquid-Solid Interface Through Infrared Nanospectroscopy*
Funding Source: Warren Anderson Fund

Research Fellow: Eva Khavin 2029 (Undeclared)
Faculty Mentor: Katie Smith
Title of Project: *Structural Modifications to an Established 5-HT1A Agonist for Improved SSRI Therapeutic Effects Onset Time*
Funding Source: Division of Natural Sciences and Mathematics

Research Fellow: Leo Liu 2027 (Chemistry; Mathematics)
Faculty Mentor: Stephanie Sanders
Title of Project: *Photophysical characterization of bismuth–nickel complexes for photocatalytic CO2 reduction*
Funding Source: Division of Natural Sciences and Mathematics

Research Fellow: Cooper More 2029 (Undeclared)
Faculty Mentor: Eric Muller
Title of Project: *Surface Plasmon Induced Reactivity*
Funding Source: Justus ’43 and Jayne Schlichting Student Research Fund

Research Fellow: Olivia Pearre 2027 (Chemistry; Mathematics)
Faculty Mentor: Gongfang Hu
Title of Project: *Defining Pnictogen-Specific Control of Palladium Catalysis through a PPnP Pincer Series (Pn = N, P, Sb, Bi)*
Funding Source: Division of Natural Sciences and Mathematics

Research Fellow: Gabe Pollock-O’Dorisio 2028 (Chemistry)
Faculty Mentor: Anne Perring
Title of Project: *Black Carbon Measurements During NASA INSPYRE Field Campaign*
Funding Source: Warren Anderson Fund

Research Fellow: Andrew Prosnitz 2029 (Undeclared)
Faculty Mentor: Jacob Goldberg
Title of Project: *Incorporation of Fluorinated Amino Acids into Proteins*
Funding Source: Justus ’43 and Jayne Schlichting Student Research Fund

Research Fellow: Penelope Schenkel 2028 (Chemistry)
Faculty Mentor: Anthony Chianese
Title of Project: *Continued Study of Kinetics of Ruthenium-catalyzed Hydrodehalogenation Reactions*
Funding Source: Division of Natural Sciences and Mathematics

Research Fellow: Micahra Semper 2028 (Biochemistry)
Faculty Mentor: Jacob Goldberg
Title of Project: *Incorporation of Fluorinated Amino Acids into Proteins*
Funding Source: Michael J. Wolk ’60 Heart Foundation

Research Fellow: Dev Sethi 2027 (Biochemistry)
Faculty Mentor: Anne Perring
Title of Project: *Black Carbon Measurements During NASA INSPYRE Field Campaign*
Funding Source: Division of Natural Sciences and Mathematics

Research Fellow: Noah-Kai Shak 2029 (Undeclared)
Faculty Mentor: Jason Keith
Title of Project: *Applications of Density Functional Theory to Reaction Mechanisms and Spectroscopy*
Funding Source: National Science Foundation Grant; Justus ’43 and Jayne Schlichting Student Research Fund

Research Fellow: Yaroslav Spytskyi 2028 (Chemistry)
Faculty Mentor: Anthony Chianese
Title of Project: *Ru-catalyzed Hydrodehalogenation*
Funding Source: Division of Natural Sciences and Mathematics

Research Fellow: Wes Sutton 2027 (Chemistry)
Faculty Mentor: Dimitar Shopov
Title of Project: *High-Valent Oxo-Bridged Iridium Cluster: Evidence for Unprecedented Ir(IV) Metal-Metal Bond*
Funding Source: Division of Natural Sciences and Mathematics

Research Fellow: John Turnbull 2028 (Chemistry)
Faculty Mentor: Jason Keith
Title of Project: *Applications of Density Functional Theory to Reaction Mechanisms and Spectroscopy*
Funding Source: Miller-Cochran Fund

Research Fellow: Sivi Ward 2029 (Undeclared)
Faculty Mentor: Jenny Peeler
Title of Project: *Influence of lysine acetylation on YajL and AdhE*
Funding Source: John C. Cochran Endowed Fund for Undergraduate Research

Research Fellow: David Ye 2027 (Chemistry)
Faculty Mentor: Anthony Chianese
Title of Project: *Mechanistic Studies and Optimization of Switchable Amide Hydrogenation Catalysts Selective for C–O and C–N Bond Cleavage*
Funding Source: National Science Foundation Grant

Research Fellow: Kyle Yoon 2029 (Undeclared)
Faculty Mentor: Gongfang Hu
Title of Project: *Role of Bismuth in Catalyzing Challenging Ketone Reactions*
Funding Source: Division of Natural Sciences and Mathematics

Research Fellow: Lezhi Zhang 2028 (Chemistry)
Faculty Mentor: Stephanie Sanders
Title of Project: *Solvent-Dependence of the Electronic and Photophysical Properties of Bi-Ni and Sb-Ni Complexes*
Funding Source: Picker Interdisciplinary Science Institute Grant

Research Fellow: Haiyu Zhu 2027 (Biochemistry; Applied Math)
Faculty Mentor: Jenny Peeler
Title of Project: *Influence of lysine acetylation on YajL and AdhE*
Funding Source: Division of Natural Sciences and Mathematics

Department of Earth and Environmental Geosciences

Research Fellow: Daniyar Ali 2028 (Geology)
Faculty Mentor: Amy Leventer
Title of Project: *Diatom Biostratigraphy and Paleoclimate Reconstruction of East Antarctica over the past Half Million Years*
Funding Source: Doug Rankin ’53 Endowment-Geology Research

Research Fellow: Samuel Chittick 2028 (Chemistry)
Faculty Mentor: William Peck
Title of Project: *Eccentric Iron Deposits in the Adirondack Highlands*
Funding Source: Doug Rankin ’53 Endowment-Appalachian Research

Research Fellow: Kate Christensen 2028 (Environmental Geography)
Faculty Mentor: Joe Levy
Title of Project: *Polar and Planetary Habitability*
Funding Source: Norma Vergo Prize

Research Fellow: Tommy Fan 2027 (Environmental Geology; Studio Arts)
Faculty Mentor: William Peck
Title of Project: *Geology of the Kilbourne graphite deposit, St. Lawrence County, New York*
Funding Source: Doug Rankin ’53 Endowment-Geology Research

Research Fellow: Nelson Rice 2029 (Undeclared)
Faculty Mentor: Amy Leventer
Title of Project: *Eucampia antarctica diatom research: Reconstructing the history of sea ice*
Funding Source: Hackett-Rathmell 1968 Memorial Fund

Research Fellow: Kira Sullivan 2028 (Environmental Studies)
Faculty Mentor: William Peck
Title of Project: *Eccentric Iron Deposits in the Adirondack Highlands*
Funding Source: Doug Rankin ’53 Endowment-Appalachian Research

Research Fellow: Megan Sweatt 2028 (Environmental Geology)
Faculty Mentor: Amy Leventer
Title of Project: *First high-resolution late Holocene paleoceanographic record, Dibble Glacier region, East Antarctica: A diatom-based approach*
Funding Source: Norma Vergo Prize

Research Fellow: Jelly Wan 2028 (Theater; Astrogeophysics)
Faculty Mentor: Joe Levy
Title of Project: *Polar and Planetary Habitability*
Funding Source: Hackett-Rathmell 1968 Memorial Fund

Department of Mathematics

Research Fellow: Ali Abdullah 2028 (Computer Science; Applied Math)
Faculty Mentor: Kelly Isham
Title of Project: *Counting 8 Arcs in 3D Projective Space*
Funding Source: Division of Natural Sciences and Mathematics

Research Fellow: Michael Boateng 2027 (Computer Science)
Faculty Mentor: Will Cipolli
Title of Project: *The Data Science Collaboratory*
Funding Source: Division of Natural Sciences and Mathematics

Research Fellow: Isabel Drexler Booth 2027 (Computer Science; Biology)
Faculty Mentor: Ahmet Ay
Title of Project: *Artificial Intelligence and Mathematical Modeling Meet Biology*
Funding Source: Michael J. Wolk ’60 Heart Foundation

Research Fellow: Maria Flores 2029 (Undeclared)
Faculty Mentor: Kelly Isham
Title of Project: *Counting 8 Arcs in 3D Projective Space*
Funding Source: Division of Natural Sciences and Mathematics

Research Fellow: Nico Hotes 2028 (Computer Science/Mathematics)
Faculty Mentor: Rob Davis
Title of Project: *Flow Polytopes, Route Cliques, and Layered DAGs*
Funding Source: Division of Natural Sciences and Mathematics

Research Fellow: Kelvin Kemboi 2029 (Undeclared)
Faculty Mentor: Will Cipolli
Title of Project: *The Data Science Collaboratory*
Funding Source: Division of Natural Sciences and Mathematics

Research Fellow: Bo Koebler 2027 (English; Mathematics)
Faculty Mentor: Rob Davis
Title of Project: *Flow Polytopes, Route Cliques, and Layered DAGs*
Funding Source: Division of Natural Sciences and Mathematics

Research Fellow: Nia Mckenzie 2029 (Undeclared)
Faculty Mentor: Gabe Sosa Castillo
Title of Project: *Strongly Stable Generators of Principal Lexsegment Ideals*
Funding Source: Division of Natural Sciences and Mathematics

Research Fellow: Hudson Miller 2029 (Mathematics)
Faculty Mentor: Gabe Sosa Castillo
Title of Project: *Strongly Stable Generators of Principal Lexsegment Ideals*
Funding Source: Division of Natural Sciences and Mathematics

Research Fellow: Malia Porter 2028 (Computer Science)
Faculty Mentor: Ahmet Ay
Title of Project: *Words, Voice, and Face: How an Explainable AI Detects Depression and PTSD*
Funding Source: Mind, Brain, and Behavior Faculty Grant

Research Fellow: Kade Santo 2027 (Mathematics; Computer Science)
Faculty Mentor: Gabe Sosa Castillo
Title of Project: *Strongly Stable Generators of Principal Lexsegment Ideals*
Funding Source: Division of Natural Sciences and Mathematics

Research Fellow: Olivia Schlegel 2027 (Applied Math; Economics)
Faculty Mentor: Nick Moore
Title of Project: *High Fidelity Numerical Simulation of Rogue Waves*
Funding Source: Office of Naval Research Grant

Research Fellow: Han Xiao 2029 (Undeclared)
Faculty Mentor: Ahmet Ay
Title of Project: *Discovering Parkinson's Disease Biomarkers with Explainable AI*
Funding Source: Sonya Lee-Chung '85, P'21 Endowed Research Fund

Research Fellow: Tony Xu 2028 (Computer Science)
Faculty Mentors: Ay Ahmet; Bineham Taye
Title of Project: *Gut Microbiome, Diarrhea, Stunting, and Thinness in School-Age Ethiopian Children: A Cross-Sectional 16S rRNA Gene Sequencing Study*
Funding Source: Mind, Brain, and Behavior Faculty Grant

Neuroscience Program

Research Fellow: Vincent Chen 2028 (Neuroscience)
Faculty Mentor: Wan-chun Liu
Title of Project: *The Effect of Nicotine and Dopamine on Zebra Finch Co-song Gestures*
Funding Source: Division of Natural Sciences and Mathematics

Research Fellow: Isla Gao 2028 (Neuroscience)
Faculty Mentor: Wan-chun Liu
Title of Project: *The Effect of Nicotine and Dopamine on Zebra Finch Co-song Gestures*
Funding Source: Division of Natural Sciences and Mathematics

Research Fellow: Joy Huang 2027 (Neuroscience)
Faculty Mentor: Bruce Hansen
Title of Project: *Exploring the Neural Representation of Aesthetic Preference*
Funding Source: Division of Natural Sciences and Mathematics

Research Fellow: Christopher Jachowicz 2028 (Computer Science)
Faculty Mentor: Bruce Hansen
Title of Project: *Learning task-relevant visual features by linking brain activity to large language models and deep convolutional neural networks*
Funding Source: Michael J. Wolk ’60 Heart Foundation

Research Fellow: Seongwon Lee 2029 (Undeclared)
Faculty Mentor: Jason Meyers
Title of Project: *Zebrafish Terminal Neuromast Regeneration*
Funding Source: Division of Natural Sciences and Mathematics

Research Fellow: Michal Lukaszewski 2029 (Undeclared)
Faculty Mentor: Jason Meyers
Title of Project: *fgf3 and wnt2 in situ hybridization during Epithelial Mesenchymal Transition post Neuromast Ablation*
Funding Source: Division of Natural Sciences and Mathematics

Research Fellow: Jorgen Martin 2028 (Neuroscience)
Faculty Mentor: Anzela Niraula
Title of Project: *Dopaminergic Neuron Activation Precedes Microglia Activation in the Arcuate Nucleus Following Poly I:C Injection*
Funding Source: Division of Natural Sciences and Mathematics

Research Fellow: Tanvi Prasad 2028 (Philosophy)
Faculty Mentor: Bruce Hansen
Title of Project: *Learning task-relevant visual features by linking brain activity to large language models and deep convolutional neural networks*
Funding Source: Division of Natural Sciences and Mathematics

Research Fellow: Devan Seidel 2028 (Neuroscience)
Faculty Mentor: Anzela Niraula
Title of Project: *Dopaminergic Neuron Activation Precedes Microglia Activation in the Arcuate Nucleus Following Poly I:C Injection*
Funding Source: Michael J. Wolk ’60 Heart Foundation

Research Fellow: Madeline Shingleton 2028 (Biology)
Faculty Mentor: Jason Meyers
Title of Project: *FGF Signaling May Be Restricted to Central Support Cell Populations During Neuromast Regeneration*
Funding Source: Michael J. Wolk ’60 Heart Foundation

Research Fellow: Madison Stevens 2028 (Neuroscience)
Faculty Mentor: Anzela Niraula
Title of Project: *Dopaminergic Neuron Activation Precedes Microglia Activation in the Arcuate Nucleus Following Poly I:C Injection*
Funding Source: Division of Natural Sciences and Mathematics

Department of Physics and Astronomy

Research Fellow: Erik Bergstrom 2028 (Mathematics; Physics)
Faculty Mentor: Kiko Galvez
Title of Project: *Encoding Data in Lambert Optical Beams*
Funding Source: Justus ’43 and Jayne Schlichting Student Research Fund

Research Fellow: Aiden Cannon 2029 (Undeclared)
Faculty Mentor: Thomas Balonek
Title of Project: *Investigating the Ongoing Optical Outburst of Quasar 1308+326*
Funding Source: Division of Natural Sciences and Mathematics

Research Fellow: Ricardo Chavarria 2028 (Physics)
Faculty Mentor: Beth Parks
Title of Project: *Measuring Building Insulation Through Heat Flow*
Funding Source: Division of Natural Sciences and Mathematics

Research Fellow: Emilia Colabello 2027 (Astrogeophysics)
Faculty Mentor: Jonathan Levine
Title of Project: *Interpreting Laser Ablation Mass Spectra Before CODEX Flies to the Moon*
Funding Source: Division of Natural Sciences and Mathematics

Research Fellow: Kanish Creary 2029 (Undeclared)
Faculty Mentor: Rebecca Metzler
Title of Project: *Effects of Ocean Hypoxia and Acidification on the Microstructure and Crystal Orientation of Discoporella depressa in the Gulf of Mexico*
Funding Source: Division of Natural Sciences and Mathematics

Research Fellow: Duncan Earl 2028 (Astronomy/Physics)
Faculty Mentor: Jeff Bary
Title of Project: *Modeling Stellar Photospheres to Improve Mass Accretion Rate Measurements*
Funding Source: Division of Natural Sciences and Mathematics

Research Fellow: Gunnar Gasper 2028 (Astronomy/Physics)
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: Mark Giacona 2028 (Physics)
Faculty Mentor: Lori McCabe
Title of Project: *Dispersion Relations of Dust Acoustic Waves in High-RF Plasmas*
Funding Source: Division of Natural Sciences and Mathematics

Research Fellow: Frank Gu 2027 (Physics; History)
Faculty Mentor: Kiko Galvez
Title of Project: *Laboratory Astrophysics of Gravitational Lensing*
Funding Source: National Science Foundation Grant

Research Fellow: Halle Hatten 2027 (Astronomy/Physics)
Faculty Mentor: Sam Usman
Title of Project: *Chemical Abundance Analysis of the Ophiuchus Stellar Stream*
Funding Source: Division of Natural Sciences and Mathematics

Research Fellow: Stephen Jervis 2028 (Physics)
Faculty Mentor: Rebecca Metzler
Title of Project: *Effects of Ocean Temperature on Biomineralizing Balanus amphitrite's Microstructure*
Funding Source: Division of Natural Sciences and Mathematics

Research Fellow: Daniel Kaper-Barcelata 2028 (Astronomy/Physics)
Faculty Mentor: Jonathan Levine
Title of Project: *Readying Pysochron for the Moon*
Funding Source: Division of Natural Sciences and Mathematics

Research Fellow: Jackson Lowell 2027 (Physics)
Faculty Mentor: Ramesh Adhikari
Title of Project: *Humidity Sensing*
Funding Source: Division of Natural Sciences and Mathematics

Research Fellow: Chris Mendina 2027 (Physics)
Faculty Mentor: Kiko Galvez
Title of Project: *Exploring Quantum Entanglement Using Polarization-Controlled Two-Photon Interference*
Funding Source: Justus '43 and Jayne Schlichting Student Research Fund

Research Fellow: Jacob Potter 2029 (Undeclared)
Faculty Mentor: Thomas Balonek
Title of Project: *Investigating the Ongoing Optical Outburst of Quasar 1308+326*
Funding Source: Division of Natural Sciences and Mathematics

Research Fellow: Thomas Prisco 2028 (Physics)
Faculty Mentor: Beth Parks
Title of Project: *Measuring Building Insulation Through Heat Flow*
Funding Source: Justus ’43 and Jayne Schlichting Student Research Fund

Research Fellow: Kyle Reece 2028 (Physics)
Faculty Mentor: Ken Segall
Title of Project: *Artificial Neural Networks using Superconductors*
Funding Source: Great Sky Grant

Research Fellow: Kiernan Robinson 2028 (Astrogeophysics)
Faculty Mentor: Jonathan Levine
Title of Project: *Testing the DIMPLE Instrument for its Flight to the Moon*
Funding Source: Division of Natural Sciences and Mathematics

Research Fellow: Chad Ruggiero 2028 (Physics)
Faculty Mentor: Ken Segall
Title of Project: *Research on Superconducting Neural Networks*
Funding Source: Division of Natural Sciences and Mathematics

Research Fellow: Lila Valaskovic 2027 (Astronomy/Physics)
Faculty Mentor: Jeff Bary
Title of Project: *Modeling Stellar Photospheres to Improve Mass Accretion Rate Measurements*
Funding Source: Justus ’43 and Jayne Schlichting Student Research Fund

Research Fellow: Nathan Walsh 2028 (Physics; Computer Science)
Faculty Mentor: Ramesh Adhikari
Title of Project: *Leaf-Based Salinity Gradient for Power Generation*
Funding Source: Division of Natural Sciences and Mathematics

Research Fellow: Allison Wen 2028 (Physics)
Faculty Mentor: Rebecca Metzler
Title of Project: *Effects of Rising Sea Surface Temperature on the Microstructure and Crystal Orientation in Nucula proxima in the Gulf of Mexico*
Funding Source: Justus ’43 and Jayne Schlichting Student Research Fund

Research Fellow: Charlotte Wilke-Olsen 2029 (Astronomy/Physics)
Faculty Mentor: Cosmin Ilie
Title of Project: *Using Bayesian Neural Networks to find Dark Star candidates in JWST photometric data*
Funding Source: Division of Natural Sciences and Mathematics

Research Fellow: Evan Zimmerman 2027 (Physics; Classical Studies)
Faculty Mentor: Lori McCabe
Title of Project: *Dispersion Relations of Dust Acoustic Waves in High-RF Plasmas*
Funding Source: Justus ’43 and Jayne Schlichting Student Research Fund

Department of Psychological and Brain Sciences

Research Fellow: Chloe Bueno 2027 (Educational Studies)
Faculty Mentor: Rebecca Shiner
Title of Project: *New Perspectives on the Co-Occurence of Post-Traumatic Growth and Deterioration: The Case of Bereaved Parents’ Changed Relationships Following Child Loss*
Funding Source: Division of Natural Sciences and Mathematics

Research Fellow: Arushi Chatterjee 2029 (Undeclared)
Faculty Mentor: Jennifer Tomlinson
Title of Project: *Sleep and Relationships in Older Adults*
Funding Source: Division of Natural Sciences and Mathematics

Research Fellow: Vincent Chen 2028 (Neuroscience)
Faculty Mentor: Wan-chun Liu
Title of Project: *The Effect of Nicotine and Dopamine on Zebra Finch Co-song Gestures*
Funding Source: Division of Natural Sciences and Mathematics

Research Fellow: Isabel Costa 2027 (Classical Studies; Psychological Science)
Faculty Mentor: Rebecca Shiner
Title of Project: *New Perspectives on the Co-Occurence of Post-Traumatic Growth and Deterioration: The Case of Bereaved Parents’ Changed Relationships Following Child Loss*
Funding Source: Division of Natural Sciences and Mathematics

Research Fellow: Isla Gao 2028 (Neuroscience)
Faculty Mentor: Wan-chun Liu
Title of Project: *The Effect of Nicotine and Dopamine on Zebra Finch Co-song Gestures*
Funding Source: Division of Natural Sciences and Mathematics

Research Fellow: Amy Glasman 2027 (Psychological Science)
Faculty Mentor: Lauren Philbrook
Title of Project: *Bedtime Family Environment and Child Temperament are Associated with Child Developmental Outcomes*
Funding Source: Division of Natural Sciences and Mathematics

Research Fellow: Kaliyah Honore 2027 (Psychological Science)
Faculty Mentor: Lauren Philbrook
Title of Project: *Bedtime Family Environment and Child Temperament are Associated with Child Developmental Outcomes*
Funding Source: Division of Natural Sciences and Mathematics

Research Fellow: Joy Huang 2027 (Neuroscience)
Faculty Mentor: Bruce Hansen
Title of Project: *Exploring the Neural Representation of Aesthetic Preference*
Funding Source: Division of Natural Sciences and Mathematics

Research Fellow: Maria Del Mar Icabalceta 2028 (Psychological Science)
Faculty Mentor: Erin Cooley
Title of Project: *Subjective Within- and Between-Group Status Predicts Hispanic Americans' Political Attitudes*
Funding Source: Division of Natural Sciences and Mathematics

Research Fellow: Christopher Jachowicz 2028 (Computer Science)
Faculty Mentor: Bruce Hansen
Title of Project: *Learning task-relevant visual features by linking brain activity to large language models and deep convolutional neural networks*
Funding Source: Michael J. Wolk '60 Heart Foundation

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

Research Fellow: Leo Li 2028 (Molecular Biology)
Faculty Mentor: Lauren Philbrook
Title of Project: *Bedtime Family Environment and Child Temperament are Associated with Child Developmental Outcomes*
Funding Source: Mind, Brain, and Behavior Scholars Award

Research Fellow: Jorgen Martin 2028 (Neuroscience)
Faculty Mentor: Anzela Niraula
Title of Project: *Dopaminergic Neuron Activation Precedes Microglia Activation in the Arcuate Nucleus Following Poly I:C Injection*
Funding Source: Division of Natural Sciences and Mathematics

Research Fellow: Amy Meng 2026 (Psychological Science; Philosophy)
Faculty Mentor: Rebecca Shiner
Title of Project: *Study of the impacts of socio-political ideology informing psychiatric and psychological services on patients' well-being*
Funding Source: The Kraynak Institute for the Study of Freedom and Western Traditions

Research Fellow: Emy Pacheco Ramirez 2028 (Educational Studies; Psychological Science)
Faculty Mentor: Erin Cooley
Title of Project: *A Mixed-Methods Analysis: Hispanic Americans' Perceptions of Relative Status within the U.S. Racial Economic Hierarchy Predict Attitudes Toward Immigration Policy*
Funding Source: Division of Natural Sciences and Mathematics

Research Fellow: Tanvi Prasad 2028 (Philosophy)
Faculty Mentor: Bruce Hansen
Title of Project: *Learning task-relevant visual features by linking brain activity to large language models and deep convolutional neural networks*
Funding Source: Division of Natural Sciences and Mathematics

Research Fellow: Devan Seidel 2028 (Neuroscience)
Faculty Mentor: Anzela Niraula
Title of Project: *Dopaminergic Neuron Activation Precedes Microglia Activation in the Arcuate Nucleus Following Poly I:C Injection*
Funding Source: Michael J. Wolk ’60 Heart Foundation

Research Fellow: Madison Stevens 2028 (Neuroscience)
Faculty Mentor: Anzela Niraula
Title of Project: *Dopaminergic Neuron Activation Precedes Microglia Activation in the Arcuate Nucleus Following Poly I:C Injection*
Funding Source: Division of Natural Sciences and Mathematics

Research Fellow: Olive Ye 2028 (Psychological Science)
Faculty Mentor: Rebecca Shiner
Title of Project: *New Perspectives on the Co-Occurence of Post-Traumatic Growth and Deterioration: The Case of Bereaved Parents’ Changed Relationships Following Child Loss*
Funding Source: Division of Natural Sciences and Mathematics

DIVISION OF SOCIAL SCIENCES (SOSC)

Department of Economics

Research Fellow: Bob Aboh 2028 (Economics)
Faculty Mentor: Daniel Kebede
Title of Project: *Economic Growth and Labor Market Outcomes in Ghana: Testing Okun’s Law (1991 – 2024)*
Funding Source: Division of Social Sciences

Research Fellow: Camille Collins 2028 (Economics)
Faculty Mentor: Takao Kato
Title of Project: *Cooperatives’ Resilience: A Study in Eroski’s Relative Performance Through the COVID-19 Recession*
Funding Source: Division of Social Sciences

Research Fellow: Emma Hanlon 2027 (Political Science; Economics)
Faculty Mentor: Takao Kato
Funding Source: Lampert Institute for Civic and Global Affairs

Research Fellow: Linh Ho 2028 (Psychological Science; Mathematical Economics)
Faculty Mentor: Takao Kato
Title of Project: *Workplace Flexibility and Job Satisfaction: Evidence from Japan*
Funding Source: Walter Broughton ’63 Research Fund

Research Fellow: Young Hu 2027 (Economics)
Faculty Mentor: Mike Mei
Title of Project: *The Demographic Consequences of Neighborhoods Opting Out of Smaller Lot Sizes: An Analysis of Houston’s Special Minimum Lot Size Areas*
Funding Source: Division of Social Sciences

Department of Educational Studies

Research Fellow: Aullie Allen 2028 (Environmental Geography; Peace and Conflict Studies)
Faculty Mentor: Mark Stern
Title of Project: *Documenting DEI: An Oral History of the Office of Undergraduate Studies*
Funding Source: Walter Broughton ’63 Research Fund

Research Fellow: Donalia Barrett 2028 (Asian Studies; Computer Science)
Faculty Mentor: Mark Stern
Title of Project: *Exploring the Relationship Between Race Conditions, CAP Theorem and Synchronization in Distributed Systems*
Funding Source: Division of Social Sciences

Research Fellow: Fausto Flores Alvarez 2027 (Africana and Latin American Studies; Educational Studies)
Faculty Mentor: Mark Stern
Title of Project: *Who Gets to Be Human?: Liberal Immigration Rhetoric and the Production of Conditional Humanity*
Funding Source: Division of Social Sciences

Department of Geography

Research Fellow: Grant Ricks 2028 (Geography)
Faculty Mentor: William Meyer
Title of Project: *Urban, Suburban, or Rural Origins of American Appellate-Court Judges*
Funding Source: Division of Social Sciences

Research Fellow: Georgia Sones 2027 (Geography; Computer Science)
Faculty Mentor: William Meyer
Title of Project: *Urban, Suburban, or Rural Origins of American Appellate-Court Judges*
Funding Source: Division of Social Sciences

Department of History

Research Fellow: Lucie Boulind 2029 (Undeclared)
Faculty Mentor: Graham Hodges
Title of Project: *The Underground Railroad*
Funding Source: Division of Social Sciences

Research Fellow: Jack Gross 2027 (History; Educational Studies)
Faculty Mentor: Graham Hodges
Title of Project: *The July 8, 1779, British Raid on Fairfield and Norwalk, Connecticut*
Funding Source: The Kraynak Institute for the Study of Freedom and Western Traditions

Research Fellow: Caroline Murphy 2028 (International Relations)
Faculty Mentor: Graham Hodges
Title of Project: *The Underground Railroad*
Funding Source: Alexander V. Wasson Fund; Division of Social Sciences

Department of International Relations

Research Fellow: Jeremy Cunliffe Saballos 2027 (International Relations)
Faculty Mentor: Fred Chernoff
Title of Project: *Alternative Facts: The Rhetoric of Science-Skepticism and the Clash Between Free Speech, Reason, and Proper Governance*
Funding Source: The Kraynak Institute for the Study of Freedom and Western Traditions

Department of Political Science

Research Fellow: Boens Beavers 2026 (Political Science)
Faculty Mentor: Juan Ibarra Del Cueto
Title of Project: *How the development of state cybersecurity aparatuses in member states of the European Union has been shaped by broader trends of securitization within state-building*
Funding Source: The Kraynak Institute for the Study of Freedom and Western Traditions

Research Fellow: Ella Benitez 2028 (International Relations)
Faculty Mentor: Masha Hedberg
Title of Project: *The Dangers of Dissidence: Comparative Case Studies of Political Repression in Russia*
Funding Source: The Kraynak Institute for the Study of Freedom and Western Traditions

Research Fellow: Will Keiser 2027 (Computer Science; Middle Eastern and Islamic Studies)
Faculty Mentor: Bruce Rutherford
Funding Source: Lampert Institute for Civic and Global Affairs

Research Fellow: Ellie McGoldrick 2027 (Political Science)
Faculty Mentor: Annie Benn
Title of Project: *Congressional Responses to Executive Orders*
Funding Source: Division of Social Sciences

Research Fellow: Tucker McPartlin 2027 (Geography; Political Science)
Faculty Mentor: Matthew Luttig
Funding Source: Lampert Institute for Civic and Global Affairs

Research Fellow: Robert Payne 2027 (Political Science)
Faculty Mentor: Danielle Lupton
Funding Source: Lampert Institute for Civic and Global Affairs

Research Fellow: London Pettibone 2027 (Political Science; English)
Faculty Mentor: Danielle Lupton
Funding Source: Lampert Institute for Civic and Global Affairs

Research Fellow: Lindsay Scheffler 2027 (Economics; Political Science)
Faculty Mentor: Annie Benn
Title of Project: *Congressional Responses to Executive Orders*
Funding Source: Stickles Fund

Department of Sociology and Anthropology

Research Fellow: Ashley Ballanco 2027 (History)
Faculty Mentor: Santiago Juarez
Title of Project: *Exploring Ancient Landscapes: Digital Conservation at Iglesia Viaja, Chiapas, Mexico Project*
Funding Source: Division of Social Sciences

Research Fellow: Giovanna Salmeron Salgado 2028 (Women, Gender, and Sexuality Studies; Anthropology)
Faculty Mentor: Santiago Juarez
Title of Project: *Exploring Ancient Landscapes: Digital Conservation at Iglesia Viaja, Chiapas, Mexico Project*
Funding Source: Division of Social Sciences

Research Fellow: Danielle Yoon 2028 (Environmental Geography)
Faculty Mentor: Santiago Juarez
Title of Project: *Exploring Ancient Landscapes: Digital Conservation at Iglesia Viaja, Chiapas, Mexico Project*
Funding Source: Division of Social Sciences; Sylvia Ellins Fund

DIVISION OF UNIVERSITY STUDIES (UNST)

Africana and Latin American Studies Program

Research Fellow: Lucie Boulind 2029 (Undeclared)
Faculty Mentor: Graham Hodges
Title of Project: *The Underground Railroad*
Funding Source: Division of Social Sciences

Research Fellow: Jack Gross 2027 (History; Educational Studies)
Faculty Mentor: Graham Hodges
Title of Project: *The July 8, 1779, British Raid on Fairfield and Norwalk, Connecticut*
Funding Source: The Kraynak Institute for the Study of Freedom and Western Traditions

Research Fellow: Caroline Murphy 2028 (International Relations)
Faculty Mentor: Graham Hodges
Title of Project: *The Underground Railroad*
Funding Source: Alexander V. Wasson Fund; Division of Social Sciences

Environmental Studies Program

Research Fellow: Matthew Arnold 2028 (Environmental Studies; Sociology)
Faculty Mentor: Frank Frey
Title of Project: *Pollinator Habitat Restoration*
Funding Source: Oberheim Memorial Fund

Research Fellow: Addie Brislen 2027 (Environmental Biology)
Faculty Mentor: Andy Pattison
Title of Project: *Rethinking Conservation: Learning from Tribal Perspectives on Cultural Burning in and Near Sequoia National Park*
Funding Source: Division of University Studies

Research Fellow: Victoria Eastment 2028 (Chemistry; Environmental Geography)
Faculty Mentor: Emily Ury
Title of Project: *A Baseline Study of Phosphorus Levels in the Chenango Canal*
Funding Source: Division of University Studies

Research Fellow: Jia Edison 2029 (Undeclared)
Faculty Mentor: Frank Frey
Title of Project: *Counting Configurations of Points and Lines*
Funding Source: Division of Natural Sciences and Mathematics

Research Fellow: Isabel Hahl 2027 (Natural Sciences)
Faculty Mentor: Emily Ury
Title of Project: *A Baseline Study of Phosphorus Levels in the Chenango Canal*
Funding Source: Division of University Studies

Research Fellow: Ella Kahn 2028 (Biology)
Faculty Mentor: Emily Ury
Title of Project: *Is Phosphorus Prosperous? An Investigation into Nutrient Levels in Taylor Lake and Payne Brook*
Funding Source: Division of University Studies

Research Fellow: Ale Lewis 2027 (Russian and Eurasian Studies)
Faculty Mentor: Ian Helfant
Funding Source: Lampert Institute for Civic and Global Affairs

Research Fellow: Jackson Macejko 2029 (Undeclared)
Faculty Mentor: Frank Frey
Title of Project: *Pollinator Habitat Restoration*
Funding Source: Division of Natural Sciences and Mathematics

Global Public and Environmental Health Program

Research Fellow: Tony Xu 2028 (Computer Science)
Faculty Mentor: Ahmet Ay; Bineyam Taye
Title of Project: *Gut Microbiome, Diarrhea, Stunting, and Thinness in School-Age Ethiopian Children: A Cross-Sectional 16S rRNA Gene Sequencing Study*
Funding Source: Mind, Brain, and Behavior Faculty Grant

Russian and Eurasian Studies Program

Research Fellow: Ale Lewis 2027 (Russian and Eurasian Studies)
Faculty Mentor: Ian Helfant
Funding Source: Lampert Institute for Civic and Global Affairs

KRAYNAK INSTITUTE FOR THE STUDY OF FREEDOM AND WESTERN TRADITIONS

Research Fellow: Boens Beavers 2026 (Political Science)
Faculty Mentor: Juan Ibarra Del Cueto
Title of Project: *How the development of state cybersecurity aparatuses in member states of the European Union has been shaped by broader trends of securitization within state-building*
Funding Source: The Kraynak Institute for the Study of Freedom and Western Traditions

Research Fellow: Ella Benitez 2028 (International Relations)
Faculty Mentor: Masha Hedberg
Title of Project: *The Dangers of Dissidence: Comparative Case Studies of Political Repression in Russia*
Funding Source: The Kraynak Institute for the Study of Freedom and Western Traditions

Research Fellow: Abby Call 2026 (Peace and Conflict Studies)
Funding Source: The Kraynak Institute for the Study of Freedom and Western Traditions

Research Fellow: Tyler Couture 2027 (German; Economics)
Faculty Mentor: Irina Kogan
Title of Project: *Historical Revisionism. Two Tales of Teutoburg*
Funding Source: The Kraynak Institute for the Study of Freedom and Western Traditions

Research Fellow: Jeremy Cunliffe Saballos 2027 (International Relations)
Faculty Mentor: Fred Chernoff
Title of Project: *Alternative Facts: The Rhetoric of Science-Skepticism and the Clash Between Free Speech, Reason, and Proper Governance*
Funding Source: The Kraynak Institute for the Study of Freedom and Western Traditions

Research Fellow: Claire Escher 2028 (Classical Studies; Molecular Biology)
Faculty Mentor: Geoffrey Benson
Title of Project: *Dreams, Deception, and the Politics of Truth in Vergil's Aeneid*
Funding Source: The Kraynak Institute for the Study of Freedom and Western Traditions

Research Fellow: Jack Gross 2027 (History; Educational Studies)
Faculty Mentor: Graham Hodges
Title of Project: *The July 8, 1779, British Raid on Fairfield and Norwalk, Connecticut*
Funding Source: The Kraynak Institute for the Study of Freedom and Western Traditions

Research Fellow: Emma Lepkowicz 2028 (Chemistry; History)
Faculty Mentor: Elizabeth Marlow
Title of Project: *Why are the Picker Gallery's late-antique Egyptian relief sculptures beginning to deteriorate and what can be done to prevent further damage?*
Funding Source: The Kraynak Institute for the Study of Freedom and Western Traditions

Research Fellow: Lauren Levin 2026 (International Relations)
Funding Source: The Kraynak Institute for the Study of Freedom and Western Traditions

Research Fellow: Rebecca Li 2028 (Art History)
Faculty Mentor: Carolyn Guile
Title of Project: *17th-Century Chinese Reinterpretations of the Jesuit Engravings Series, Evangelicae Historiae Imagines (1593)*
Funding Source: The Kraynak Institute for the Study of Freedom and Western Traditions

Research Fellow: Luke Lostumbo 2026 (Psychological Science)
Faculty Mentor: David Dudrick
Title of Project: *Efficiency and The Panopticon: Living Well in a Culture of Death*
Funding Source: The Kraynak Institute for the Study of Freedom and Western Traditions

Research Fellow: Gillian Lustenberger 2027 (Peace and Conflict Studies)
Funding Source: The Kraynak Institute for the Study of Freedom and Western Traditions

Research Fellow: Amy Meng 2026 (Psychological Science; Philosophy)
Faculty Mentor: Rebecca Shiner
Title of Project: *Study of the impacts of socio-political ideology informing psychiatric and psychological services on patients' well-being*
Funding Source: The Kraynak Institute for the Study of Freedom and Western Traditions

Research Fellow: Bennett Rowe 2026 (Classical Studies; Art History)
Faculty Mentor: Carolyn Guile
Title of Project: *The Tomb of the Unknown Soldier at Arlington National Cemetery in the period 1920-1932 asking the question, "How did Americans mourn in the wake of unimaginable tragedy?"*
Funding Source: The Kraynak Institute for the Study of Freedom and Western Traditions

Research Fellow: Hannah Zubatyy 2028 (Philosophy; Political Science)
Faculty Mentor: David Dudrick
Title of Project: *A Thomist Critique of Sartre's Moral Relativism*
Funding Source: The Kraynak Institute for the Study of Freedom and Western Traditions

LAMPERT INSTITUTE FOR CIVIC AND GLOBAL AFFAIRS

Research Fellow: Madeleine Callahan 2029 (Undeclared)
Funding Source: Lampert Institute for Civic and Global Affairs

Research Fellow: Chayce Canty 2027 (Peace and Conflict Studies; Political Science)
Funding Source: Lampert Institute for Civic and Global Affairs

Research Fellow: Helena Cerutti 2028 (International Relations; Economics)
Funding Source: Lampert Institute for Civic and Global Affairs

Research Fellow: Louie Derechin 2027 (Political Science)
Funding Source: Lampert Institute for Civic and Global Affairs

Research Fellow: Kriti Dhakal 2029 (Undeclared)
Funding Source: Lampert Institute for Civic and Global Affairs

Research Fellow: Ruben Engels 2027 (International Relations)
Funding Source: Lampert Institute for Civic and Global Affairs

Research Fellow: Hiba Farooq 2029 (Undeclared)
Funding Source: Lampert Institute for Civic and Global Affairs

Research Fellow: Abigail Fenton 2027 (International Relations)
Funding Source: Lampert Institute for Civic and Global Affairs

Research Fellow: Emma Hanlon 2027 (Political Science; Economics)
Faculty Mentor: Takao Kato
Funding Source: Lampert Institute for Civic and Global Affairs

Research Fellow: Ja'Zhana Henderson 2028 (Philosophy; Neuroscience)
Funding Source: Lampert Institute for Civic and Global Affairs

Research Fellow: Agnes Kaumbulu 2028 (Computer Science; Applied Math)
Title of Project: *Does CBC (the new Kenyan Education System) actually deliver higher-order education, or does it simply replace one banking model with another, repackaged in progressive language?*
Funding Source: Lampert Institute for Civic and Global Affairs

Research Fellow: Will Keiser 2027 (Computer Science; Middle Eastern and Islamic Studies)
Faculty Mentor: Bruce Rutherford
Funding Source: Lampert Institute for Civic and Global Affairs

Research Fellow: Ale Lewis 2027 (Russian and Eurasian Studies)
Faculty Mentor: Ian Helfant
Funding Source: Lampert Institute for Civic and Global Affairs

Research Fellow: Gillian Lustenberger 2027 (Peace and Conflict Studies)
Funding Source: Lampert Institute for Civic and Global Affairs

Research Fellow: Tucker McPartlin 2027 (Geography; Political Science)
Faculty Mentor: Matthew Luttig
Funding Source: Lampert Institute for Civic and Global Affairs

Research Fellow: Robert Payne 2027 (Political Science)
Faculty Mentor: Danielle Lupton
Funding Source: Lampert Institute for Civic and Global Affairs

Research Fellow: Jack Pearlson 2027 (International Relations)
Funding Source: Lampert Institute for Civic and Global Affairs

Research Fellow: London Pettibone 2027 (Political Science; English)
Faculty Mentor: Danielle Lupton
Funding Source: Lampert Institute for Civic and Global Affairs

Research Fellow: Kate Slone 2027 (English; International Relations)
Funding Source: Lampert Institute for Civic and Global Affairs

UPSTATE INSTITUTE

Research Fellow: Julia Bihari 2027 (History)
Faculty Mentor: Rachel Amann-Burns
Title of Project: *Understanding Native Collections: Researching Native American Baskets at Fenimore Art Museum*
Funding Source: Upstate Institute

Research Fellow: Allan Crounse 2027 (Neuroscience; Economics)
Faculty Mentor: Rachel Amann-Burns
Title of Project: *Developing Community Informed Efforts to Address Food Insecurity in Herkimer County*
Funding Source: Upstate Institute

Research Fellow: Sonia Erbe 2027 (Environmental Biology)
Faculty Mentor: Julie Dudrick
Title of Project: *Central New York Regional Planning and Development Board*
Funding Source: Upstate Institute

Research Fellow: Lucy Garnaas 2028 (Environmental Biology)
Faculty Mentor: Julie Dudrick
Title of Project: *Invasive Species Removal and Native Species Restoration within the Essex Quarry Nature Preserve*
Funding Source: Upstate Institute

Research Fellow: Solomon Kirby 2029 (Undeclared)
Faculty Mentor: Julie Dudrick
Title of Project: *Loving Our Country with John Brown Lives!*
Funding Source: Upstate Institute

Research Fellow: Lauren Klebba 2028 (Psychological Science)
Faculty Mentor: Julie Dudrick
Title of Project: *Driving Solutions for Hudson Headwaters*
Funding Source: Upstate Institute

Research Fellow: Sophia Luzietti 2028 (Peace and Conflict Studies; Geography)
Faculty Mentor: Rachel Amann-Burns
Title of Project: *Toward a Second Abolition: National Abolition Hall of Fame and Museum*
Funding Source: Upstate Institute

Research Fellow: Pallen McArdle 2027 (Peace and Conflict Studies)
Faculty Mentor: Julie Dudrick
Title of Project: The Making of an Exhibit: Black Experience in the Adirondacks
Funding Source: Upstate Institute

Research Fellow: Maya Mendez 2029 (Environmental Studies)
Faculty Mentor: Julie Dudrick
Title of Project: *Identifying and Assessing Best Management Practices for Invasive Species on Conservation Properties*
Funding Source: Upstate Institute

Research Fellow: Daniel Montan Jacome 2028 (Sociology)
Faculty Mentor: Nicole Simpson
Title of Project: *Making Ends Meet: Strengthening the Programs Rural Families Need*
Funding Source: Upstate Institute

Research Fellow: Tejas Prakash 2028 (Economics)
Faculty Mentor: Julie Dudrick
Title of Project: *Madison Grown: Madison County's Online Food Market App*
Funding Source: Upstate Institute

Research Fellow: Summer Raimondo 2028 (Classical Studies)
Faculty Mentor: Julie Dudrick
Title of Project: *From Archives to Public History: Connecting Hamilton's Revolutionary War Past to Its Present*
Funding Source: Upstate Institute

Research Fellow: Thomas Rivier 2028 (Political Science)
Faculty Mentor: Rachel Amann-Burns
Title of Project: *Helping Refugees Attain Citizenship: Evaluating the Updated 2025 Naturalization Exam*
Funding Source: Upstate Institute

Research Fellow: Catherine Stevens 2027 (Biology; Middle Eastern and Islamic Studies)
Faculty Mentor: Julie Dudrick
Title of Project: *Documenting Native Pollinator Diversity at Rogers Center*
Funding Source: Upstate Institute

Research Fellow: Ava Thur 2027 (Educational Studies; Peace and Conflict Studies)
Faculty Mentor: Rachel Amann-Burns
Title of Project: *How do the Barriers to Postpartum Care in Rural New York Influence the Health of Birthing People?*
Funding Source: Upstate Institute

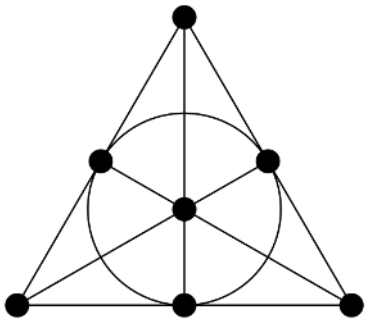
Research Fellow: Brendan Werries 2027 (History; Native American Studies)
Faculty Mentor: Julie Dudrick
Title of Project: *Developing a Custom Photographic Archival and Metadata System for Public Communications*
Funding Source: Upstate Institute

Research Fellow: Arden Williamson 2028 (Political Science)
Faculty Mentor: Rachel Amann-Burns
Title of Project: *More Than Graves: What the Oneida Community Cemetery Can Tell Us*
Funding Source: Upstate Institute

Research Fellow: Ryan Wilson 2028 (Environmental Economics; Philosophy)
Faculty Mentor: Julie Dudrick
Title of Project: *Informing the Impact Investing Program of Adirondack Community Foundation*
Funding Source: Upstate Institute

Research Summaries

Research Fellows: Ali Abdullah (2028) **Concentrations:** Computer Science; Applied Math
Maria Flores (2029) **Concentration:** Undeclared
Faculty Mentor: Kelly Isham **Department:** Mathematics
Title of Project: Counting 8 Arcs in 3D Projective Space
Funding Source: Division of Natural Sciences and Mathematics
Project Summary:



If we scattered 8 dots in the air so that they are fixed and floating, what are all the possible ways that they could arrange themselves so that no 4 points lie on the same sheet of paper? To answer this question, we work in projective space. In ordinary 2D geometry, lines can be parallel or intersect, but in projective space, we add a "point at infinity" where parallel lines meet, so any two lines always intersect. Furthermore, we work over finite projective space, which contains only finitely many elements, rather than an infinite space, where the count would be meaningless. With this approach, we want to find the number of ways that we can arrange 8 points such that no 4 of them lie on the same plane, which we call an 8-arc in 3D projective space. This is a concept that relates directly to MDS codes in computer science, which are used in data transmission and data storage for error correction algorithms in case the data gets corrupted or lost.

In general terms, an n-arc in k-dimensional projective space is a set of n points such that no k+1 lie on a common hyperplane (the generalization of a plane in 3D to higher dimensions). Counting n-arcs by brute force means checking every subset of points against every hyperplane; for n=7, this means checking 34 billion cases, which is infeasible. In 1988, mathematician David Glynn produced an algorithm that reduces the problem of counting n-arcs in 2D projective space (n points, no 3 collinear) to counting strong realizations of superfigurations, which are highly connected, irreducible sets of points and lines. A well-known superfiguration in 2D projective space is the Fano plane, pictured above. A strong realization of a superfiguration is a one-to-one assignment of coordinates to its points so that all the lines (and planes in 3D) are exactly preserved without accidentally forming anything extra. Counting these strong realizations is intricate because they're highly dependent on the finite space we're working in, and we need counts that hold across all finite spaces.

In 2022, Professor Kelly Isham generalized this algorithm to work in 3D projective space, where we now consider hyperfigurations (the 3D version of superfigurations) — highly connected irreducible sets of points, lines and planes. This leaves us with the formula $C_{n,4}(q)=p(q)+\sum_h p_h(q)A_h(4,q)$. This formula expresses the count of n-arcs in terms of an inductively derived polynomial plus the sum of terms contributed by each hyperfiguration's strong realization count. Her paper gives counts for sets up to n = 7. Over the summer, we extended this work to n=8, where we ran into a combinatorial explosion leaving us with 235 hyperfigurations, compared to just 6 for n=7, each needing its own strong realization count. We developed two methods using a programming language called Sage to computationally make these counts feasible, then used mathematical counting techniques to count the strong realizations, cross-referencing our results to ensure accuracy. Many of these counts required a substantial understanding of advanced algebra and theory to resolve. We've found counts for roughly half of the hyperfigurations needed and plan to continue work this semester to finish the counts. Once all of them are found, we piece them together into the modified Glynn's algorithm to give us counts of 8-arcs in 3D projective space.

Research Fellow: **Bob Aboh (2028)** **Concentration:** **Economics**

Faculty Mentor: **Daniel Kebede** **Department:** **Economics**

Title of Project: **Economic Growth and Labor Market Outcomes in Ghana: Testing Okun's Law (1991 – 2024)**

Funding Source: **Division of Social Sciences**

Project Summary:

Ghana has experienced periods of strong economic growth, particularly following major economic reforms and the discovery of oil, yet unemployment has remained a persistent challenge. This reflects a broader pattern across Africa, where economic growth, particularly from sectors like mining, does not always translate into employment growth. This study examines the relationship between economic growth and unemployment using Okun's Law, particularly focusing on Ghana. Using annual World Bank data from 1991 to 2024, I compared the relationship across randomly selected developed[1], emerging[2], and developing[3] economic clusters before applying the lessons from the cluster analysis to Ghana's labor market. The analysis uses a two-way fixed-effects model for the economic clusters and time series regressions for Ghana while controlling for inflation. The results show that the relationship between economic growth and unemployment differs across economic clusters. Developed and developing economies show no significant relationship, while emerging economies capture a statistically significant negative association. Holding inflation and country and time fixed effects constant, a 1% increase in GDP is associated with a 0.155% decrease in the change in unemployment. Ghana, however, stands out among the broader developing economies. Holding inflation constant, a 1% rise in GDP correlates with a 0.214% reduction in total unemployment variation. The negative relationship remains significant across different disaggregations of unemployment. Youth unemployment remained considerably higher than male and female unemployment and showed the largest estimated association with GDP growth, with a 1% increase in GDP growth associated with a 0.410% decrease in the change in youth unemployment, holding inflation constant. This shows how Ghana's overall unemployment is greatly driven by youth unemployment. Although economic growth is associated with better employment outcomes in Ghana, the much higher level of youth unemployment shows that growth alone may not entirely address all labor market challenges. Education, vocational training, and policies that better connect young people to the job market are necessary as the economy grows.

[1] The developed economies cluster includes the USA, France, UK, Japan and Canada.

[2] The emerging economies cluster includes China, Brazil, South Africa, India and Mexico.

[3] The developing economies cluster includes Ghana, Kenya, Nigeria, Bangladesh, Nepal and Zambia.

	Developed		Emerging		Developing		All Countries	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
GDP_Growth_pct	-0.047	-0.057	-0.155**	-0.155**	-0.021	-0.018	-0.080**	-0.080**
	(0.111)	(0.108)	(0.051)	(0.050)	(0.030)	(0.032)	(0.031)	(0.031)
Inflation_pct		-0.114		-0.000		0.003		-0.000
		(0.087)		(0.000)		(0.002)		(0.000)
Constant	0.871***	1.189***	0.765*	0.781*	0.387	0.248	0.633***	0.639***
	(0.167)	(0.194)	(0.284)	(0.328)	(0.267)	(0.348)	(0.177)	(0.179)
Observations	165.000	165.000	165.000	165.000	198.000	198.000	528.000	528.000
Within R-squared	0.529	0.536	0.400	0.400	0.207	0.211	0.259	0.259

Standard errors in parentheses
* $p<0.10$, ** $p<0.05$, *** $p<0.01$

	(1)	(2)	(3)	(4)
	Total	Youth	Male	Female
GDP_Growth_pct	-0.080**	-0.149**	-0.087***	-0.073*
	(0.031)	(0.064)	(0.028)	(0.037)
Inflation_pct	-0.000	-0.000	-0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)
Constant	0.639***	1.045**	0.741***	0.493*
	(0.179)	(0.320)	(0.204)	(0.232)
Observations	528.000	528.000	528.000	528.000
Within R-squared	0.259	0.235	0.272	0.209

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Research Fellow: **Daniyar Ali (2028)** **Concentration:** **Geology**

Faculty Mentor: **Amy Leventer** **Department:** **Earth and Environmental Geosciences**

Title of Project: **Diatom Biostratigraphy and Paleoclimate Reconstruction of East Antarctica over the past Half Million Years**

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

Project Summary:

As the world warms, there is increasing concern about the melting of glacial ice and the impact that will have on coastal communities. Since most of today's glacial ice is stored in Antarctica, understanding how its ice sheet has reacted to warmer periods in the past can help us understand the effects of climate change. Two particularly informative times to study are marine isotope stage (MIS) 5 (~120-70 thousand years ago), the last interglacial period, and MIS 11 (~420-370 thousand years ago), the most recent superinterglacial, when Earth was warmer than it is today. To determine what occurred then, I analyzed the distribution of diatoms in a marine sediment core collected from an understudied region off the coast of East Antarctica. Diatoms are photosynthetic organisms with glass shells that are well preserved in Southern Ocean sediments. During glacial intervals, as sea ice expanded northward over the ocean surface, limiting the penetration of sunlight, diatom production also decreased. Thus, evaluation of changes in absolute diatom abundance downcore documents alternating glacial and interglacial intervals, the marine isotope stages, with odd numbers representing warm interglacials and even numbers representing cold glacials. Additionally, several extinct diatom species, including Rhizosolenia harwoodii, Actinocyclus ingens, and Thalassiosira elliptipora found at the bottom of the core allow us to date the bottom of the 305cm core as ~550-600 thousand years ago, in MIS 15. This indicates that the exceptionally warm superinterglacial MIS 11 was recovered. In addition to developing the core chronology, I tabulated the relative abundance of each species, which will be used to reconstruct past oceanographic conditions.

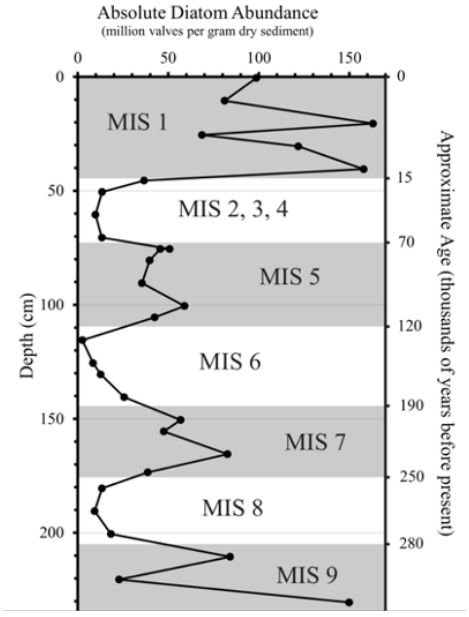


Figure 1 (left): Absolute Diatom Abundance (ADA) versus depth. Each period with higher ADA corresponds to an interglacial period, shaded in gray, while the periods with lower ADAs correspond to glacial periods. Approximate ages are listed on the right.

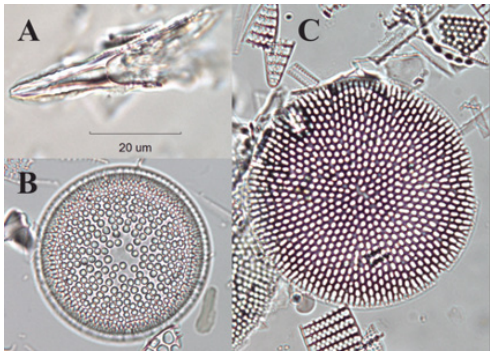


Figure 2: Images of (a) *Rhizosolenia harwoodii*, (b) *Actinocyclus ingens*, and (c) *Thalassiosira elliptipora*, three of the extinct species found at the bottom of the core.

Research Fellow: Aullie Allen (2028) **Concentrations: Environmental Geography; Peace and Conflict Studies**

Faculty Mentor: Mark Stern **Department: Educational Studies**

Title of Project: Documenting DEI: An Oral History of the Office of Undergraduate Studies

Funding Source: Walter Broughton '63 Research Fund

Project Summary:

Colgate University's Office of Undergraduate Studies (OUS) Program began in 1967 as an initiative to attract and support students who did not attend the wealthy schools that typically produced college students, or who otherwise did not have the opportunity to perform well in formal academic measures. Initially, the program was designed to recruit Black students fitting these guidelines who nevertheless exemplified determination, intelligence, and tenacity. It emerged in the midst of weighted public discourse about inclusion, non-discrimination, and equal opportunity, where Colgate's existing Black students were already demanding more room for themselves in the overwhelmingly white campus. Over time, OUS has attempted to serve as both a social "third space" for its scholars and a center of academic support. Over the course of the summer, this research has examined the political history of the OUS program, paying special attention to national legal context and emerging racial and linguistic trends, in order to think about how OUS has fostered community amongst its scholars, created a sense of shared identity, or at its worst, reproduced stigmatization and division on campus. A driving question behind this project is what language institutions utilize to record their own histories, and how we can fill in the gaps with personal, unedited narrative. Given these considerations, oral history seemed to be the best method of evidence-gathering and testimony-sharing. Referring to a method of eye-witness, anthropological interview, oral history provides a useful framework for recording marginalized voices and memory.

A large portion of the summer was dedicated to the first pursuit described: investigating the contexts in which the OUS program was founded and changed. A lengthy literature review discussed the path of the legal precedents surrounding segregation, affirmative action, and DEI. It found that a significant driver to the legal and political attitudes around those subjects was the Supreme Court's shifting political philosophy. At the time of Brown v. Board of Education, the Supreme Court advanced racial egalitarianism: policy-ordered racial consciousness and consideration. In proceeding decisions regarding integration and affirmative action, both the Supreme Court and Executive Orders reflected this racial egalitarian philosophy. However, the Court overturned decades of federal precedent by effectively ending race-conscious college admissions practices in the Students for Fair Admissions, Inc. (2023) cases. This explicitly established a "colorblind" philosophy: any acknowledgement of race– even to address racial inequality– would be considered discrimination. This, plus longstanding structural and historical issues that justify covert racial discrimination in institutions (such as colleges and businesses) led to both the creation and destruction of both affirmative action and DEI. These policies are often organized for white people in order for them to feel comfortable, yet it is people of color who have to do the labor of enactment.

The second part of this research involved creating a "how-to" on oral history and reaching out to OUS alumni to interview them on their experiences in the program. An oral history archive will invite them to tell their stories authentically, in exactly the ways they want to be and can be represented. The archive also provides a valuable opportunity to analyze silence: the voices that can not or do not want to be heard carry their own weight. In this way, sixty years of OUS students can find themselves represented authentically.

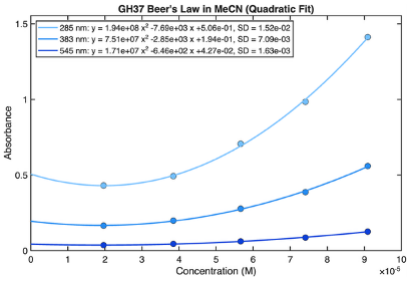
Research Fellows: **Matthew Arnold (2028)** **Concentrations: Environmental Studies; Sociology**
Jia Edison (2029) **Concentration: Undeclared**
Jackson Macejko (2029) **Concentration: Undeclared**
Faculty Mentor: **Frank Frey** **Departments: Biology; Environmental Studies**
Title of Project: **Pollinator Habitat Restoration**
Funding Source: **Oberheim Memorial Fund; Division of Natural Sciences and Mathematics**
Project Summary:

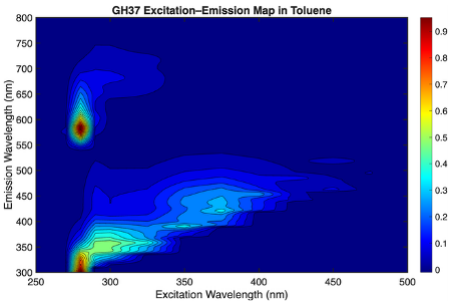
Native pollinators and their ecosystems are threatened by habitat loss due to agriculture. Agriculture can diminish pollinator habitat and when left to rewild on its own, formerly agricultural land does not develop an ecosystem suitable for native pollinators and often is taken over by non-native, invasive species. Rogers Environmental Education Center has two plots of land, Cush Hill and Adam's Farm, that fit this description and were designated for pollinator habitat restoration. The landscape at both properties appeared to have been severely impacted by introduced and invasive plant species colonization, which seemed to result in the loss of native plant species, shifts in plant species composition, as well as a decline in native pollinators. Our project focused on the early season (May-June) and middle season (July-August) floral communities at both of these sites. Purpose: The purpose of this study was to determine to what extent the native floral community had been affected by introduced invasive species, and how this change impacted native pollinator populations. To assess floral composition and the impact on pollinators we randomly sampled the plots, and to assess the total pollinator diversity we implemented a targeted method called freestyle sampling. Methods: For random sampling we utilized a transect approach to sample Adams Farm and Cush Hill. At Adams Farm we placed flags 10m apart along the main path and then ran transects perpendicular to the main path and set up 3m x 3m sampling plots marked with flagging at 10m intervals with a 5m buffer around the border. At Cush Hill the transect lines were marked by flags 20m apart and the plots were spaced alone 20m intervals. We established plots in the early season as described above. In the middle season, we shifted our transects by 5 meters in both directions to sample a different plot at both sites. Photographs were taken of every plot. After the 10-minute interaction period, we counted all of the stalks and flowering units of each flowering plant within each plot. We used a google form to record all of the data. For each plot we recorded the date, time, floral community and conditions and uploaded a photograph of the plot. We uploaded insect photographs to iNaturalist and made positive identifications only when there was >90% confidence at a particular taxonomic level. To better understand the insect composition at each of the sites, we also conducted replicate 20-minute intervals of freestyle sampling where we would identify a particularly floriferous location and take multiple photographs of individual insects. For this sampling, we focused exclusively on bees, butterflies, and moths visiting flowers within the plots as described above. We used the same methods for identifying the insects as for random sampling and were able to identify down to the species level for most of the insects. Results & Conclusion: The existing floral community is not diverse and not appropriate pollinator habitat. During both the early and middle season at both sites we found that invasive non-native plants outnumbered native flora. This mainly non-native flora community was not utilized well by native bees, butterflies and moths. In the early season flies accounted for the majority of the visits at both sites, and while pollinator visitation picked up during the mid season, native plants like Common Milkweed (Asclepias syriaca) were responsible for this uptick. During our freestyle sampling we found that there are native bees, butterflies, and moths present in high numbers at both sites with 42 pollinator species at Cush Hill and 34 at Adams Farm. Because both sites have diverse native pollinator populations present but do not have adequate flora to support them, we conclude that both sites would benefit greatly from habitat restoration in accordance with recommendations put forward by the Xerces Society for pollinator habitat restoration.

Research Fellows: **Sakhi Balaji (2029)** **Concentration: Undeclared**
Sivi Ward (2029) **Concentration: Undeclared**
Haiyu Zhu (2027) **Concentrations: Biochemistry; Applied Math**
Faculty Mentor: **Jenny Peeler** **Department: Chemistry**
Title of Project: **Influence of lysine acetylation on YajL and AdhE**
Funding Source: **Michael J. Wolk '60 Heart Foundation; John C. Cochran Endowed Fund for Undergraduate Research; Division of Natural Sciences and Mathematics**

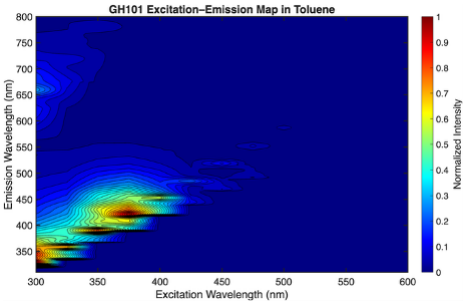
Project Summary:

Lysine acetylation (AcK) is a post-translational modification that involves the addition of an acetyl group onto a lysine side chain. This modification can alter the structure of proteins, potentially changing their functionality. Previous proteomic studies have identified many proteins containing AcK, but the functional influence of this modification remains mostly unknown. We are studying this phenomenon in two E. coli proteins known to be modified by AcK: YajL and AdhE. These proteins play roles in bacterial stress response and redox homeostasis, respectively. Using genetic code expansion, we have successfully expressed and purified homogeneous samples of both unmodified (wild-type) and site-specifically acetylated versions of each protein. We then use kinetic and enzymatic assays to provide insight on protein functionality.





YajL catalyzes the conversion of several harmful carbonyl substrates, including glyoxal and cyclic 3-phosphoglyceric anhydride, to less reactive species. YajL can become acetylated, and this acetylation increases in a glucose-dependent manner. Therefore, it is likely that the acetylated version of the protein is present when glycolytic rates are high and concentrations of reactive carbonyl glycolytic byproducts are elevated. We are investigating whether glucose-dependent acetylation influences YajL catalytic activity toward reactive carbonyl substrates. To address this question, we used genetic code expansion to incorporate AcK into YajL, generating homogeneous samples of acetylated and wild-type YajL. These protein variants were expressed and purified, and steady-state kinetic assays were performed. Overall, our study concluded that acetylated YajL, which would appear in carbon stress environments, maintains its ability to reduce reactive carbonyl species.



AdhE is a bifunctional enzyme that catalyzes the conversion of acetyl-CoA to ethanol. Though lysine acetylation occurs at many positions across this protein, we focus on acetylation at positions 51 and 759. These two residues are important for AdhE oligomerization, which in turn can affect its enzymatic functioning. We hypothesize that acetylation will affect both oligomerization and enzyme activity. We successfully expressed and purified homogeneous samples of both unmodified and acetylated AdhE. We have already performed functional assays to assess wild-type AdhE kinetics, and in the future we will use these same assays to understand how acetylated AdhE function differs.

Research Fellows: **Ashley Ballanco (2027)** — **Concentration: History**

Giovanna Salmeron Salgado (2028) — **Concentrations: Women, Gender, and Sexuality Studies; Anthropology**

Danielle Yoon (2028) — **Concentration: Environmental Geography**

Faculty Mentor: **Santiago Juarez** — **Department: Sociology and Anthropology**

Title of Project: **Exploring Ancient Landscapes: Digital Conservation at Iglesia Viaja, Chiapas, Mexico Project**

Funding Source: **Division of Social Sciences; Sylvia Ellins Fund**

Project Summary:

Iglesia Vieja is an impressive archaeological site, not only for its size, but for its distinct culture and architectural styles. Iglesia Vieja features a myriad of architectural styles and qualities. Specifically, the site includes pyramids constructed from massive stone blocks and slabs, and each building exhibits different cultural traditions from all across ancient Mesoamerica (see Figure 1). While in the early 20th century explorers and researchers documented the site, due to the site's remoteness, it was unexplored for the next 40 years until the next fieldwork in 1998, with a new access road opened in 2000.

The first 2.5 weeks were spent in Chiapas, Mexico with the focus of digitally documenting the archaeological site. The site had several granite structures and was filled with vegetation where the weather was cooler and at many times unpredictable. It also featured many petroglyphs that are significant to the site. The research team's digital reconstruction of the site serves as a visual tool for public and academic audiences, helping teach them about the past and the significance of present cultures. Additionally, the research team prepared materials for public sharing through a website and future presentations. The methods included photogrammetry, deriving accurate measurements and 3D models from overlapping 2D photographs using the Nikon DSLR. Handheld LiDAR scanning uses laser light to measure spaces and create accurate 3D maps, it also works as a digital measuring tool to measure surrounding surfaces. GPS-based field reconnaissance which recorded the locations of important features while on site, and further on-site documentation using an antigravity drone and 3D scanning with Scaniverse which creates realistic 3D scans of objects and spaces, combining photogrammetry with 3D Gaussian Splatting. Together these tools allowed us to document the site from multiple perspectives.

The research team spent the remaining 6.5 weeks on Colgate's campus, processing data, building 3D models, analyzing spatial patterns, and helping develop virtual environments for scholarly and public use. At the site we used the XGRIDS PortalCam, which combines LiDAR cameras and AI to capture real environments. We then incorporated this data into Lixel Cyber Color software, which allowed us to create interactive 3D models. Additionally, the Insta360 X5 captured immersive 360° images and video at the site which we used to create an interactive virtual tour using 3D Vista software.

Finally, we hope to utilize the digistar planetarium software which combines our 3D methods and drone imagery, for site reconstruction and to look for astronomical alignments as well. The primary research question we examined was whether Iglesia Vieja was a peripheral community. Through our investigation, fieldwork, and cultural heritage preservation, we identified Iglesia Vieja as a potential independent multicultural ceremonial center. Many of the site's features led us to believe different theories but one can only interpret what the site was and while there is no set explanation to the site, its history and connections to these other cultures significantly show its ceremonial aspects. Examining the site's connection to multiple different civilizations, such as the ancient Maya, Olmec, Teotihuacano, and Zoque. Alongside this, the purposes of the buildings are still largely a mystery, with some seeming like ceremonial centers and others suggesting communal living. During our research, we also analyzed the cultural fabric of this site, aiming to find artifacts and artwork to connect Iglesia Vieja to other spaces and places.

Research Fellow: Donalia Barrett (2028) **Concentrations:** Asian Studies; Computer Science
Faculty Mentor: Mark Stern **Department:** Educational Studies
Title of Project: Exploring the Relationship Between Race Conditions, CAP Theorem and Synchronization in Distributed Systems
Funding Source: Division of Social Sciences
Project Summary:

In the study of Computer Science, concurrency is used to define the ability of a system to perform multiple tasks and threads/processes at once. Through executing multiple small tasks of processes simultaneously (multithreading), system performance and efficiency are ultimately improved. However, with this ability, systems run the risk of multiple processes/threads accessing and changing the same shared data at the same time. This is called a race condition. In order to avoid this, the mechanism, synchronization is used to coordinate these processes safely. This is done using varying techniques/ mechanisms such as mutexes, semaphores and many more.

Without synchronization, the result is solely dependent on what order these processes run which can lead to having an incorrect and/or unpredictable final result. When threads/processes are not properly synchronized, in addition to unpredictable behavior, there exists the possibility of corrupted data and major security vulnerabilities such as unauthorized access. The CAP(Consistency, Availability, Partition Tolerance) Theorem states that in distributed systems, data stores can only guarantee two out of three properties. The three properties are consistency, availability and partition tolerance. Consistency can be defined as every node/piece seeing the same data while availability is the act of every request being answered at all times and partition tolerance is the ability of the system to still be able to perform despite system failures.

This research investigated the closely tied relationship between synchronization, race conditions, and the CAP Theorem by simulating race conditions and distributed systems under various operating environments. With the use of a distributed system, different operating system environments were created to observe the patterns in performance for the three CAP properties. This study ultimately shows how the CAP Theorem trade-offs affect the events of race conditions occurring and why the trade-offs between the 3 components occur.

Research Fellow: Erik Bergstrom (2028) **Concentrations:** Mathematics; Physics
Faculty Mentor: Kiko Galvez **Department:** Physics and Astronomy
Title of Project: Encoding Data in Lambert Optical Beams
Funding Source: Justus '43 and Jayne Schlichting Student Research Fund
Project Summary:

The goal of this project was to produce a type of beam that can carry a higher bandwidth of information more reliably through turbulent air than current methods of freespace communication. We accomplished this by programming a beam with devices called spatial light modulators. Spatial light modulators, or SLMs, are a similar technology to what you might find in a projector. They work by applying voltages across liquid crystal, which allows a pixel by pixel programming of the phase of the light. The images projected by the SLMs are such that they create spiraling patterns of vectors. The center of these spirals are known as skyrmions (see Fig. 1). It is by encoding and decoding the number of skyrmions present in a beam that we can transmit data with it.

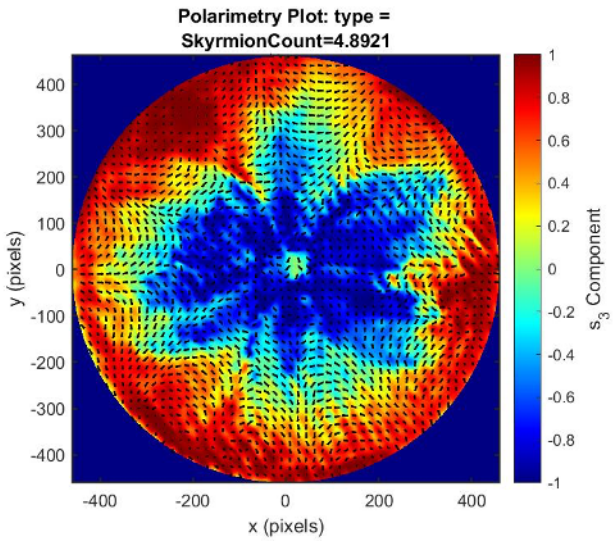


Figure 1: The skyrmion count of a 2-3 Lambert Beam

The number of skyrmions present in a beam is determined by the topological charges of the two component Laguerre-Gauss modes that are combined to create the final beam. The charge, or l-value, of each mode determines how many times the phase of the light wraps from 0 to 2π around the beam. If the first SLM imparts a mode with a topological charge of 2, and the second imparts a mode with a topological charge of -3, that will result in 2 - (-3) = 5 total wrappings in the final beam, as in Figure 2. This is also equal to the number of skyrmions we expect to see in the beam.

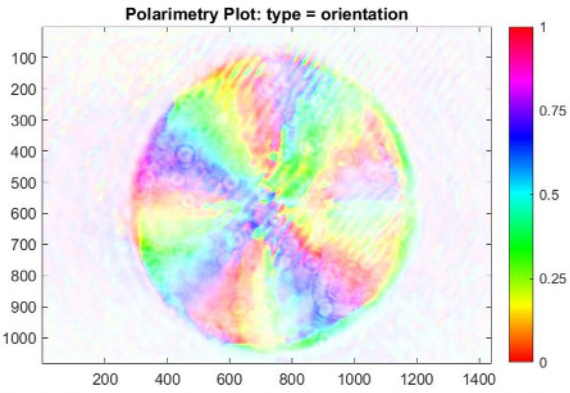


Figure 2: A visual representation of the orientations of the polarization states of a 4-1 Lambert beam, which shows a similar wrapping as the phase, and is identically determined by the topological charges of the two component modes.

Going forward, we will be looking into how machine learning may be implemented into our processes in order to obtain more accurate and consistent skyrmion counts. Additionally, we will explore continuously varying the relative phase between the two components that make up the final beam. In doing so we will induce a rotation in the beam, which we can then use as another means to encode data.

Research Fellow: **Julia Bihari (2027)** **Concentration:** **History**

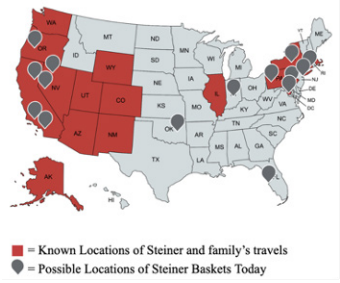
Faculty Mentor: **Rachel Amann-Burns** **Department:** **Upstate Institute**

Title of Project: **Understanding Native Collections: Researching Native American Baskets at Fenimore Art Museum**

Funding Source: **Upstate Institute**

Project Summary:

This summer, I had the honor and privilege to work under the Thaw Curator of Native Art, Christina Burke, at the Fenimore Art Museum in Cooperstown, New York. During my fellowship, I conducted provenance research on a collection of baskets and objects from the Gottlieb Adam Steiner (1844-1916) Collection and Native objects donated by his grandson, William Steiner Huff (1927-2021). The Fenimore Art Museum features a well-known collection of American fine art, Native art, folk art, and photography. The museum's Native art collection was established in 1995, when art collectors Eugene and Clare Thaw donated a renowned collection of Native art from North America; this established the Thaw Collection of Native American Art at the Fenimore Art Museum. The museum's primary audience is the local Cooperstown and Mohawk Valley community, focusing most of their efforts on education and accessibility to the arts in a rural area.



Gottlieb Adam Steiner (1844-1916) was a Pittsburgh steel magnate who upon retirement spent his accumulated wealth establishing an impressive collection of over five-hundred Native North American baskets. From 1914-37, his collection was on loan at the Carnegie Museum of Natural History in Pittsburgh, PA. It was later displayed in the late 1970s and early 1980s at a private family museum in Lawrence County, PA. In 1986, the collection was sold, though Huff held onto a few baskets from his grandfather and the family's collection. Fifteen baskets and several other related objects, either through gift of Huff or through the purchase of the Thaws, ended up in the Fenimore Art Museum collection.

In the beginning, the end product of my research was unclear and the process was fluid. I frequently consulted in tandem a large variety of primary and secondary sources including ancestry documents, government records, newspaper articles, basketry monographs, auction records, and a series of unique primary sources the Fenimore Art Museum obtained from Huff. With this fluidity, I was able to slowly piece together the Steiner collection, which included creating a full inventory of the 500+ baskets and tracing down the current location of over 100 baskets (see image below). In addition, I created a significant constituent file on Steiner, which impacts the Steiner family history. This includes notes and analysis on Steiner family documents, a family timeline and tree, list of dealers, and a map of the family's travels (see image to left).

	PLATE ID	STEINER ID	TRIBE	USE	Proprietor Information	Remarks from Steiners	Current Loc. (if known) / Notes
2	18-6	G113	Panamint		Whalen's Curio Store		Additional inventory sheet from Huff in back of this photo section noting that Grace misidentified two G113, based on the inventory it implies this basket is actually G115.
3	16-4	A10	Aleut or Atta	Fish Basket	provisionally M. Lee; "Old Collection"		attributed to Mollie Lee
4	29-6	A25	Haida	Hat	"Old Collection"		Fenimore Art Museum, T0193
5	26-3	B21	Fraser River	Storage Basket	Grace Nicholson		Fenimore Art Museum, T0517a-b
6	17-3	H3	Mission		Poss. Southern Pomo, Wappo or Coast Miwok; "	"Made by deaf = dumb Indian"	M.E.T. 2025.860.2, attributed to Mary Moon; Prov: Steiner; Quinn; Charles + Valerie Diker; M.E.T. 2025
7	46-4	NO ID	Kaweah Yokut	Feast Bowl	Grace Nicholson	"Choice Specimen"	No ID, likely G114
8	35-1	G74	Panamint		"Old Collection"		Sold by Bohmans June 28, 2021 Lot 229; Prov: Steiner, Blue Water Collection of Native American Baskets
9	49-50-2	G107	Kern		Whalen's Curio Store		Sold by Bonsitiny June 18, 2025 Lot 113; Prov: Whalen, Steiner, Bob Adams, Tucson AZ, Merill B. Dumas American Indian Art, Baton Rouge, LA, Collection of Alexander Schoser, San Francisco, CA in 2004

This work expands the Fenimore Art Museum's archives and better contextualizes the collections and helps professionals understand collecting practices of Native Art and the art and lives of Native communities. As well, my work is part of the Fenimore Art Museum's efforts to connect their collection with other major museums and will be shared with museum professionals across the country including curators at the M.E.T. and Carnegie Institute. The sharing of this information is an alternate form of archive expansion, where other institutions across the nation can also have this information for future researchers and curators.

Research Fellows: **Michael Boateng (2027)** **Concentration: Computer Science**
Kelvin Kemboi (2029) **Concentration: Undeclared**
Faculty Mentor: **Will Cipolli** **Department: Mathematics**
Title of Project: **The Data Science Collaboratory**
Funding Source: **Division of Natural Sciences and Mathematics**
Project Summary:

The Data Science Collaboratory is a data analysis collaboration network focussed exclusively on smaller colleges and universities in New York State. Leveraging expertise across the New York State Liberal Art Consortium (NY6), the collaboratory brings together a cohort of statisticians and data librarians from regional colleges and universities. As summer research students, we contribute to the development of R Shiny applications that provide data visualizations and statistical procedures, while also providing statistical consultation to both students and faculty. This initiative allows individuals regardless of their programming backgrounds to easily dive into quantitative research data analysis.

This summer, we embarked on an extensive upgrade across our software suite and released Version 3.0 for our existing applications. This update comes with a complete redesign of our user interface in addition to a key new feature: reproducibility. At the beginning of the research period, we thoroughly tested every aspect of the applications to identify and resolve any lingering bugs. This process not only stabilized the software but gave us a solid understanding of the framework behind which the applications were built, making it easier to implement a completely redesigned user interface.

The UI updates include an upgrade to modern front-end styling, bringing greater screen real-estate and dark mode that is easier on the eyes allowing our users to carry out their work more efficiently. Because each application maintains its own unique codebase, we carefully perfected the UI redesign on a single application, before propagating those improvements across the rest of the suite making specific changes here and there.

With the aim of tackling one of scientific research's biggest problems: reproducibility. Often, many published scientific studies cannot be repeated by other researchers due to factors such publication bias or the lack of data and code transparency. Through the new reproducibility tab, our users now have the ability to retrieve the results of their work on our website and the necessary files needed to reproduce them. Our users can now download: source code for the analysis, a bibliography file and a Word or PDF report of their work and its results. Finally, we're excited to be introducing two new applications: the Mixed-Effects regression app and Poisson regression app.

Research Fellow: **Juliette Boots (2028)** **Concentration:** **German**
Faculty Mentor: **April Sweeney** **Department:** **Theater**
Title of Project: **Midsummer Night's Dream**
Funding Source: **Storytelling Fund; Division of Arts and Humanities**
Project Summary:

The number one question posed during my summer research has been: "Why Midsummer?" Whether it was deciding costumes, stage blocking, or adapting lines, every part of the process lived in answering that question.

My role during the process was to be an assistant director, which gave me a close view into every part in the system that makes up a drama production throughout its stages of development. The first stage of this production process began in my apartment with reading the text of A Midsummer Night's Dream, and then rereading the text, to familiarize myself with the foundation of all my work going forward. I then met with my faculty advisor, Professor April Sweeney, and fellow student researcher, Antonius D. Robello, to discuss the text and our initial impressions. April encouraged us, and all the members of the production, to follow our instincts, which started with talking about what parts of the play we felt were most interesting and important to each of us. From there, we began to shape the look of the play by each doing individual research that was later combined together with the best and most cohesive ideas. We then brought in the actors to begin rehearsing, and it was through their performances and acting choices that much of the costume and prop choices were developed, along with additions to the original text. It was also through the actors that much of the "why" of the production was found; All the actors were from different places, were different ages, and spoke English as a second language—only being united by a love of theater. Their presence and interpretations created a Midsummer that has never been made before.



Much of my work in this production ended up enveloped in the world of the fairies—costume design, piece sourcing, styling, embroidery, sewing adjustments, and even acting as one myself. There were 9 actors for the fairies, and their voices wove throughout the theater to create a truly ethereal and inimitable atmosphere.

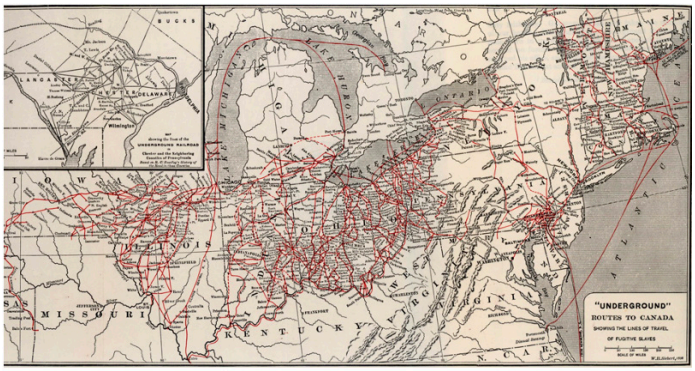


When it came to the end of the process with the dress rehearsal and the show nights, I learned to balance the many working pieces and stressors that came with putting everything together and facing unexpected scenarios. Things broke, people got sick, there was interpersonal drama and power struggles, but I navigated through it every night with the help of my fellow Colgate directors. And, what came from these difficulties each night was a unique show unlike the night before; I think that was the most thrilling aspect of this process—how every performance is alive and could have only existed at that time with those people in that theater. That, to me, is the answer to "why midsummer" and "why" this summer research.

Research Fellows: **Lucie Boulind (2029)** — **Concentration: Undeclared**
Caroline Murphy (2028) — **Concentration: International Relations**
Faculty Mentor: **Graham Hodges** — **Departments: History; Africana and Latin American Studies**

Title of Project: **The Underground Railroad**
Funding Source: **Division of Social Sciences; Alexander V. Wasson Fund**
Project Summary:

This summer we conducted research on the Underground Railroad, mostly focusing on its connections in Ohio and Pennsylvania. The goal of our research is an eventual book highlighting the individual stories of fugitive slaves. The majority of the research was done through newspaper archives, mostly in the period 1840-1865, using keyword searches such as "Underground Railroad," "fugitive," or "runaway." These newspapers were accessed through online archives including Newspapers.com and America's Historical Newspapers, providing nation-wide newspaper coverage, as well as local papers found through the states' library systems. Through the clippings we collected, we began to piece together the stories of fugitive slaves and the networks and abolitionists that aided them.



The names and events we highlighted were verified through secondary searches on sites such as Ancestry.com (to find family trees), HaithiTrust (to find references to individuals in all types of material - court proceedings, censuses, etc.), and Last Seen: Finding Family After Slavery (ads published by escaped slaves to find family/friends). There were also helpful location-specific online archives that could cross check some of the individuals we spotlighted and provide more information: for Ohio, the Wilbur H. Siebert Underground Railroad Collection, and for Pennsylvania, the Dickinson House Divided Project and The Civil War Search Engine. As the weeks went on, we began to recognize recurring figures and events, building their narratives as we came across new perspectives in newspapers.
In addition to this, we gathered information from physical archives in the area. The Picker Art Gallery provided us with resources and primary documents regarding Underground Railroad activity in the area, and Colgate University's own connections to abolitionism. We also visited the Madison County Historical Society to look through their archives, many of which aren't yet digitized. There, we combed through boxes on Gerrit Smith, a prominent local abolitionist. We scanned pages of his correspondences with references to abolitionist activity and the Underground Railroad.

Throughout the summer, often in the same archives we searched for information on the Underground Railroad, we sought information on Henry Highland Garnet, the subject of Professor Hodges's book which comes out in February. Occasionally we looked for specific articles or references to him which would corroborate information in the book. We searched through Gerrit Smith's archives as the two men were friends. We also examined local Ohio newspapers which contained information about Garnet's whereabouts and speeches he gave there. Further work on the Henry Highland Garnet book included proofreading the manuscript for errors and pulling out names and events to build an index.

Research Fellow: **Addie Brislen (2027)** **Concentration:** **Environmental Biology**

Faculty Mentor: **Andy Pattison** **Department:** **Environmental Studies**

Title of Project: **Rethinking Conservation: Learning from Tribal Perspectives on Cultural Burning in and Near Sequoia National Park**

Funding Source: **Division of University Studies**

Project Summary:

In the past 5 years, uncontrollable wildfires in the Sierra Nevada region have killed an estimated 20% of the Sequoia tree population. Climate change is not the sole contributor to these wildfires. The forced removal of Native Tribes from these areas and criminalization of their cultural fire practices have led to a 150-year buildup of flammable undergrowth. After these fires, more attention has been centered on sustainable ways to prevent wildfires while moving away from intense fire suppression. Cultural burning by Indigenous communities has been shown to effectively reduce the risk of catastrophic fires. I interviewed Tribal chairmen and council members involved with cultural burning in and around Sequoia National Park. The goal was to understand what barriers and successes they have experienced working in this field, specifically dealing with policy and relationships within federally governed protected areas. I was able to find several commonalities within the interviews.



Overall, there seemed to be a positive relationship between local tribes and Sequoia NP. In terms of common barriers, according to an interviewee, “It’s easier for the federally recognized tribes” to negotiate no gathering and no fire policies in the national parks and forests. Many of these policies are flexible depending on the relationships between the tribes and federal leadership. Another interviewee states that federally recognized tribes, “have more clout because they can work government to government.” Non-federally recognized tribes can only consult with federal agencies. Federally recognized tribes may also have more full-time staffing positions that can fund consistent involvement in upcoming policy changes. One interviewee explained that, “for us to be engaged on a daily basis, we’re a non federally recognized Tribe. We don’t have the capacity”. US Forest Service policies under NFMA are reviewed “every 10 years or every 15 years… the big issue there is that unless you are there helping develop that plan from the Indian perspective… you may miss out a whole decade of work.” Although there seems to be a progressive trend, historically, tribal perspectives have not been compensated for their professional ecological advice. Even if they are given a seat at the table, it may be difficult to attend meetings with park or forest staff due to lack of resources. An interviewee states, “people who are involved with the tribal councils are stretched very thin.” There seems to be a willingness from federal staff to support Indigenous involvement on these lands. However, staff reductions under the current administration make it difficult to sustain momentum.

Cultural burns focus on community, cultural survival, and long-term ecological sustainability and resilience. An interviewee explains, “What we’re doing is sustainability. What we’re doing allows the land to return. Regrow. Revitalize.” Another states, “We are burning the resource we want to come back.” Cultural burning is an opportunity to teach the next generation the language, stories, and practices of each tribe. Many tribes who were removed from their ancestral lands do not have areas of land to burn in, and without the ability to connect with that land again, there is the possibility of losing one’s culture that is difficult to reclaim. Not only is cultural burning important for ecological sustainability in the climate crisis, but it is also a first step on the pathway to decolonizing federally protected areas in America.

Research Fellows: **Chloe Bueno (2027)** — **Concentration: Educational Studies**
Isabel Costa (2027) — **Concentrations: Classical Studies; Psychological Science**
Olive Ye (2028) — **Concentration: Psychological Science**
Faculty Mentor: **Rebecca Shiner** — **Department: Psychological and Brain Sciences**

Title of Project: **New Perspectives on the Co-Occurence of Post-Traumatic Growth and Deterioration: The Case of Bereaved Parents' Changed Relationships Following Child Loss**

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

Project Summary:

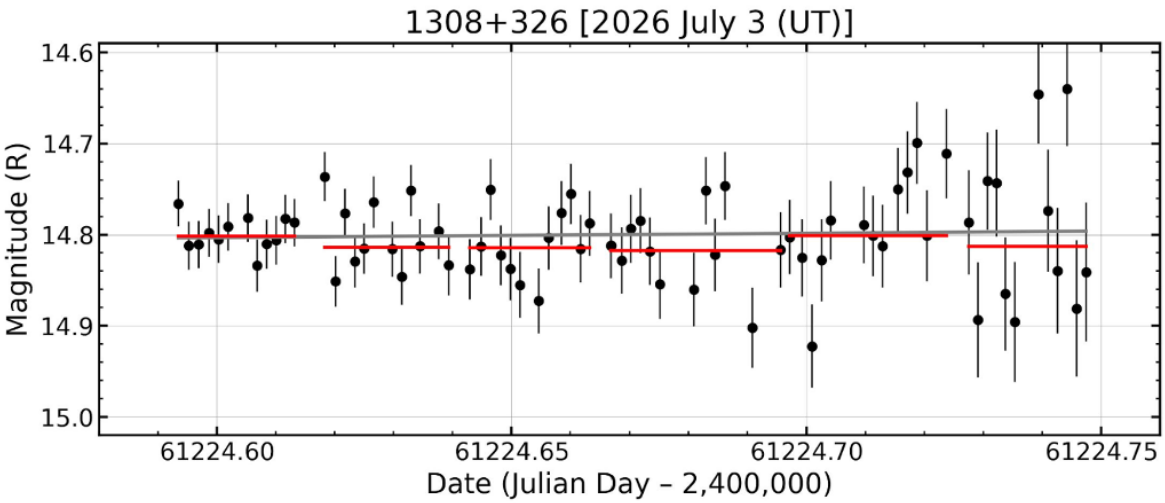
Whereas previous literature typically focuses solely on the phenomenon of Post-Traumatic Growth, our study confirms that growth and deterioration often coexist, even in the same dimension of one's life. Child loss is specifically considered one of the most traumatic life events, and our research focused on a sample of 213 bereaved parents recruited via various bereavement groups. A mixed-method design was used, with participants completing four writing prompts about their experiences since their child died (turning point, relationships, change since loss, and future chapter) as well as several questionnaires on post-traumatic growth, mental health outcomes, and social support.

Each of the narratives was coded by all research assistants (RAs) for the presence or absence of both positive and negative change in each of seven dimensions: relating to others, relationship with self, appreciation of life, personal strength, new possibilities, acceptance, and spiritual development. Additionally, the presence or absence of various types of continuing bonds with the child was coded. A coding manual was made in the beginning of the process, then RAs coded each of the participants separately and discussed the result together to determine the final codings. Inter-rater reliability was calculated for both growth and deterioration in each of the domains.

The present study focused on the "relating to others" domain, which tracks change in specific relationships, relational abilities, and general attitudes towards others. Based on the coding, participants were divided into four groups: Both Positive and Negative Change (117), Only Positive Change (67) and Negative Only (21), and Neither Positive nor Negative Change (8). Due to its small size, the Neither group was not included in further analysis.

Each of the three groups' results on a series of questionnaires were analyzed for differences. There were significant differences between each group on questionnaires that measured social support, post-traumatic growth, stress-related growth, depression, and well-being. Further analysis revealed that the Both group's results on average lay in between the Positive Only and Negative Only groups, with a slight lean towards Negative Only. Additional qualitative analysis of a random sample of Both group narratives was conducted to identify any themes that were present across the group. Four unique, frequently occurring themes were identified within this group: rupture and repair of a relationship, painful interactions followed by better boundary setting, lack of understanding from others leading to an increased desire to be of service to others, and experiences of expected support systems failing while unexpected ones appeared in their place. Narrative methods reveal not only whether post-traumatic growth and post-traumatic deterioration co-occur, but how co-occurring deterioration changes the meaning and experience of reported growth.

Research Fellows: **Aiden Cannon (2029)** **Concentration: Undeclared**
Jacob Potter (2029) **Concentration: Undeclared**
Faculty Mentor: **Thomas Balonek** **Department: Physics and Astronomy**
Title of Project: **Investigating the Ongoing Optical Outburst of Quasar 1308+326**
Funding Source: **Division of Natural Sciences and Mathematics**
Project Summary:



In order to investigate the optical variability of quasars, we had to learn the operation of the Colgate University Foggy Bottom Observatory's 16-inch telescope and charge-coupled device (CCD) camera. We first had to calibrate our images, subtracting a dark image (an image without the shutter being opened) which removed extraneous signal and camera noise, and then dividing by a master flat image which accounted for differing responsivity to light across the camera. The brightness (magnitude) of each quasar was then determined by comparing it to standard comparison stars of known brightness using the astronomical image reduction program AstroImageJ.

We obtained sequences each night of twelve images of each of the quasars 1308+326, MRK 501, 3C345, and 1749+09. To obtain a higher accuracy of each night's measurements, we averaged the brightness values of the twelve-image sequence. Analysis of the variations of the four quasars revealed that the most interesting object was 1308+326, which was undergoing an outburst. During the two months we spent observing, it varied by a factor of ten in brightness. One night, we decided to spend an entire night observing only 1308+326 (see graph). Although we were searching for intra-night variability in the brightness of quasar 1308+326, we found no strong evidence of any variability within that night, as evidenced by the red lines representing the mean magnitude value of each sequence of twelve images. The gray line is a least-squares linear fit to the entire night's data, showing no significant evidence of intra-night variability.

Research Fellows: Arushi Chatterjee (2029) — **Concentration:** Undeclared
Josephine Jenne (2027) — **Concentrations:** Psychological Science; English
Faculty Mentor: Jennifer Tomlinson — **Department:** Psychological and Brain Sciences

Title of Project: Sleep and Relationships in Older Adults
Funding Source: Division of Natural Sciences and Mathematics
Project Summary:

The Sleep and Relationships in Older Adults study focuses on couples who live together where at least one partner is at least 55 years old. The project is ongoing and is in collaboration with the University of Texas at Dallas. Past research shows that relationships play an important role in our well-being and health (Pietromonaco & Collins, 2017), with sleep being an important health factor (Kiecolt-Glaser & Wilson, 2017). This study measures factors that may be related to an individual's sleep, such as their partner's sleep, relationship satisfaction, and participating in self-expanding activities. Self-expansion, or personal growth through novel, exciting, or challenging experiences, has also been linked to well-being. Self-expansion can occur both individually and within close relationships (McIntyre et al., 2023).

The study has a goal sample size of 110 couples. Currently, 73 couples have participated across both universities. Eligible participants fill out a baseline questionnaire asking about sleep, relationships, and health. After, participants wear a sleep (actigraphy) watch for 10 days, while completing daily surveys about their sleep, relationships, health, and activities. Eventually, participants complete 2-month and 1-year follow-up surveys, which are similar to the baseline survey. The data from the sleep watches, daily surveys, and follow-ups are all used for analysis.

Figure 1. Example Representation of Actor and Partner Effects

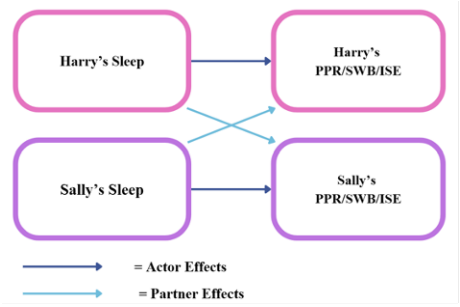


Table 1. Daily Actor Partner Analysis

Dependent Variables	Actor PPR	Partner PPR	Actor SWB	Partner SWB	Actor ISE	Partner ISE
Sleep Quality	0.04 †	0.04*	0.79**	0.13 †	0.08**	0.02
Sleep Efficiency	0.00	-0.00	0.01 †	-0.00	0.00	-0.00
Wake After Sleep Onset (WASO)	-0.00	0.00*	-0.01**	-0.00	-0.00 †	0.00

**p<.01; *p<.05; †.05≤p≤.10

This summer, we focused our work on baseline questionnaire sessions with participants, analyzing sleep data, creating participant sleep reports, and conducting preliminary analyses. Figure 1 depicts the actor and partner effects that were explored during the study. Considering both actor and partner effects indicates how individuals' sleep can influence their partner's health and well-being, as well as their own. Table 1 presents the B values and their level of significance found by executing these Actor/Partner analyses. Results include significant actor effects between sleep quality & subjective wellbeing, sleep quality & individual self-expansion, and wake after sleep onset & subjective wellbeing. A significant partner effect was found between sleep quality & perceived partner responsiveness. So far, these preliminary analyses are consistent with past literature and indicate that there are significant links between sleep and relationships, sleep and health, and sleep and self-expansion.

Key: PPR = Perceived Partner Responsiveness, SWB = Subjective Well-Being, ISE = Individual Self-Expansion

Research Fellows: Ricardo Chavarria (2028) **Concentration:** Physics
Thomas Prisco (2028) **Concentration:** Physics
Faculty Mentor: Beth Parks **Department:** Physics and Astronomy
Title of Project: Measuring Building Insulation Through Heat Flow
Funding Source: Division of Natural Sciences and Mathematics; Justus '43 and Jayne Schlichting Student Research Fund

Project Summary:

This summer we worked to improve the repeatability and accuracy of an insulation-measuring device. This research has the goal of increasing the energy efficiency of homes by helping homeowners measure the insulation within their walls. Typically when purchasing a house, details about insulation are not given to homeowners which could mean that they are unaware of cost-effective improvements that could be made. Thus understanding the effectiveness of a home's insulation can allow homeowners to make improvements that will reduce the amount of energy they use to heat/cool their homes. Additionally, our measuring device is designed to be non-invasive and doesn't require an expert to look inside the wall, making understanding the home's insulation much easier and more convenient.

The device is taped to the interior surface of an external wall. It consists of an aluminum sheet, a known piece of insulation (typically an R-value of 3 or 5), and a thermocouple, and it uses two different types of tape (woodworking and painters tape). A thermocouple is an inexpensive device consisting of two different types of wire that meet at junctions. The difference in temperature of the two junctions creates a voltage difference that we are able to read through a multimeter. We use the thermocouple to measure the temperature difference between the side of the device facing the wall and the side facing the room, which were separated by the piece of known insulation. Then by also measuring the temperature difference between inside and outside the house, the insulation of the wall can be calculated.

The main problem that previous students had when collecting data from the device was that they were not able to get repeatable measurements between datasets when they moved and reattached the device to the wall. We hypothesized that the method used to attach the device to the wall was not repeatable, and sometimes allowed a small layer of air to get in between the wall and device. This led us to improve the thermal contact between the device and the wall by creating as close to an airtight environment as possible to have repeatable measurements.

We created two different designs that are consistent between each other. Both use a section of the metal sheet that is slit so a thermocouple secured by a heat-conducting paste can lay flat. Then in the first design, we milled out a section of the insulation so the aluminum sheet can also lay flat when attached to a wall. To minimize damage to the wall, but have a tight connection, painters tape is applied to the entire bottom of the device, then woodworking tape on top, which allows for a strong airtight attachment of the device to the wall. We also used a second design that used a piece of EVA foam that overlapped the aluminum sheet and was hotglued at the edges to painters tape to keep out any air in between the foam, sheet and the wall.

To test the device we have two different test houses in the lab, roughly the size of closets. One is made only of foam insulation and another is closely similar to a regular home made up of plywood, insulation and wooden support studs. This setup allowed us to create different environments to test the repeatability and accuracy of the device when it has to be used in the real world. We also utilized other pieces of equipment to ground our observations of our device, such as two different types of heat flux sensors that measure the rate of thermal energy through the wall and a pair of thermometers placed inside and outside of the test homes.

During the majority of the summer we tested our device on the insulation-only house due to improving the design to a point where we were able to obtain consistent repeatable results from our devices before moving on to a complex system similar to a regular house. After a series of tests and redesigns we reached the final design described above, which enabled calculations of insulation within 1-2% of the known value of R = 10.

With these results we are confident that the device is able to make repeatable measurements for us to analyze. The next step in our research is to see how repeatable and accurate the device collects data when it is placed on stud within our test home and understanding how studs affect the overall insulation of an exterior wall.

Research Fellows: Vincent Chen (2028) — **Concentration:** Neuroscience
Isla Gao (2028) — **Concentration:** Neuroscience
Faculty Mentor: Wan-chun Liu — **Departments:** Psychological and Brain Sciences; Neuroscience

Title of Project: The Effect of Nicotine and Dopamine on Zebra Finch Co-song Gestures

Funding Source: Division of Natural Sciences and Mathematics

Project Summary:

When people speak to each other it is intuitive to gesture while talking. This gesturing phenomenon is also seen in song birds, when male zebra finches sing their learned song in order to court a female, they often gesture on the most complex syllable. By discovering the mechanisms within the brain that regulate this function it can also provide a reasonable hypothesis as to how co-speech gesturing works in humans as well. In previous research it has been found that these co-song gestures can be modulated under different social contexts or cognitive cognitive states, varying in rhythm, form, and or magnitude of head movement. Since modulations in bird songs are regulated by dopaminergic neurons in the basal ganglia of birds, specifically in Area X, we believe that these modulations in co-song gesturing could also be due to these same neurons. In testing this hypothesis we aim to find a way to activate these dopamine neurons within Area X.

Previous research has shown that subcutaneous injections of nicotine altered the tempo and the rhythm of the zebra finches' song via nicotinic acetylcholine receptors. When nicotine interacts with the nicotinic acetylcholine receptors a release of dopamine targets the basal ganglia, the now more active basal ganglia, can cause suppression on song variability. We propose that the change in song variability could lead to change in co-song gestures as well. Using Raven and BORIS software we were able to quantify the movements and which syllables they fell on. In our preliminary trial (n=2) the injection of nicotine resulted in decreased average movement angle of undirected co-song gesturing (free singing), and thus aligning more with the features of directed song gestures (singing to female) rather than undirected when compared to their baseline data. This allowed for us to conclude that nicotine did have an effect on the gesturing of birds which has allowed for us to continue on to adding more birds to understand if the vocalization pathway might also regulate gesturing.

Dopamine agonists (D1 & D2) were also proposed and injected subcutaneously into the inguinal fold of legs in the preliminary trial (n=2). The neurotransmitter dopamine has long been known to modulate highly motivated, goal directed behaviors (such as courtship singing in birds), and emerging evidence suggests that dopamine plays a crucial role in altering neuronal activity in zebra finch cortical-basal ganglia circuit, upon shifting between directed and undirected singing. Together with the established theory that zebra finches produce stereotypical songs with little variation in directed singing compared to undirected singing, as a result of increasing dopamine levels in the basal ganglia (Area X), we hypothesize that dopamine levels may be a crucial factor in altering song variability. The experimental results were rather surprising, as little to no song was produced after either D1 or D2 injections, providing insufficient data for movement analysis and suggesting potential song suppression effect. This could also be due to increased stress levels as a result of injections itself, and further understanding of the cause would require another preliminary trial with an adjusted protocol.

Research Fellows: **Samuel Chittick (2028)** **Concentration: Chemistry**
Kira Sullivan (2028) **Concentration: Environmental Studies**
Faculty Mentor: **William Peck** **Department: Earth and Environmental Geosciences**
Title of Project: **Eccentric Iron Deposits in the Adirondack Highlands**
Funding Source: **Doug Rankin '53 Endowment-Appalachian Research**
Project Summary:

The Adirondacks are home to many historic iron deposits. Most were deemed unprofitable and abandoned following World War II, when iron was no longer in such heavy demand, and the other iron mines in the area soon followed in the subsequent decades. Over the summer we examined rocks from two historic mines: the Green Farms Mine and the Clifton Mine. These sites are particularly interesting since they lie in the Adirondack highlands, which experienced the major geologic event that greatly shaped the composition of the rest of the rocks in the Adirondacks, however, it retains similar geology to the Adirondack Lowlands, which it lies on the precipice of. For our project, we read about these deposits' histories, the rich minerals they contain, and visited them ourselves to collect samples. We attempted to draw conclusions about the conditions these iron deposits may have formed in. By examining the mineralogy and geochemistry of the rocks from these mines, we sought to trace the origins of these rocks and determine when they may have formed which required drawing conclusions about certain factors, such as the temperature and pressure to form the mineralogy and geochemistry observed at these sites.

The samples were obtained via the New York State Museum or collected out in the field. Most of the samples we collected were igneous or metamorphic rocks such as: ores with calcite, skarn pyroxene, granite pyroxene, facoidal granite gneiss, and lucogranite gneiss. Much of the work we did this summer was to determine the minerals within these samples using various methods including: creating thin sections, using an SEM (Scanning Electron Microscope), and conducting carbon isotope analysis. Each of these methods required specific techniques and preparation. To prepare samples for Carbon Isotope analysis, we split and grinded the sample from each site into sand-sized grains. Carbon isotope analysis required grains of calcite to be separated from individual samples of rock. The collected calcite was reacted with phosphoric acid to produce carbon dioxide, which was then purified cryogenically and analyzed using a mass spectrometer to find the ratio of 13C/12C and 18O/16O. Preparation for SEM and light microscope work required cutting the samples using a diamond saw, grinding rock billets, and polishing them using wheels with varying sizes of grit in order to smooth the surface. For smaller samples, we placed them into a cylindrical mold, sealed them with epoxy, and polished them. A well polished sample with a smooth surface was required for SEM analysis, to get a clear and accurate image of the sample and its mineral contents. SEM analysis entailed analyzing parts of the sample to record detected minerals such as Zircon, Titanite, Pyrite, Epidote, Clinopyroxene, and Feldspars. We documented our findings into a shared spreadsheet and our notes to keep track of data.

Following the large data collection phase of the project came a smaller data interpretation phase. We identified particular trends and used some of our compositions in combination with already existing literature on these deposits to gain a general understanding of the temperature these deposits may have formed at. Using the magnetite chemistry, we determined the deposits were of a high temperature origin of around 500ºc. We also attempted to use scapolite chemistry to determine the composition of the brine which formed the deposits, however, these calculations yielded very inconsistent results in the range of .091% to 24.6% Overall, through this project we succeeded in naming, and identifying rock types, gained an idea for the different kinds of minerals which compose the samples, and the isotopes associated with each site and rock type. We also gained a deeper understanding of the history of the Adirondack area and its iron deposits, and gained a deeper appreciation for geological research and the materials, technology, and technical processes it requires.

Research Fellows: Kate Christensen (2028) **Concentration:** Environmental Geography
Jelly Wan (2028) **Concentrations:** Theater; Astrogeophysics
Faculty Mentor: Joe Levy **Department:** Earth and Environmental Geosciences
Title of Project: Polar and Planetary Habitability
Funding Source: Norma Vergo Prize; Hackett-Rathmell 1968 Memorial Fund
Project Summary:

The Alvord Hot Springs discharge plume into the Alvord Desert playa could be a good analog for martian surfacial processes based on observations from remote sensing. The Helihabitable project aims to monitor the change in playa hydropattern as a result of hydrothermal spring discharge t. The goal of the research was to answer the question: does the spectroscopic signature of water in the sediments disappear over the course of the day, even as the overall sediments remain wet?

The Alvord Desert is a hyper-arid playa featuring fine-grained, smectite-rich clay soils with extensive desiccation cracks. In summer, strong convective winds and low precipitation conditions dominate outside of the scattered hydrothermal springs and fringing wetlands that support robust bacterial ecosystems (Levy and Johnson,2021). After two field seasons of work, this year's goal was to collect more hyperspectral imaging data through remote sensing as well as testing and cross calibrating new ground sensors to get more accurate measurements of water content, even in these highly saline soils. To evaluate soil and moisture dynamics across the plume, we integrated high-resolution remote sensing with multi-sensor ground-truth measurements. To develop cross calibration curves among the sensors, soil samples were collected from the field and dried in the lab to determine gravimetric water content (GWC) via weighing of wet and dry soil splits. Samples were air-dried for 6 days in the fume hood. Finally, calibration curves were established to directly correlate the remote sensing spectral indices with ground-based sensor and physical soil data.

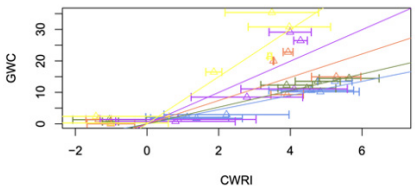


Figure 1: R Studio generated chart comparing the CWRI values to the GWC. This chart reveals that throughout the course of the first day of flights, the slope of the comparison became steeper.

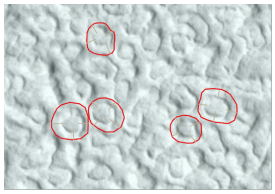


Figure 4: Mapped open cell brain terrain on the surface of Mars. The red circle around them represents the general area, while the tan lines across represent various widths that are then averaged out.

Brain terrain is a morphological feature on Mars that consists of ridges and troughs and that is common on glacial surfaces in a latitudinal band spanning 35-45˚ latitude. A current hypothesis we are following is that these features are a result of sublimation processes that do not inherently require liquid water. Most of the terrain is either classified as closed cell (long, almost baguette shaped figures), or open cell (circular ridges that can resemble a doughnut). To better understand this morphology, we are comparing these martian features to analogs on Earth in the arctic that resemble similar features. The goal of this research was to create a concrete framework for comparing these Earth and Martian features, furthermore narrowing down the possible conditions that are necessary for its formation. Working with Shannon Hibbard from the Desert Research Institute, we collaborated on mapping the open cell features across Earth and Mars using a shared set of criteria. We followed a standardized mapping criteria that would allow the features to be better compared across the two planets. Using the Geographic Information Systems program QGIS, we took various HiRISE (High Resolution Imaging Experiment) images of Mars and mapped as many open cell figures as possible that fit the decided upon criteria. By the end of our brain terrain work, we mapped 11 different HiRISE images and identified a total of 523 open cell figures.

While many of the sites had abundant open cells, others were completely devoid of any at all. This leads us towards the interpretation that they are a feature of glacial processes, only present in highly specific areas of the Mars terrain. This data that we have collected will be helpful in further research regarding Earth to Mars terrain comparison, and will hopefully continue to reveal the true cause behind these fascinating morphological features.

Research Fellow: **Katherine Cline (2027)** **Concentration: Molecular Biology**
Faculty Mentor: **Sarah McMillan** **Department: Biology**
Title of Project: **Characterizing How Exonuclease IX Interacts with Single-Stranded DNA-Binding Protein (SSB)**
Funding Source: **Michael J. Wolk '60 Heart Foundation**
Project Summary:

Introduction & Background

DNA is constantly getting damaged by normal cell processes like replication as well as external factors like UV light and chemicals. If this damage is not repaired, it can cause mutations that lead to diseases like cancer in humans or antibiotic resistance in bacteria. In bacteria, one of the main proteins involved in repair processes is single-stranded DNA-binding protein (SSB). SSB coats single-stranded DNA during replication and repair to protect it from being degraded. It also acts as a recruitment platform for proteins involved in DNA replication, repair, recombination, and replication restart. One known binding partner is Exonuclease IX (ExoIX), an E. coli DNA repair protein. While ExoIX is known to interact with the C-terminal tail of SSB, the specific molecular characterization of this interaction is not fully understood.

Methods and Results

To figure out which amino acids on ExoIX interact with SSB, I used AlphaFold structure predications in UCSF ChimeraX to map out the predicted binding pocket (as shown below). Based on this model, I picked three candidate residues near the binding pocket (L110, N243, and Q245) to mutate using Q5 site-directed mutagenesis. I then transformed the mutant plasmids into E. coli, confirmed them using Sanger sequencing, and then moved them into a yeast two-hybrid (Y2H) system to test if the mutations affected the ExoIX-SSB interaction.

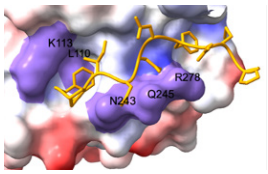


Figure 1. Structural model of ExoIX showing the predicted SSB-binding pocket. Residues selected for site-directed mutagenesis (L110, N243, and Q245).

Binding Domain	Activation Domain
SSB	SSB
SSB	Empty
SSB	ExoIX
SSB	N243A
SSB	Q245A
Empty	N243A
Empty	Q245A

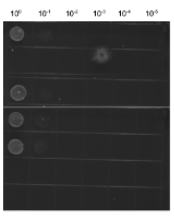


Figure 2. Y2H analysis of ExoIX-SSB interactions. Wild-type and mutant ExoIX constructs were tested with both positive and negative controls. ExoIX Variants (N243A and Q245A): The negative control showed no growth, while both variants grew at rates similar to wild-type ExoIX when interacting with SSB. This suggests that these specific substitutions don't significantly disrupt the interaction under our test conditions. ExoIX Variant (L110K): I am currently working to determine whether the L110K mutation disrupts this interaction.

I also set up a Y2H system to look at the interaction between ExoIX and H-NS, a known protein known to bind to ExoIX. Since the ExoIX-H-NS interaction is already established, it acts as a positive control to help us validate our Y2H. I built the H-NS activation-domain constructs using PCR amplification, Gibson assembly, bacterial transformation, and plasmid minipreps, before interactions were tested with ExoIX, and we are currently waiting to confirm these results.

Future Directions

Right now, I am working on replicating the Y2H assays for all of our constructs, including the previously identified ExoIX mutations, current ExoIX mutations, and the H-NS constructs, to confirm that these interactions are reproducible. I also plan to switch the fusion orientation of ExoIX and SSB between the activation domain (AD) and DNA-binding domain (BD) vectors, which will further validate my results.

Research Fellow: **Emilia Colabello (2027)** **Concentration:** **Astrogeophysics**
Faculty Mentor: **Jonathan Levine** **Department:** **Physics and Astronomy**
Title of Project: **Interpreting Laser Ablation Mass Spectra Before CODEX Flies to the Moon**
Funding Source: **Division of Natural Sciences and Mathematics**
Project Summary:

DIMPLE (Dating an Irregular Mare Patch with a Lunar Explorer) is a NASA-selected payload designed to date and find the geological composition of irregular mare patch Ina. The low density of impact craters at Ina means either that it is a volcanic eruption only 33 ± 2 million years old, or that unusual rock properties there lead to poor retention of impact craters. If Ina is as young as 33 million years old, this would challenge current assumptions about lunar thermal evolution.

The experiment will utilize CODEX (Chemistry, Organics, and Dating EXperiment), a resonance ionization mass spectrometer. CODEX will perform Rb and Sr isotopic microanalysis on lunar rock samples, which will be used to calculate their 87Rb/87Sr isochron ages and the crystallization age of the rock. CODEX will also obtain laser-ablation mass spectra, used in determining the chemical composition of the samples. The time-of-flight of ions generated by a 266nm ablation laser will determine the elemental composition.

Figure one displays spectra and calibration from the ablation of test sample NIST SRM 1155a, a stainless steel standard. The lasers induced noise in the signal, which I subtracted before calibration. On the basis of flight time, we identified Na, Al, K, and Fe ions, and compared their signals to assess correlations. Most of these detections were unexpected, given the composition of the test sample. Figure two displays the correlation between Fe and the other three elements. Fe and K have the best correlation with a coefficient of 0.97, followed by Na (0.91) and Al (0.87).

Based on the known composition of the sample, we expected strong correlations among Fe, Cr, Ni, and Mo signals. Contaminant detections would anti-correlate with signal from the steel, which is not observed. Potassium is the strongest signal obtained from this sample, yet it is not a certified component of this NIST standard. One possible explanation is that K is very easy to detect, even in low abundance, because it has a very low ionization energy. Moreover, K and Fe have the best correlation, suggesting that K is not a surface contaminant. K and Na signals become more prominent over weeks of experimentation, while Cr and Ni remain undetected. Tuning the mass spectrometer is ongoing. Perhaps we have thus far tuned it on a “fringe” population of ions that does not contain Cr, Ni, or Mo. It is possible that the 266 nm ablation laser is colliding with a portion of the instrument as it travels, ionizing K and Na from the instrument rather than the sample.

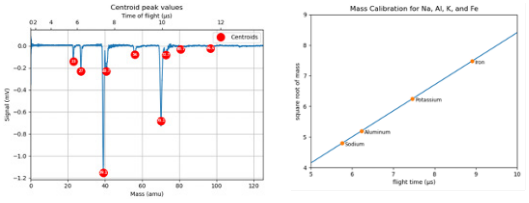


Figure one: Time-of-flight mass spectrum from laser ablation of NIST SRM 1155a. Identified ion peaks labeled by element.

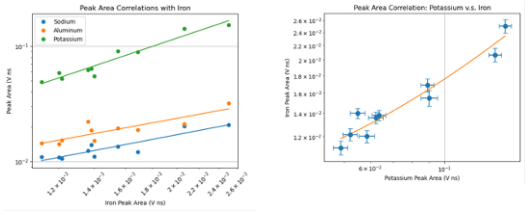


Figure two: Correlation plots between Fe signal and Na, Al, and K signals across repeated run

Research Fellow: Camille Collins (2028) **Concentration:** Economics
Faculty Mentor: Takao Kato **Department:** Economics
Title of Project: Cooperatives' Resilience: A Study in Eroski's Relative Performance Through the COVID-19 Recession
Funding Source: Division of Social Sciences
Project Summary:

In the years following the Great Recession, the shared capitalist business model such as cooperatives has gained attention as an alternative to the investor-owned, conventional business model due to the emerging evidence that they tend to be more resilient in the face of economic downturn. In my literature review, I found that in cooperatives, business decisions are made by company-wide votes in which each worker-owner is entitled to participate, endowing the firm with unique flexibility. For example, while conventional capitalist firms tend to be quick to lay off their workforce during a recession, in cooperatives, the employees are more apt to decide to reduce their own overall wages or working hours in order to preserve jobs.

This study examines the performance of the popular Eroski grocery chain in Spain, a cooperative and member of the Mondragón corporation, in comparison to two of its conventional capitalist competitors, Centros Commerciales Carrefour and Lidl Supermercados S.A.U., as well as a large portion of the aggregate Spanish food and beverage retail sector during the COVID-19 recession (2019-2021). I was able to compare Eroski's performance with these comparable conventional capitalist firms by retrieving their annual balance sheet and income statement data over 2019-2021 from the S&P Capital IQ Pro database and conducting a comparative statistical analysis of total assets, EBITDA, total revenue, gross profits, return on assets, and the debt/EBITDA ratio.

In all metrics except for total revenue, Eroski was either on par with or performing better than its peers. Most notably, I found that from 2019 to 2021, Eroski's total assets grew 42%, while Lidl's, Carrefour's, and the industry's average assets increased 26%, 16%, and 36%, respectively. These statistics are contradictory to the commonly held belief that because of a lack of funding from typical investors, cooperatives cannot expand as fast as conventional capitalist firms. Additionally, while all four entities saw a decrease in profitability (measured by return on assets), Eroski saw a smaller decline than the industry average, Carrefour, and Lidl by 1%, 12%, and 21%, respectively. Total revenue is the single category that Eroski performs meaningfully worse than its peers, a finding at odds with its superior performance in gross profits, in which it was the only entity to see a positive change from 2019-2021. I further explored why Eroski outperformed its conventional capitalist peers in profit but not in revenue. My working hypothesis is that Eroski more effectively lowered its costs, a value that is factored into profits, but not revenue. Despite the poor performance in revenue, Eroski's profitability performance was as strong, if not stronger, than its conventional capitalist peers in all other metrics.

Not only did Eroski succeed under its cooperative business model, it was able to do so while following the cooperative principle of community solidarity. In practice, this social action meant that Eroski and its clients worked together to donate health equipment, support the Red Cross and local food banks, and distribute meals to families in need. This aid totalled 12,419,918 euros in 2020 alone. Future research will examine Eroski as well as other cooperatives and their conventional capitalist peers over longer periods of time to solidify the worker-owned model as not only a viable but profitable and widely-beneficiary way to do business.

Research Fellows: Emily Collins (2027) **Concentration:** Molecular Biology
Shegufta Mehjabeen (2028) **Concentrations:** Biology; Neuroscience
Faculty Mentor: Krista Ingram **Department:** Biology
Title of Project: Single- and multi-SNP haplotype analyses of the circadian-related SLC20A2 gene reveal sex-specific associations with seasonal affective disorder (SAD)
Funding Source: Mind, Brain, and Behavior Scholars Award; Division of Natural Sciences and Mathematics

Project Summary:

Nearly one half of our genes are regulated by our circadian rhythms, and therefore circadian rhythms can have many effects throughout the body, including effects on mental health and behavior. Circadian sleep patterns vary according to photoperiod (summer or winter), and certain individuals have stronger seasonal encoding than others. Therefore, it is possible that certain circadian clock genes may be involved in Seasonal Affective Disorder (SAD), a mental health disorder that is similar to depression but is more dependent on seasonal photoperiod changes. Building on animal and human evidence that SLC20A2 influences seasonal circadian adaptation, we tested associations between five SLC20A2 single-nucleotide polymorphisms (SNPs) and symptoms of SAD and depression in a deeply phenotyped population. In the lab, we extracted DNA from hair samples gathered from a study of Colgate students and faculty at the beginning of the summer, and used this DNA along with extracted DNA samples from previous studies conducted by the Ingram Lab to run qPCR experiments and determine the genotype for each sample at each SNP. We examined both single-SNPs and multi-SNP haplotypes and assessed whether these associations differed by sex. Three SNPs (rs6988483, rs13281070, rs3763510) were significantly associated with SAD symptom severity, with the effects of SLC-3 and SLC-4 concentrated in males. Haplotype analysis identified ten multi-SNP combinations associated with SAD. Four of these haplotypes, one risk haplotype conferring roughly nine times greater odds of SAD symptoms in females and three protective haplotypes, showed no corresponding association with general depressive symptoms, suggesting these variants influence seasonal depression specifically, rather than depressive symptoms broadly. Six additional haplotypes were protective against both SAD and depression. These findings provide initial evidence that SLC20A2 variation, at both the single-SNP and haplotype level, contributes to SAD risk in a sex-specific manner and that a subset of this variation may act on seasonal mood regulation independent of general depression risk. Our results support SLC20A2 as a candidate gene for circadian-related mood disorders and point to potential new therapeutic targets, though replication in larger, sex-balanced cohorts is needed.

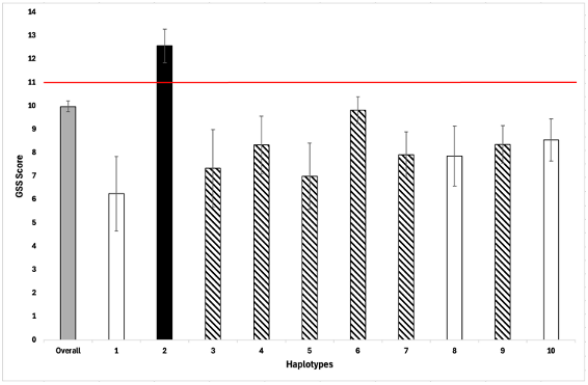


Figure 1. Multi-SNP SLC20A2 haplotypes significantly different from GSS score (11) at SAD diagnostic threshold. Bars represent average GSS Score for SLC Haplotypes (±SE). All haplotypes shown were significantly associated with SAD ($p<0.05$). Haplotype 2 (n=7) is associated with increased risk of SAD with a mean GSS score above the SAD threshold (12.57 ± 0.72). Haplotypes 1, 3, 4, 5, 6, 7, 8, 9, 10 are protective against SAD and had GSS scores significantly lower than 11. Black and white striped bars indicate haplotypes with associations with both SAD and depressive symptoms. White bars indicate a protective haplotype for SAD only. Black bars indicate a risk haplotype for SAD only. The gray bar represents the overall average GSS score for the population sample.

Research Fellow: Veronica Cordero (2027) **Concentrations:** Molecular Biology; Spanish
Faculty Mentor: Engda Hagos **Department:** Biology
Title of Project: Investigating the Role of Krüppel-like Factor Four (KLF4) in Oxidative Stress and Lipid Metabolism
Funding Source: Michael J. Wolk '60 Heart Foundation
Project Summary:

Krüppel-like Factor Four (KLF4) is a master transcription factor involved in the regulation of multiple cellular processes such as differentiation, cell cycle and growth, and metabolism. In cancer, it acts in a context dependent manner to either promote or suppress cancerous growth. As a tumor suppressor, KLF4 has been found to regulate metabolic pathways to prevent tumorigenesis such as promoting energy efficiency in glucose metabolism. Cancer cells upregulate metabolic pathways which also produce harmful byproducts of reactive oxygen species (ROS) to support tumorigenesis. Under oxidative stress because of an imbalance between ROS and protective antioxidants that reduce these harmful byproducts, severe levels of ROS can increase the metabolic rate or even damage the mitochondrial membrane and eventually DNA to induce mutations that would further support tumorigenesis. Therefore by inducing oxidative stress and inhibiting glucose metabolism, this study aims to understand KLF4's role in regulating antioxidant activity and lipid metabolism protein expression as a way to prevent cancerous growth and preserve genomic stability.

In order to understand the role of KLF4 in oxidative stress and lipid metabolism, experiments were performed with two cell lines expressing KLF4, WT MEFs (+/+) and lacking KLF4, KO MEFs (-/-). For Figure 1A, WT and KO MEFs treated with DMSO for basal conditions and antimycin to induce superoxide production, incubated with Mitosox Red to detect superoxide, and analyzed under flow cytometry for quantification. Under basal and antimycin conditions, WT MEFs exhibited lower superoxide levels than the KO (Fig. 1A). After establishing the correlation of KLF4 and lowered ROS levels, a western blot was performed to quantify the protein expression of KLF4 and NRF2 (Nuclear factor erythroid 2-related factor 2), a transcription factor that regulates antioxidant genes to reduce ROS (Fig. 1B). As an attempt to induce KLF4 expression, WT and KO MEFs were treated with Apto253. Protein expression of KLF4 correlated with NRF2 (Fig. 1C and 1D), indicating that KLF4 could possibly be downregulating ROS through an NRF2-antioxidant pathway. Hypothesizing that KLF4 could be downregulating lipid metabolism pathways to lower the overall production of ROS, western blotting was performed for fatty acid synthesis enzyme ACC (Acetyl CoA Carboxylase) and fatty acid oxidation transcription factor PPARa (Peroxisome Proliferator Activated Receptor alpha). In Figure 2A, WT and KO KLF4 MEFs were glucose starved to shift to lipid metabolism. At 100% and 0% glucose, KO MEFs exhibit slightly higher protein expression of ACC than the WT. In Figure 3B, WT and KO MEFs were treated with DMSO or antimycin. At antimycin treated conditions, KO MEFs exhibited much higher expression of PPARa, indicating that KLF4 could be downregulating lipid metabolism genes in response to oxidative stress. This preliminary data suggests that KLF4 is involved in the downregulation of ROS and lipid metabolism, supporting our previous hypothesis of klf4 as a tumor suppressor gene.

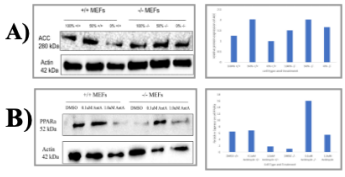


Figure 2. *KLF4 WT MEFs exhibit lower expression of lipid metabolism*

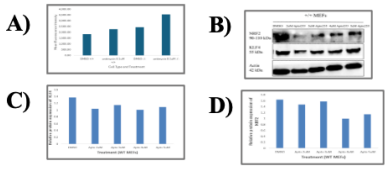


Figure 1: KLF4 *WT KLF4 MEFs exhibit lower superoxide levels than KO and KLF4*

Research Fellow: **Gavin Coull (2028)** **Concentration:** **Biochemistry**

Faculty Mentor: **Jacob Goldberg** **Department:** **Chemistry**

Title of Project: **Enzyme-Activatable Fluorogenic Zinc Sensors**

Funding Source: **Organic Syntheses PUI Summer Research Grant; Division of Natural Sciences and Mathematics**

Project Summary:

Zinc(II) ions play various roles in human health; disruptions in zinc homeostasis have been implicated in many diseases. Because zinc(II) is spectroscopically silent, it cannot be detected by conventional methods. 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. Controlling the localization and activity of these sensors, however, still remains a challenge. Many strategies have been developed to direct zinc(II) sensors to almost every organelle within a cell, enabling opportunities for new discoveries in zinc biology.

The goal of our research was to develop and analyze new methods for visualizing zinc(II) ions in complex biological systems using fluorescence microscopy. By conjugating well-characterized small-molecule sensors, such as Zinpyr-1 (ZP1), with protecting groups, selective activation can be achieved. Our laboratory sought to protect the zinc(II) binding sites of ZP1 with small molecules that are removable by specific enzymes. We used organic synthesis and characterization techniques to develop such zinc sensors. Additionally, we conducted in vivo fluorescent microscopy experiments with cultured HEK293T cells.

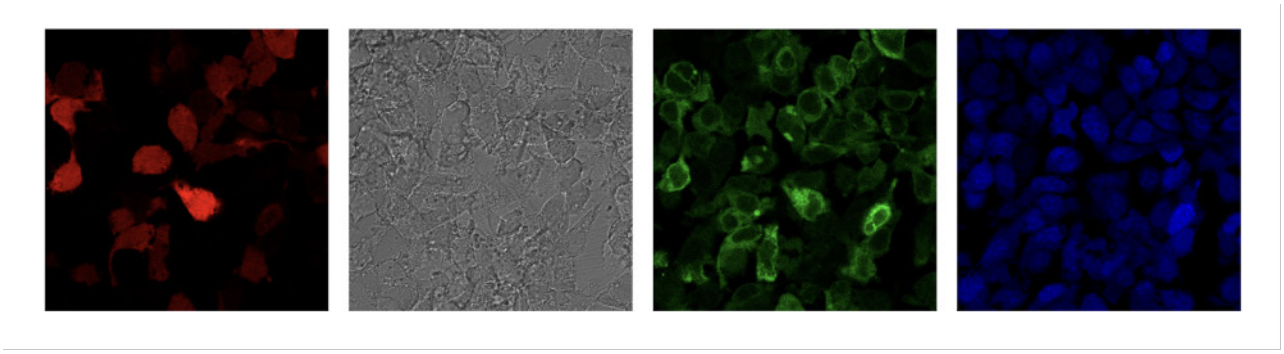


Figure 1. Fluorescence microscopy images. Protected ZP1 cannot bind zinc until it enters the cells, where it is cleaved by an esterase enzyme, which is why there is localized fluorescence rather than a wash.

Research Fellow: **Kanish Creary (2029)** **Concentration: Undeclared**

Faculty Mentor: **Rebecca Metzler** **Department: Physics and Astronomy**

Title of Project: **Effects of Ocean Hypoxia and Acidification on the Microstructure and Crystal Orientation of Discoporella depressa in the Gulf of Mexico**

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

Project Summary:

Ocean hypoxia, commonly known as a "dead zone," occurs when there is not enough oxygen in the water to support many marine organisms. One major cause of ocean hypoxia is agricultural runoff, which introduces excess nutrients such as nitrogen and phosphorus into surrounding waters. These nutrients can cause algae blooms, and as the algae decompose, bacteria consume oxygen in the water. This process can create areas with very low oxygen levels, especially along coastlines. In addition, aerobic bacteria respire carbon dioxide which, when combined with water, reduces pH leading to more acidic conditions. The Gulf of Mexico is particularly affected by these processes, making it an interesting region to study how hypoxia and acidification affect marine organisms.

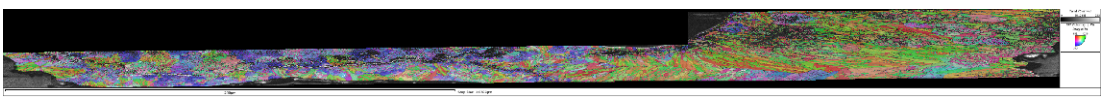
This summer, Professor Metzler and I broadened our understanding of the effects of ocean hypoxia and acidification on the bryozoan Discoporella depressa by examining its microstructure and crystal orientation. Discoporella depressa is a filter-feeding bryozoan typically found throughout the Gulf of Mexico and western Atlantic regions. We focused on specimens from three regions: Louisiana, Alabama, and Florida. Louisiana provided an especially useful comparison because of its proximity to a prominent dead zone. By looking at samples from these different regions, we could compare and contrast the skeletal composition of D. depressa under different environmental conditions. Our hypothesis was that samples from areas with more prominent dead zones, such as Louisiana, would have greater variation in their crystal orientation, while samples from areas with less surface runoff, such as Florida, would have more organized crystal orientations.

I for our study, we focused on cross sections extending from the basal surface (underside) to the operculum (top side) of each D. depressa colony. To prepare our specimens, we fractured them, embedded them in one-inch resin molds, vacuum-impregnated them, and polished them using progressively finer grits followed by an alumina slurry. This allowed us to use electron backscatter diffraction (EBSD) to examine the crystal orientation and grain area (i.e., crystal size) in each cross section. We focused on Multiples of Uniform Density (MUD) scores, which measure the uniformity of crystal orientations.

Our results showed that D. depressa has surprisingly disordered crystal orientations, as indicated by its relatively low MUD scores. Our specimens had MUD scores ranging from 6.24 to 24.22, which is much lower than those of other organisms studied in our lab, which have had MUD scores of 80 and above. Our preliminary results also suggest that whether a sample was collected before or after the Industrial Revolution had little to no apparent effect on its crystal orientation.

Although these results did not support the differences we initially hypothesized, they revealed several interesting patterns that could broaden our understanding of bryozoans and potentially other marine life in the Gulf of Mexico. When comparing live specimens from each region, Florida samples showed greater crystal organization than samples from Alabama and Louisiana. We also found that live Louisiana specimens had larger crystal sizes than live specimens from Alabama and Florida.

When comparing live and dead specimens within each region, we generally saw an increase in crystal organization in Florida as we approached modern times. In Louisiana, we observed an increase in crystal size as we approached modern times. Together, these findings highlight the complexity of bryozoan skeletal structures and may help us better understand how these organisms have persisted for millions of years. Our ongoing work focuses on increasing the sample size of our dead specimens, which will give us a more complete baseline for future comparisons.



Cross section of our Louisiana Live X5 sample

Research Fellow: **Allan Crounse (2027)** **Concentrations:** **Neuroscience; Economics**

Faculty Mentor: **Rachel Amann-Burns** **Department:** **Upstate Institute**

Title of Project: **Developing Community Informed Efforts to Address Food Insecurity in Herkimer County**

Funding Source: **Upstate Institute**

Project Summary:

For my fellowship, I was partnered with Food Bank of Central New York, or FBCNY. My project sought to help "Mend the Meal Gap" in Herkimer County through a survey that would allow FBCNY to better understand people's perceptions, awareness, and experiences with food insecurity and the food assistance network. To do so, I worked with food bank staff to create a 14+ question survey, researched organizations and retailers in the county to partner with, and coordinated online efforts to share the survey with in-person site visits at six locations in the county.

[Methods:] We created a survey that would provide insights on individual and community food security as well as on community perspectives of the food assistance network. In the first section, on individual food security, we borrowed official food security screening questions and added questions about the potential causes of difficulty getting food. In the second section, on community food security, we asked about participants' zip codes, beliefs about the prevalence of food insecurity, and beliefs about the prevalence of food resources. In the third section, on food assistance, we asked about participants' knowledge, experience, and comfort levels accessing food assistance resources, as well as their belief about which sorts of food assistance were most helpful to their communities. In the fourth section, we asked about participants' interest in learning more or being contacted in the future, and provided an option to provide contact information.

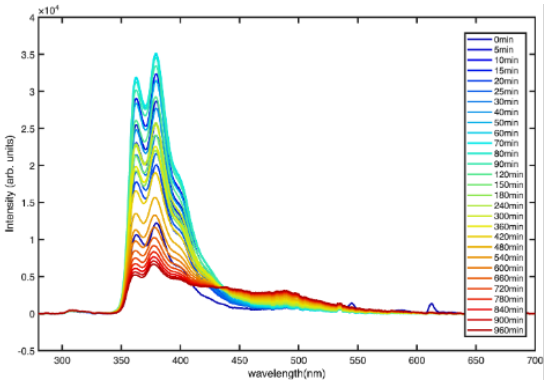
To share this survey with the residents of Herkimer County, we contacted each school major district in the county, libraries in nearly every town in the county, each of FBCNY's retail grocery partners in the county, and FBCNY's partner agencies in the county. Contacted organizations were asked to share details about the survey and a link to access it (with promotional templates and materials provided), or else asked to host a site visit by which representatives from FBCNY could administer the survey directly at their location. We conducted six such site visits throughout the county: at the Frankfort Free Library, at the Jordanville Public Library, at Kirby Free Library in Salisbury, at the Old Forge Public Library, at the West Winfield Library, and at the Price Chopper supermarket in Little Falls.

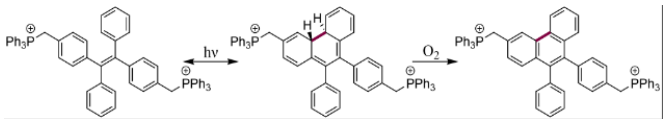
We collected 172 survey responses, originating from 17 of the 29 ZIP codes within Herkimer County, 3 on the county periphery, and 2 from further away. These responses provided important results in each of the three major survey sections. In the first section, only 53 out of 171 (31%) of participants reported complete food security across all three screening questions, implying that a majority of the population faced some level of food insecurity or marginal food security. In the second section, a majority of participants (97/171, or 57%) throughout the county reported that food insecurity was a major issue in their community, indicating that communities tend to be aware of local food insecurity as a significant challenge. In the third section, a majority of participants (116/171, or 68%) reported relative comfort in using food assistance resources, while 51 (30%) reported greater hesitance, indicating that discomfort accessing food assistance resources may be a barrier for a substantial minority of neighbors.
These results provide rough estimates on the extent of food insecurity, awareness thereof, and public opinion on food assistance programs in Herkimer County. As the goal of this project is improvement of community outcomes rather than knowledge generated for research purposes only, next steps are likely to include listening sessions and conversations to follow up on the present findings in further detail as well as the adjustment or creation of food assistance programs to better suit community needs in the short and long run.

Research Fellow: Cathy Dai (2029) **Concentration:** Undeclared
Faculty Mentor: Stephanie Sanders **Department:** Chemistry
Title of Project: Spectroscopic Investigation of the UV-Included Photocyclization of Bis(triphenylphosphonium) tetraphenylethylene
Funding Source: Justus '43 and Jayne Schlichting Student Research Fund
Project Summary:

While most fluorophores experience aggregation-caused quenching in condensed phases, molecules exhibiting aggregation-induced emission (AIE) display enhanced fluorescence when aggregated and have stronger emission in restricted environments. Tetraphenylethylene (TPE) is a prototypical AIE molecule that provides a platform for chemical modification. Bis(triphenylphosphonium) tetraphenylethylene (TPE-TPP), a TPE derivative, has been utilized in mitochondrial imaging and protein aggregation sensing. Because ultraviolet (UV) light is used to excite the molecules to monitor fluorescence, we investigated how UV irradiation changes the structure of TPE-TPP. Based on previous work in our research group and reported photochemical mechanisms of other TPE derivatives, we hypothesized that UV irradiation of TPE-TPP may first form an intermediate, and then undergo further change with oxygen to form new chemical bonds. We used UV–Vis spectroscopy, fluorescence spectroscopy, nuclear magnetic resonance (NMR) spectroscopy, time-correlated single-photon counting (TCSPC), and mass spectrometry to investigate this photochemical transformation.

To monitor their photophysical behavior over time, we irradiated TPE-TPP solutions with a 310 nm UV LED and measured fluorescence and NMR spectra. During irradiation, the fluorescence intensity initially increased and then decreased, while the emission bands shifted toward shorter wavelengths. Both the UV–Vis absorption and fluorescence emission spectra differed substantially before and after UV irradiation, providing evidence that UV light altered the molecular structure of TPE-TPP. In addition, the fluorescence emission spectra of the samples after UV irradiation differed under oxygen-containing and oxygen-free conditions, indicating that oxygen influences the photochemical evolution of TPE-TPP. TCSPC measurements showed that the fluorescence lifetime decreased after UV irradiation, suggesting changes in the excited-state relaxation behavior of TPE-TPP. In the 31P NMR, four new peaks appeared after 2 hours of irradiation and subsequently evolved into a single, downfield peak after overnight irradiation when oxygen was present. The identities of these intermediate peaks have not yet been determined and will be investigated in future work. In addition, the 31P NMR spectrum of the sample irradiated overnight under oxygen-free conditions was similar to those of the sample irradiated for 2 hours in the presence of oxygen. This result suggests that oxygen is required for the formation of the final photoproduct.





Research Fellows: **Duncan Earl (2028)** **Concentration: Astronomy/Physics**
Lila Valaskovic (2027) **Concentration: Astronomy/Physics**
Faculty Mentor: **Jeff Bary** **Department: Physics and Astronomy**
Title of Project: **Modeling Stellar Photospheres to Improve Mass Accretion Rate Measurements**
Funding Source: **Division of Natural Sciences and Mathematics; Justus '43 and Jayne Schlichting Student Research Fund**

Project Summary:

Young, low-mass pre-main-sequence stars are often characterized by active accretion of material from the inner edge of their circumstellar disks. As gas from the disk falls onto the stellar surface, accretion shocks are formed, heating the gas. The shock heated gas produces emission features, with the strongest being Pa β, Br *y*, and He I. The connection between accretion activity and these emission features have led to their use as tracers of the mass accretion rates in these systems. One of the challenges to using these tracers rests on an accurate characterization of the star's photospheric emission. In this accretion study, we applied synthetic models of spotted stellar photospheres to the near-infrared spectra of three young stars: LkCa 15, DQ Tau, and GK Tau to account for the effects of cool starspots. This modeling approach was implemented to spectra obtained across multiple epochs using data acquired from NASA's Infrared Telescope Facility (IRTF) and Apache Point Observatory (APO). We aim to extend this method to the remaining stars in our sample to strengthen the broader picture of accretion in young stellar samples.

Research Fellow: **Victoria Eastment (2028)** **Concentrations: Chemistry; Environmental Geography**

Faculty Mentor: **Emily Ury** **Department: Environmental Studies**

Title of Project: **A Baseline Study into Methane Emissions Along the Chenango Canal in Madison County, NY**

Funding Source: **Division of University Studies**

Project Summary:

Methane is a potent greenhouse gas with many natural sources including inland water bodies like ponds and wetlands. The Chenango Canal is a historically significant waterbody in Madison County that once linked Hamilton to Binghamton and the Erie Canal. As the canal has fallen out of use it has started to become more "wetland like" raising the question - is the Canal a significant source of methane and if so, could restoring hydrologic flows to the Canal play a role in emissions reduction? Our aim was to determine baseline methane emissions and to observe the role moving water has in controlling these emissions.

We monitored methane emissions weekly at multiple sites along the canal using floating chambers connected to a LI-COR 7810 Greenhouse Gas Analyzer (Figure 1). We also measured depth, flow, water temperature, water quality (phosphorus), dissolved oxygen, conductivity, and pH at each sample site. Preliminary analysis showed that methane emissions tended to decrease as flow increased, however for some sites and sampling dates this trend did not hold (Figure 2). Further investigation into environmental predictors, including sediment carbon content, may help explain these findings. In the future, efforts to improve recreational access to the canal by clearing sediment buildup, removing fallen trees, and restoring hydrologic flow could simultaneously help reduce methane emissions - an environmental win-win!



Figure 1. Measuring methane from a portion of the canal that is impounded behind the culvert under Route 46.

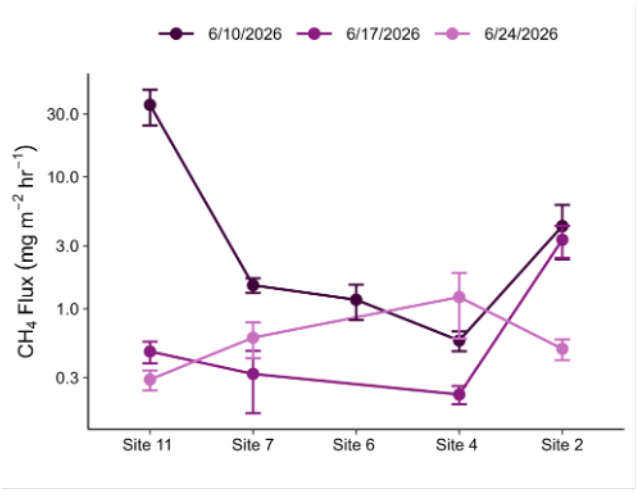


Figure 2. Methane from the most stagnant portion of the canal (Site 11) to the most free-flowing (Site 2).

Research Fellows: Vivian Eckert (2028) — **Concentration:** Biochemistry
Wes Sutton (2027) — **Concentration:** Chemistry
Faculty Mentor: Dimitar Shopov — **Department:** Chemistry

Title of Project: High-Valent Oxo-Bridged Iridium Cluster: Evidence for Unprecedented Ir(IV) Metal-Metal Bond

Funding Source: Division of Natural Sciences and Mathematics

Project Summary:

Catalysts speed up chemical reactions without being consumed, and finding better ones is central to clean energy development. Iridium-based catalysts that split water into hydrogen and oxygen are especially promising for generating clean hydrogen fuel. However, standard synthesis methods produce a complicated "blue solution" mixture of molecular structures, making it difficult to identify which species drive catalysis. Our project addressed this by designing custom dinuclear molecules with organic frameworks to isolate a single, well-defined structure. In pursuing this design, we discovered a new type of iridium-iridium bond with implications for how these catalysts function at the atomic level. Oxo-bridged clusters are common among early transition metals but rare and poorly understood for late transition metals like iridium, despite iridium oxo clusters being unusually robust and efficient for water-oxidation catalysis. We designed "dipyalk" ligands that retain the pyridine-alkoxide structure for the original catalyst while spacing two iridium clusters ~3.7 Å apart and resisting oxidative degradation. We explored two variants. The methylene-linked (me-dipylak) and novel biphenyl-linked version (bph-dipylam). Metalation used Ir(I) carbonyl precursors, favoring iridium-iridium proximity for oxo-bridged formation. CO ligands were removed via oxidation.

Periodate oxidation of the me-dipylak precursor produced a blue-solution mixture, from which we isolated a single distinct species (Figure 1). X-ray crystallography revealed an unusually short Ir-Ir distance of 2.54 Å in a novel "inverted diamond core" geometry (Figure 2), unmatched among ~50 structures with shorter Ir-Ir contacts.

The me-dipylak ligand degrades under the oxidizing conditions needed to access this species, with weak points at the methylene bridge and methyl groups. We are now developing more oxidation-resistant ligands (fluorinated and phenyl-linked variants, a rigid double-backbone design) and exploring a protected synthetic route. Future work will focus on scaling up synthesis, fully characterizing the isolated species, and evaluating its water-oxidation activity.

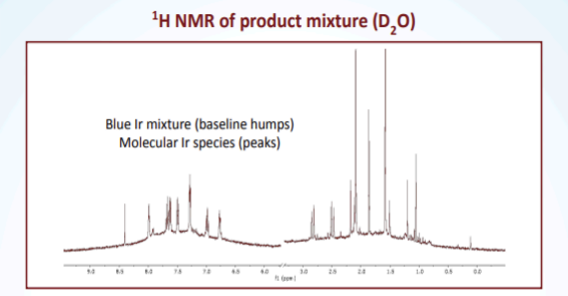


Figure 1. ^{1}H NMR spectrum of the crude oxidation product (D_2O), showing baseline humps from the "blue Ir mixture" and sharp peaks from the distinct molecular Ir species.

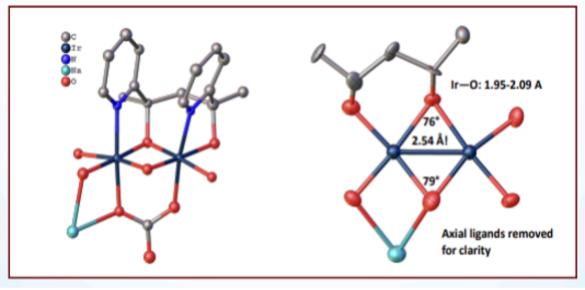


Figure 2. X-ray crystal structure of the isolated dimeric species (left, full structure; right, axial ligands removed for clarity), showing the unusually short 2.54 Å Ir-Ir distance within

Research Fellow: Tommy Fan (2027) **Concentrations: Environmental Geology; Studio Arts**
Faculty Mentor: William Peck **Department: Earth and Environmental Geosciences**
Title of Project: Geology of the Kilbourne graphite deposit, St. Lawrence County, New York
Funding Source: Doug Rankin '53 Endowment-Geology Research
Project Summary:

The Adirondack region, located in northeastern New York, is mostly composed of Proterozoic metamorphic and igneous rocks. The rocks in the Adirondack region have undergone several major geologic events, including mountain-building and the formation of metallic mineral deposits, making the area an important place for geological study.

The Jayville deposit is an iron-rich skarn deposit located in the northwestern Adirondacks. The Jayville mine was opened around 1850 for iron ore, operated for decades, and then abandoned in the late 1880s. According to previous studies, the Jayville deposit contains Vonsenite, a boron-bearing iron oxide ($Fe_3(BO_3)O_2$) which is difficult to distinguish from the primary iron ore magnetite (Fe_3O_4). The deposit also contains the iron oxide hematite (Fe_2O_4). The presence of three iron oxides and several iron silicate minerals in the deposit suggests a complex origin for this deposit, which is why it was selected for focussed study. Samples were collected from the abandoned ore dump at Jayville.. Samples were cut and polished into billets and thin sections using diamond saws and grinding wheels, then analyzed using the scanning electron microscope and microscopes. Representative pieces of the samples were powdered using the ball mill and analyzed using X-ray diffraction. Calcite was collected from several samples for oxygen and carbon isotope analysis.

The SEM results, further confirmed by XRD examination, confirmed the presence of vonsenite, which grows within magnetite bands that cut through amphiboles and pyroxenes. Pyroxenes found in samples show different chemical compositions by SEM analysis, suggesting different times and conditions of formation. The samples also show an abundance of fluorine (in micas and amphiboles) and sulfur (in scapolite), which provides information about the fluids responsible for mineralization. Future work will focus on quantifying temperature and fluid compositions during ore formation.

Research Fellow: **Fausto Flores Alvarez (2027)** **Concentrations:** **Africana and Latin American Studies; Educational Studies**

Faculty Mentor: **Mark Stern** **Department:** **Educational Studies**

Title of Project: **Who Gets to Be Human?: Liberal Immigration Rhetoric and the Production of Conditional Humanity**

Funding Source: **Division of Social Sciences**

Project Summary:

In 2010, immigrant rights activists launched the "Drop the I-Word" campaign to challenge the use of the term "illegal" in media outlets and encouraged journalists to adopt more humane terminology for immigrants. The campaign contributed to a broader shift towards employing more positive terms such as "undocumented." However, contemporary liberal media continues to define immigrants with restrictive labels such as worker, parent, and asylum seeker.

Drawing on theoretical and methodological frameworks grounded in Feminist Disability Studies, this project analyzes how pro-immigrant rhetoric reproduces what scholars refer to as selective inclusion: the admission of certain groups of individuals with desired traits while excluding others. By constructing immigrants according to normative ideas of productivity, intelligence, ability, and deservingness, I suggest that the labels materialize and condition personhood.

The project makes a claim that replacing language that explicitly criminalizes individuals, such as "illegal immigrant," with positive representation does not eliminate the underlying practice of categorizing immigrants negatively. Instead, liberal immigration rhetoric creates a hierarchy in which individuals become worthy of inclusion only when they demonstrate economic productivity, civic contribution, or other socially valued abilities. Although these narratives might be thought of as "counternarratives" to the dehumanizing and harmful rhetoric constantly being weaponized, by examining labeling as a rhetorical and disabling practice, this paper extends existing scholarship on immigration rhetoric beyond the binary anti- and pro-immigrant rhetoric by arguing that labeling itself can reproduce a form of conditional humanity in which immigrants are recognized not as people but through their perceived usefulness and capacity to contribute to an imagined national future.

Ultimately, the paper calls for a more complex understanding of immigration rhetoric that interrogates not only the dehumanizing language, but also the seemingly inclusive narratives that determine who is considered valuable, capable, and deserving of belonging.

Research Fellow: Nicolette Fox (2027) **Concentration:** French
Faculty Mentor: Katherine Brown **Department:** Romance Languages and Literatures
Title of Project: Portraits of Anxiety: a Medical Humanities Analysis of 19th-Century Literature
Funding Source: J. Curtiss Taylor ’54 Endowed Student Research Fund
Project Summary:

Mental health disorders like generalized anxiety disorder can profoundly affect daily life but elements of these conditions continue to elude researchers and physicians and prevent them from creating a comprehensive understanding. In light of this gap, literary portraits can offer understanding of anxiety from an artistic, emotional viewpoint that is often excluded from initial primary care visits and scientific understandings of the disorder as a whole. This project aims to explore how French authors of the 19th century depicted anxiety, employing examples from texts written by Honoré de Balzac, Théophile Gautier, and Guy de Maupassant. These examples are compared to the innovative neurological and psychological research emerging during the same time period and analyzed in conjunction with our modern scientific comprehension of anxiety, in hopes of demonstrating literature’s essential role in medical spaces and conversations. While mental health research has made drastic improvements since the 19th century, the care itself still presents its shortcomings today; narrative medicine, and the discipline of medical humanities as a direct result of the presence of literature in medical spaces in general, can provide a solution to these faults. Narrative medicine is centered around the personal testimonies of patients, which are only possible in clinician-patient relationships built on respectful, active listening. This model of practicing medicine also incorporates close, analytical reading of written testimonies to pick up on small details or important clues that could further inform the doctor about the patient’s condition. Like real patients entering a clinic, fictional characters are not defined by one aspect of their life, one personality trait, or one particular experience. How their condition manifests itself is a result of their life story with defining moments that may contribute more than others; these details, for understanding the whole story of a patient’s condition and for understanding a character, are an essential aspect of practicing narrative medicine and analyzing literature.

Throughout the project, literary representations of anxiety were sorted into three categories: observed, linguistic expression versus self-expression and psychosomatic representations, whether feelings of pressure or eye-related symptoms. After reflecting on these 19th-century portraits of anxiety, literary and scientific conversations surrounding anxiety are not incompatible but have shown to overlap on several occasions. As our culture’s conversations surrounding mental health prioritize research and clinical definitions, the human experiences, such as those in the previously discussed literature, become anecdotal. Rather than using these literary portraits as equal support in mental health care, the anecdotal status that these types of descriptions have given shows our society’s loss for the prioritization of the individual and the personal. Not only is this detrimental to the initial care that a patient receives, especially if they are both undiagnosed and apprehensive about or inexperienced with mental health care, but this anecdotal nature of personal experiences limits the care within a broader community level. This grave problem within the medical industry opens the opportunity to discuss psychotherapy, as it offers important insight to treatment on a broader scale; this form of care, as the primary or additional aspect of care, demonstrates the importance of attentive conversation as part of a patient’s care plan. Literary representations of anxiety add nuance to these conversations of mental health care; it also, or more importantly, brings humanity and empathy to care. Engaging with literature can only benefit the way physicians care for their patients and strengthen clinician-patient relationships, improving the sphere of interpersonal care, one literary account at a time.

Research Fellow: **Miriam Garnaas (2028)** **Concentration:** **Environmental Biology**

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

Title of Project: **Invasive Species Removal and Native Species Restoration within the Essex Quarry Nature Preserve**

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. Their mission is to save local land, create and maintain trails, promote local economic vitality, and connect people to nature. As a Field School Fellow, I was tasked with becoming familiar with the Essex Quarry Nature Preserve (EQNP) ecosystem and its most loyal group of volunteers, its particular chapter of the Adirondack Garden Club (AGC). Through this experience, I indexed many of the plant species found in the EQNP, removed the invasive plant species that have taken over much of the quarry (specifically buckthorn), and replanted native species in the invasive's space.

To remove Rhamnus cathartica, commonly known as common buckthorn, one must cut it to six inches from its base, then place a Buckthorn Baggie over the stump. A Buckthorn baggie is a small black plastic bag that blocks all sunlight from reaching the buckthorn, and therefore stops it from growing. The AGC has taken ripe seeds from native plants in the Quarry and germinated them ex situ for the past three years. After germination, they replant the species in areas of the Quarry where buckthorn has been eradicated. I documented this process in the form of a brochure. This brochure made the volunteers' work accessible to the public, so others could understand how important and intentional their work truly is.

Research Fellow: **Gunnar Gasper (2028)** **Concentration: Astronomy/Physics**

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

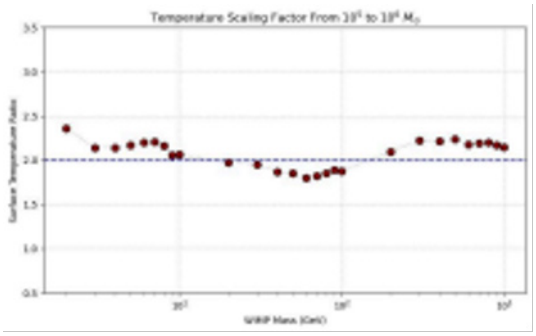
Title of Project: **Probing the nature of Dark Matter with the first stars and galaxies in the Universe**

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

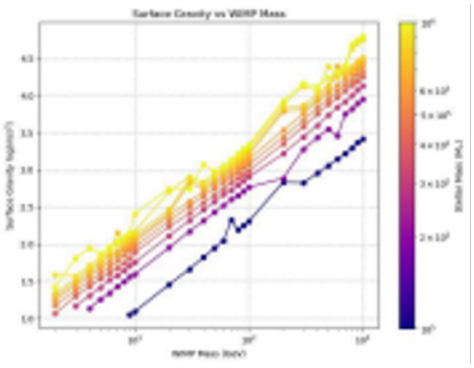
Project Summary:

The James Webb Space Telescope (JWST) has discovered several bright objects in the early universe, difficult to explain with current models of galaxy formation. One explanation is Supermassive Dark Stars (SMDSs), stars which are powered by annihilating dark matter. We take the DM particle to be WIMPs, weakly interacting massive particles, which could theoretically annihilate when interacting with themselves. The dark star forms around a halo of WIMPS, increasing the gravitational well and building up enough mass to support the star. This type of star would be very large and luminous, enough to be seen today at very high redshifts.

Previous research had taken the WIMP mass to be 100 GeV. For this project, we worked on expanding the breadth of our simulations to WIMP masses from 1 to 1000 GeV. We did this through the use of MESA, a suite of programs that simulate the growth of a star. We begin with a small starting mass, and continue to accrete more material and watch as the star grows up to 5 million solar masses. We can then examine the data and extract the properties of the dark star at certain masses, such as effective surface temperature and surface gravity, which we can then use to simulate the star's spectra.



We simulated the spectral energy distributions of SMDSs formed through both Adiabatic Contraction over a range of stellar masses and WIMP dark matter masses. The stellar atmosphere code TLUSTY was used to produce the spectra, which were then passed into the photoionization code CLOUDY to model the effects of surrounding ionized nebulae. We found that changing the mass of the WIMP causes the same stellar mass dark star to increase in effective surface temperature and surface gravity. We also found that when going from a 1e5 to 1e6 solar mass Dark Star, the surface temperature roughly doubles, regardless of WIMP mass. When surrounded by a nebula, the emission spectrum becomes more intense than the incident at earlier, shorter wavelengths as WIMP mass increases.



Further use of MESA will allow us to refine our Dark Star templates for the search for candidates, such as training neural networks on the synthetic data. We also can use the atmospheric data directly from MESA to simulate an even more accurate spectrum through more advanced programs like CMFGEN.

Research Fellows: Mark Giacona (2028)
Evan Zimmerman (2027)
Faculty Mentor: Lori McCabe

Concentration: Physics
Concentrations: Physics; Classical Studies
Department: Physics and Astronomy

Title of Project: Dispersion Relations of Dust Acoustic Waves in High-RF Plasmas

Funding Source: Division of Natural Sciences and Mathematics; Justus '43 and Jayne Schlichting Student Research Fund

Project Summary:

Regarded as the fourth state of matter, plasmas are formed when intense heat or electric currents strip electrons from their atoms, leaving a mix of free electrons and ions. Plasmas are created in labs using vacuum chambers, various inert gases such as argon, and high-voltage power supplies. They are commonly made using radio frequency (RF) power, a high-frequency form of alternating current that is effective at ionizing gases. In plasmas generated using high-RF power, a phenomenon is observed when micron-sized silica particles, called dust, are added to the plasma system. A dust cloud forms within the plasma, and when cross-sectional slices of this cloud are observed using lasers, visible waves are detected (shown in Figure 1). These waveforms are known as dust acoustic waves (DAWs), and their properties change when a magnetic field is applied to the plasma. Calculating the wave velocity under different magnetic fields at various angles provides information about how the magnetic field and gravity influence the plasma.

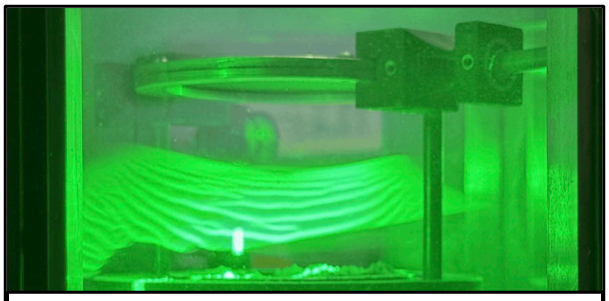


Figure 1
Photo of dust acoustic waves taken at Auburn University

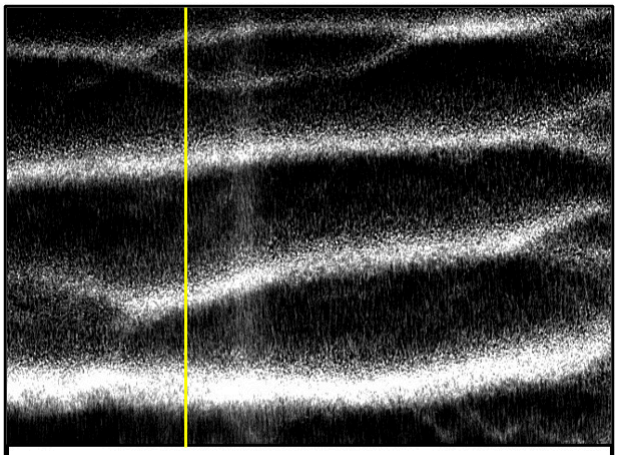


Figure 2
Image of waves used for data analysis

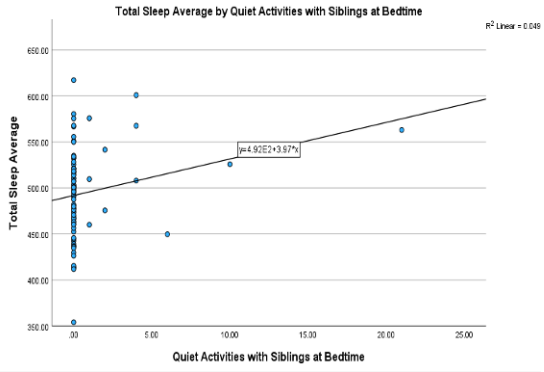
A wave's velocity can be calculated through a relationship known as a dispersion relation. Using video data gathered from a high-speed camera (as shown in Figure 2), a space-time diagram, called a kymograph, is created by taking slices along the y-axis for every x-pixel of the dataset (shown in yellow in Figure 2). From this graph, the wave's angular frequency and wavenumber can be found, and the speed of the wave can be calculated from the relationship between the two quantities.

DAWs have been studied for around forty years; however, it was only more recently that they have been studied under the effects of magnetic fields and decoupled from gravity by applying these fields at different angles. Determining a relationship between DAWs and magnetic fields in low-temperature systems could be used to overcome current challenges faced during high-temperature experiments in nuclear fusion research and astrophysical plasmas.

Research Fellows: **Amy Glasman (2027)** **Concentration: Psychological Science**
Kaliyah Honore (2027) **Concentration: Psychological Science**
Leo Li (2028) **Concentration: Molecular Biology**
Faculty Mentor: **Lauren Philbrook** **Department: Psychological and Brain Sciences**
Title of Project: **Bedtime Family Environment and Child Temperament are Associated with Child Developmental Outcomes**
Funding Source: **Division of Natural Sciences and Mathematics; Mind, Brain, and Behavior Scholars Award**

Project Summary:

This study aims to investigate how neighborhood characteristics and familial influences impact sleep quality and outcomes, as well as executive functioning in children aged 3-5 years old. The intention of this study is to provide research to parents regarding how to establish routines and interactions that are conducive to better sleep outcomes and strongly associated with better executive functioning.
In this study, neighborhood characteristics and family factors were gathered through self-report surveys completed by participants' parents. Additionally, families provided one night of bedtime routine on camera so we could evaluate family factors further. We specifically evaluated family factors through coding specific practices/interactions that may have a soothing/arousing impact on the children and quantifying through marking how many times an action occurred or on a scale of 1-4. We used the number scale to measure parental sensitivity, looking at each parent separately. They were scored on acceptance, sensitivity, consideration, quality of physical contact, and quality of vocal contact.
Sleep quality is measured with a movement-sensing watch (Actiwatch) and defined by four variables: Minutes (time asleep), Latency (time to fall asleep), Efficiency (ratio of sleep to time in bed), and Wake After Sleep Onset (WASO, total time awake after sleep onset). After being documented, all collected data are analyzed and tested for correlations in SPSS.



The research conducted this summer revealed several significant correlations; for instance, one between quiet activities with siblings at bedtime and the average total sleep (shown below). Due to a temporarily small sample size to date (n=98) and the limited representation of siblings in the sample, the correlation, though significant, warrants further investigation. However, it suggests that bedtime activities among siblings, low-stimulation, and sleep-conducive conditions were associated with higher average total sleep, indicating circumstances in which sibling interactions may be beneficial for child developmental outcomes.

Moreover, findings suggested that increased parent sensitivity was correlated with increased executive functioning development. Parent involvement can help children develop effective regulation skills, which are a foundation of executive functioning. The results identify characteristics of family environment at bedtime, as well as child temperament, that are predictive of better sleep outcomes, which will be beneficial for developing bedtime routines that promote adequate sleep and executive functioning in children.

Results also demonstrate that supportive bedtime routines may promote healthy sleep habits, which contribute to improved cognitive development.

Research Fellow: **Frank Gu (2027)** **Concentrations:** **Physics; History**

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

Title of Project: **Laboratory Astrophysics of Gravitational Lensing**

Funding Source: **National Science Foundation Grant**

Project Summary:

Massive objects bend light: a galaxy or black hole lying between us and a distant source acts as a lens, sometimes smearing that source into a luminous Einstein ring. This astronomy is usually described as rays that simply bend. But light is a wave, and so are the gravitational waves LIGO detects from merging black holes — and long-wavelength waves do not merely bend, they diffract and interfere, producing structure ray optics cannot predict. Binary black holes are common sources, yet a gravitational-wave detector records only a single "pixel" of the resulting pattern. We built a tabletop optical stand-in for a binary gravitational lens that photographs the whole pattern at once. A collimated 632.8 nm HeNe beam illuminates the SLM and the diffracted field is recorded 530 mm downstream.

By using a SLM and a collimated 632.8 nm HeNe laser source, this summer I extended the measurement from intensity to the complex field. In a phase-shifting interference scan, a reference beam's phase is stepped through a full cycle while dozens of full-resolution frames are captured, and software reconstructs the phase of the lensed field at every pixel,. Measured intensity cuts match the wave-optical prediction with no adjustable parameters across 14 wavelengths from 403 to 684 nm, validating an analogue whose scales differ from the astrophysical ones by many orders of magnitude. I also tested the geometric-optics limit by driving the SLM only inside small disks around the stationary points of T, where about half the aperture still reproduces the caustic's backbone. Ongoing work extends the analogue to polarization, using two cascaded SLMs as a programmable rotator to emulate the gravitational Wigner rotation of a photon's polarization plane.

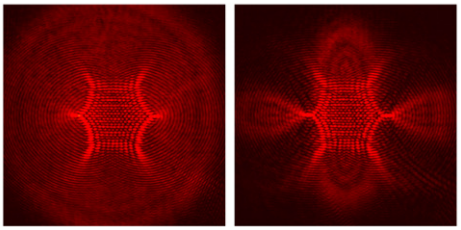


Figure 1. Far-field caustic |F(y)|^2 from the binary-lens hologram at scaled separation d̃=1.09. Left: the full lens. Right: the same pattern with the SLM active only in five small disks around the stationary points of the time-delay function (~51% of the aperture) — the geometric-optics limit made literal in hardware.

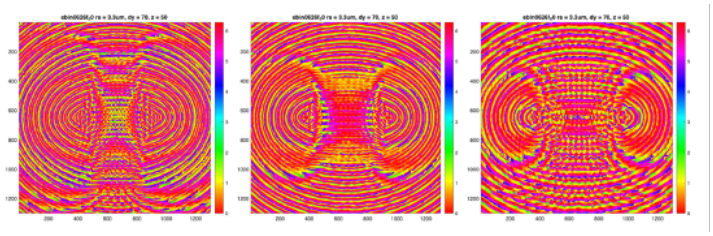


Figure 2. Measured phase of the lensed field, wrapped to [0, 2π] and reconstructed by phase-shifting interferometry, for binary separations d̃= 0.8, 1.1, and 1.6.

Research Fellows: **Maya Guha (2028)** **Concentration: Biology**

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

Kendall Newsome (2028) **Concentration: Biology**

Faculty Mentor: **Therese Frauendorf** **Department: Biology**

Title of Project: **Sticks and Stones and Poop and Bones: Shifts in Invertebrate Diets with Wildlife Input**

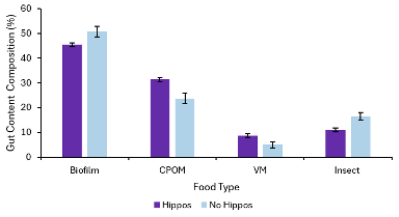
Funding Source: **Division of Natural Sciences and Mathematics**

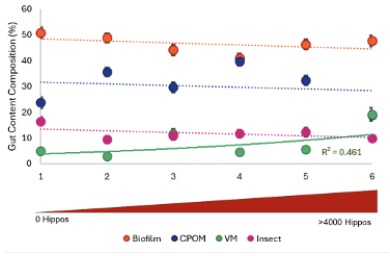
Project Summary:

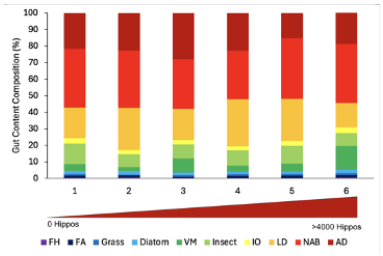
Many freshwater ecosystems depend on food sources that come from outside the river (allochthonous), typically leaves and wood detritus. In the Mara River in Kenya, most of the allochthonous input comes from wildlife such as hippo dung and wildebeest carcasses. Hippos migrate to and from the river daily, grazing terrestrially at night, and cooling off and defecating into the river during the day. Hippos defecate up to 13,200 tons of biomass annually into the Mara River (Subalusky et al. 2015). Hippo dung plays a significant role for invertebrate communities in the river, serving as a food source and habitat. As hippos increase along the Mara River, aquatic invertebrate production increases tenfold (Frauendorf in Prep.). Annual wildebeest crossings during wet season can cause mass drownings, contributing an additional 1,100 tons of biomass at crossing sites along the river (Subalusky et al. 2017). The bones of drowned wildebeest can accumulate biofilm over time, which can provide an additional food source alongside the rest of the carcass. The objective of our research was to understand the importance of hippo dung and wildebeest carcasses on invertebrate diet along the hippo gradient in the Mara River.

In our experiment, invertebrates from 8 taxa were collected at 6 sites along the Mara River hippo gradient across 3 seasons: dry (Jan-Feb, July-Oct), wet (Mar-Jun, Oct-Dec), and wildebeest wet (Sep-Nov). Gut contents were extracted from invertebrates (469 individuals), placed on filters, and photographed at 400x magnification. This summer, we looked at gut content photos on ImageJ, sorted them into 10 subcategories, which were grouped into 4 supercategories: biofilm: non-algal biofilm (NAB), filamentous algae (FA), fungal hyphae (FH), diatoms; coarse particulate organic matter (CPOM): leaf detritus (LD), grass; vertebrate material (VM); insect.

We found that the amount of hippo dung (CPOM) consumed in invertebrate diets did not significantly change with increasing dung present along the Mara River. While the magnitude of hippo dung had little effect on invertebrate diet, the presence of hippos significantly increased the amount of CPOM consumed by ~10%. We also found a significant increase in vertebrate material (VM) along the gradient, likely from wildebeest carcasses during mass drowning events. VM is a nutritionally rich food compared to hippo dung (low C:N:P ratio; Frauendorf et al. 2026). Our data suggest that the increase in invertebrate production along the hippo gradient may not be due to increases in hippo dung but due to the seasonal input from wildebeest carcasses . Also, these carcasses can have a prolonged impact on food webs following mass drowning events (Subalusky et al. 2017). They not only provide soft tissue for invertebrates to consume, but their bones remain in the water for much longer, which acts as a fertilizer allowing biofilm to accumulate. According to our findings, biofilm is the most important food source for Mara invertebrates. Wildebeest may drive changes in invertebrate production along the gradient, while the presence of hippos increases the amount of CPOM that invertebrates consume. Therefore, we concluded that both hippo dung and wildebeest carcasses play important roles in shaping the Mara River food web.







Research Fellow: **Isabel Hahl (2027)** **Concentration:** **Natural Sciences**
Faculty Mentor: **Emily Ury** **Department:** **Environmental Studies**
Title of Project: **A Baseline Study of Phosphorus Levels in the Chenango Canal**
Funding Source: **Division of University Studies**
Project Summary:

The Chenango Canal is a man made water body that passes through Hamilton NY, and eventually reaches the Hudson River through Oriskany Creek and the Mohawk River. A 7 mile portion of the canal near Hamilton is maintained as a walking trail by the Chenango Canal Association. Since the decommissioning of the canal, the waterbody has filled in with sediment, plant life, and fallen trees, all of which created "wet-land" like conditions in some areas. The Canal Association is interested in managing the waterway for recreational purposes but there is no preliminary data concerning the water quality of the canal and no water monitoring plan, both of which will be important for monitoring future restoration efforts.
It is likely that the canal contains high levels of phosphorus in its current state, as its position near agricultural and residential areas make it susceptible to fertilizer, manure, and septic runoff. In excess, phosphorus degrades water quality, causing algal blooms and harming aquatic life. Our aim was to create a baseline dataset of phosphorus concentrations in the canal and establish a long-term monitoring plan for the association.

We established 12 sites that holistically encapsulate the canal's varied conditions (Fig. 1) and conducted weekly water quality monitoring. Phosphorus was assessed using the molybdenum blue method and UV-Vis Spectroscopy to determine the concentration of orthophosphate (a biologically available form of phosphate) based on absorbance values relative to a standard curve. Phosphate concentration in the canal tended to be undetectable or below the typical water quality threshold for lakes and streams (0.04 mg/L), indicating that the phosphorus levels of the canal are not currently a cause for concern. The only site that regularly deviated from this trend was site 12, which demonstrated phosphorus levels at or above the water quality threshold for nearly every week of the summer. Site 12 was our furthest upstream site and was consistently covered in duck weed (Fig. 2). The efforts of the Ury lab this summer will be essential in informing and guiding future canal monitoring efforts.



Figure 1: Map of synoptic sampling sites of the Chenango Canal.

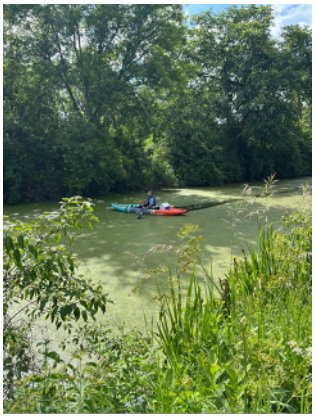


Figure 2: Sampling efforts at site 12.

Research Fellow: Halle Hatten (2027) **Concentration:** Astronomy/Physics

Faculty Mentor: Sam Usman **Department:** Physics and Astronomy

Title of Project: Chemical Abundance Analysis of the Ophiuchus Stellar Stream

Funding Source: Division of Natural Sciences and Mathematics

Project Summary:

This summer, I conducted research through Colgate University under the advising of Professor Sam Usman, investigating the chemical abundances of stars in the Ophiuchus stellar stream. Stellar streams are remnants of disrupted star clusters, or dwarf galaxies, that preserve information about the formation and evolution of the Milky Way. As these systems are gradually torn apart by the Milky Way's gravitational forces, their stars disperse into long, narrow streams that retain a record of their historical environment. Because these stars formed together, they share chemical signatures that remain largely unchanged even after the cluster has been disrupted. The Ophiuchus stream is believed to have originated from a globular cluster, making it an interesting target for studying multiple stellar populations. In particular, variations in light-element abundances, such as sodium, can reveal whether chemically enriched second-generation stars were present within the original cluster before it was disrupted.

My summer research focused on deriving stellar atmospheric parameters and elemental abundances for members of the Ophiuchus stream using high-resolution spectra obtained with the Magellan (MIKE) spectrograph. I used a spectral analysis pipeline to determine effective temperatures, surface gravities, metallicities, microturbulent velocities, and abundances for light elements, as well as several neutron-capture elements. Preliminary results identify one star with enhanced sodium abundance relative to the rest of the sample, indicating that the Ophiuchus progenitor potentially hosted chemically enriched second-generation stars before its tidal disruption. These results contribute to our understanding of globular cluster evolution and the formation history of the Milky Way.

Research Fellow: Linh Ho (2028) **Concentrations: Psychological Science; Mathematical Economics**

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

Title of Project: Workplace Flexibility and Job Satisfaction: Evidence from Japan

Funding Source: Walter Broughton '63 Research Fund

Project Summary:

Does having more discretion at work lead to higher job satisfaction? My research centers on the relationship between workplace flexibility and job satisfaction. While flexibility has been widely studied in relation to workplace performance, less is known about its effect on employees' subjective well-being, and even less is known when accounting for unobserved innate attributes of individual workers. Using large and representative 10-year panel data from Japan, I examine whether greater flexibility leads to higher job satisfaction within the same worker and whether this relationship is non-linear.

After considerable data cleaning and variable construction, I conducted regression analysis. I used two-way fixed effects to control for individual time-invariant characteristics and time-varying factors such as life satisfaction (as opposed to work satisfaction), income, marital status, working hours, children, promotion and demotion, training opportunities, contract type, industry, position, and occupation. I also explored different ways of measuring job satisfaction and flexibility and conducted robustness checks to better understand the relationship.

My results show a positive and statistically significant relationship between workplace flexibility and job satisfaction. In the baseline linear probability model, a one-point increase in flexibility on a five-point scale is associated with about a 1 percentage-point increase in the probability of being highly satisfied. Taking a further step to examine the non-linear relationship by dividing flexibility into five levels, I find that the increase in job satisfaction becomes larger at higher levels of flexibility. In particular, moving from neutral toward feeling flexible is associated with a larger increase in job satisfaction than moving from feeling inflexible to neutral.

Through this research, I gained experience working with large panel datasets and developed a better understanding of labor economics and human resource practices. More importantly, working with different specifications allowed me to see how different empirical models can reveal different nuances while answering the same question. My findings suggest that greater workplace flexibility can improve job satisfaction, although the effect is relatively modest, and motivate further research into the mechanisms through which flexibility affects employees' well-being.

Research Fellows: Audrey Holland (2027) — **Concentration:** Biochemistry
Eva Khavin (2029) — **Concentration:** Undeclared
Faculty Mentor: Katie Smith — **Department:** Chemistry

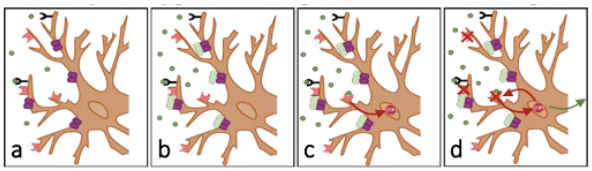
Title of Project: Structural Modifications to an Established 5-HT1A Agonist for Improved SSRI Therapeutic Effects Onset Time

Funding Source: Michael J. Wolk '60 Heart Foundation; Division of Natural Sciences and Mathematics

Project Summary:

Selective Serotonin Reuptake Inhibitors (SSRIs) are a type of medication commonly used to treat a variety of mental health conditions, like depression and anxiety. SSRIs bind to the Serotonin Reuptake Transporter Protein (SERT), inhibiting the reuptake of serotonin into cells, which increases the concentration of serotonin between neurons and improves mood. There is a delay in improvement from SSRIs associated with 5-HT1A autoreceptors, which regulate serotonin levels via a negative feedback loop. Increased serotonin in the synapse from SSRIs activates these receptors and signals a decrease in serotonin release, inhibiting the work of the SSRIs. It takes approximately 4-6 weeks for the autoreceptor to be desensitized, which then allows cerebral serotonin concentration to increase enough for patient improvement. This lag period can be agonizing and potentially dangerous for those struggling with severe mental health conditions.

This project aims to develop an SSRI co-drug that would bind to 5-HT1A as an agonist to desensitize it, shortening this lag period and improving efficacy of SSRIs.



Serotonin (green circles), SSRI (green oval), SERT (purple), and 5-HT_{1A} receptors (pink).

Figure: Illustration of the SSRI and 5-HT_{1A} autoreceptor response in the somatodendritic region of serotonergic cells in the raphe nucleus

Buspirone, an existing 5-HT1A agonist, is an FDA-approved medication currently on the market to treat generalized anxiety disorder. It binds to the 5-HT1A receptor, but has a low binding affinity and therefore requires a higher dose to be effective. BMY-7378, another known 5-HT1A agonist, has a high binding affinity but low selectivity, leading to side effects. Our goal is to develop a molecule with both high affinity and high selectivity, leading to a lower-dose medication than Buspirone with fewer side effects than BMY-7378.

This summer, we experimented with different computational modeling software to try and figure out the most efficient and accurate pathway to drug design. The set of programs (in order of use) we landed on is ChemDraw, Avogadro, ChimeraX, CB-Dock3, and Maestro. From there, we built a library of potential ligands that could outperform BMY 7378 and Buspirone, with higher binding affinity and specificity. We also created a detailed workflow manual for future students so onboarding to computational work is smooth and accessible moving forward.

Further work on this project includes testing more modifications, mix-and-matching the promising ones, and evaluating their Vina scores and binding residues. We will then test promising molecules on the 5-HT1A receptor to determine specificity and active-site retention using molecular dynamics simulations with our collaborator, Dr. Shrikant Nilewar. Next, we will synthesize ligands and test for cytotoxicity or other possible biological barriers such as solubility, pI, and blood-brain barrier (BBB) permeability. Finally, we will perform in vitro studies for binding affinity and selectivity, as well as activity.

Research Fellows: Nico Hotes (2028) **Concentration:** Computer Science/Mathematics
Bo Koebler (2027) **Concentrations:** English; Mathematics
Faculty Mentor: Rob Davis **Department:** Mathematics
Title of Project: Flow Polytopes, Route Cliques, and Layered DAGs
Funding Source: Division of Natural Sciences and Mathematics
Project Summary:

Many problems in mathematics ask a simple question with a difficult answer: how many objects are there? This project studies that question for a family of geometric objects called flow polytopes, which record all possible ways to send one unit of flow through a directed network, subject to some simple conditions. Although flow polytopes are geometric, many of their important features can be studied combinatorially: instead of measuring the polytope directly, we count structured paths, graphs, cliques, and matchings associated with it.

Our research focused on a particular family of layered Directed Acyclic Graphs, or DAGs, denoted $D_{2,n,2}$. The flow polytope associated with such a graph has a triangulation in which maximal simplices correspond to maximal cliques of mutually coherent routes. Thus, counting maximal route cliques gives the normalized volume of the flow polytope.

The project began computationally. We built code to construct these graphs, enumerate routes, test route coherence, and count maximal route cliques. This gave us full data for the first two nontrivial cases: $D_{2,2,2}$, with normalized volume 496, and $D_{2,3,2}$, with normalized volume 610,848. These computations confirmed the expected volume data, but the raw numbers did not yet explain why the examples behaved as they did.
We then explored whether the structure of these flow polytopes could be explained through a connection with order polytopes. This did not give a direct explanation for the route-clique data, but it helped redirect our attention to the local combinatorics of the routes themselves. The key question became: can the maximal cliques be organized into smaller, more meaningful structural families?

The first major pattern we found was a simple U/L structure at the middle vertices of $D_{2,2,2}$, since each maximal route clique determined one of two local support shapes, one we call U and the other L, at each middle vertex. We later refined this binary language into a more general D/R staircase-path language. At every inner vertex, the routes passing through that vertex occupy certain incoming and outgoing edge ranks, and these occupied grid cells form a monotone staircase path. Recording these local paths at all inner vertices gives an "all-inner path word."

This all-inner path-word structure turned out to be remarkably useful. For $D_{2,2,2}$, every possible word in S26 occurs, where Sr denotes the set of monotone staircase paths in an r × r grid. For $D_{2,3,2}$, every possible word in S34 × S23 occurs, reflecting the fact that four inner vertices have 3 × 3 local grids while three have 2 × 2 local grids. In other words, the path-word support is not missing any locally possible configurations in these cases. The local path sets also have a natural lattice structure: adjacent local paths differ by one swap DR↔RD, and path area gives the corresponding rank.

This led to a quotient-graph viewpoint. Instead of studying hundreds of thousands of maximal cliques individually, we group them by all-inner path words. For $D_{2,3,2}$, adjacent maximal simplices either preserve the all-inner path word or change exactly one local staircase path by one adjacent swap. This gives a visual and lattice-theoretic framework for organizing the triangulation.

Our current work focuses on the fiber-size problem: for a fixed path word, how many maximal cliques realize that word? We developed a transfer-style model that decomposes a clique into middle-column configurations. For $D_{2,3,2}$, exhaustive verification showed that these fiber sizes can be computed from simple column-size polynomials. We have begun testing this model for $D_{2,4,2}$, where full maximal-clique enumeration is currently impractical. The broader goal is to turn the original geometric counting problem into a recurrence or transfer model for the family $D_{2,n,2}$.

Research Fellow: Tori Houser (2027) **Concentration:** Biochemistry

Faculty Mentor: Anthony Chianese **Department:** Chemistry

Title of Project: Characterizing an Iridium Pincer Catalyst for Amide Hydrogenation

Funding Source: National Science Foundation Grant

Project Summary:

The Chianese lab 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. This summer, I focused on the catalysis of amide hydrogenation, organic compounds that are difficult to reduce to amines without expensive reagents that are atomically inefficient. The pathway where the C-O bond is cleaved has the most potential, since not many catalysts have been observed to do this. Studying the mechanisms of various catalysts that are able to do this reaction under extreme conditions may yield insight into the design of a novel catalyst that would not need such a high temperature and pressure. Prior to the summer, I was able to synthesize an iridium catalyst from literature that was able to do the reaction, but did not have a well studied mechanism. Using this catalyst, I ran a set of reactions where I measured the relative amounts of reactants and products over time as the reaction proceeded to provide insight into the reaction mechanism.

To start, I ran a crossover experiment to determine whether there was evidence of a hydrogen borrowing pathway. The hydrogen borrowing pathway involves C-N cleavage of the amide to form an alcohol and amine, then the combination of the amine and alcohol to form the C-O cleavage product. This pathway is less useful due to the alcohol intermediate having the potential to react in undesired ways. It was observed that the crossover product was made. In a follow up test where the product of the C-O cleavage was used as the substrate for the crossover test, crossover product was observed but only at 0.7% yield. This implied that hydrogen borrowing was not coming from the C-O cleavage product. We determined at that point that kinetic studies needed to be run to learn more about the mechanism. Various tests were done to determine the best conditions for kinetic studies, including altering the concentrations of NaBArF and tris(pentafluorophenyl)borane (abbreviated as BCF). We also tested the ability of the reactants and products to complex with BCF, since that would affect how well we could quantify yield and conversion. We determined that our model amide, diphenylformamide, formed a complex with BCF. This meant that percent conversion could not be calculated, as it would be unclear how much of the reactant was complexed with the BCF and therefore not at its normal peak at any given point in the reaction. The C-N cleavage product, C-O cleavage product and crossover product had slightly decreasing concentrations with more BCF added, implying that there was some interaction but that percent yields could still be calculated for the products. After this, a kinetic study was done for the reaction. Aliquots of the reaction mixture were taken every 15 minutes for the first hour, then every 30 minutes until 4 hours had passed. It was observed that the concentration of both the C-O and C-N cleavage products, methyldiphenylamine and diphenylamine respectively, increased over time. The concentration of methyldiphenylamine increased more than the diphenylamine. Additionally, the concentration of the reactant, diphenylformamide, was observed to increase over time. It is thought that this is potentially due to the formamide being released from its complex. These results are a little confusing because if there was hydrogen borrowing, the graph of diphenylamine would be expected to remain constant after a certain point as it was being made and used up. More kinetics experiments need to be run in the future to determine the cause of this.

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

Faculty Mentor: Mike Mei **Department:** Economics

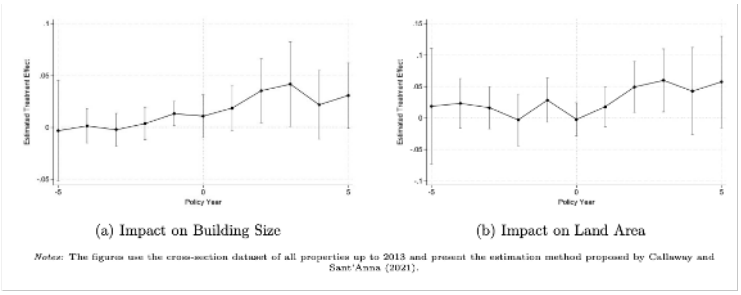
Title of Project: The Demographic Consequences of Neighborhoods Opting Out of Smaller Lot Sizes: An Analysis of Houston's Special Minimum Lot Size Areas

Funding Source: Division of Social Sciences

Project Summary:

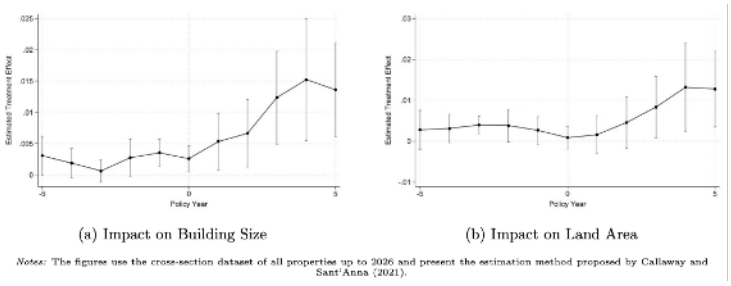
In 1999, Houston implemented zoning reforms to make the houses more affordable and address the increase of population. One of the major reforms was to reduce minimum lot sizes to as low as 1400 sqft for single-family homes. Due to strong opposition from homeowners because reducing minimum lot size would decrease the market price for housings, Houston made a compromise and introduced the opt-out provision, which allowed neighborhoods to transition to Special Minimum Lot Size (SMLS) areas and retained the larger lot sizes. Initially, the opt-out provision only applied to neighborhoods in Houston city center and it was not until 2013 where the policy expanded to rural areas of Houston.

We utilize an event study methodology and difference-in-differences estimation to evaluate the demographic changes for the SMLS blocks. Out results reveal that the SMLS blocks experience increases in both building size and land area that peak around three to four years after the neighborhoods opted-out from the zoning reform. Additionally, difference-in-differences estimates reveal that retaining the original minimum lot sizes would catalyze notable demographic transformations. Relative to the areas that don't opt out, SMLS opt-out blocks adopted between 2002 and 2009 experience increases in household income, property values, and homeownership rates, and have more educated residents. Although the 2013 citywide expansion introduced SMLS blocks with lower incomes and higher proportions of non-white residents, evidence of significant pre-treatment trends among SMLS blocks adopted between 2010 and 2019 suggests that early adopters could influence surrounding areas to eventually opt out as well. While the opt-out provision has successfully preserved larger lot sizes and lower-density housing developments in opted-out neighbourhoods, it does shift demographic characteristics and could create exclusive areas that undermine housing affordability for medium-to low-income households



(a) Impact on Building Size (b) Impact on Land Area

Notes: The figures use the cross-section dataset of all properties up to 2013 and present the estimation method proposed by Callaway and Sant'Anna (2021).



(a) Impact on Building Size (b) Impact on Land Area

Notes: The figures use the cross-section dataset of all properties up to 2026 and present the estimation method proposed by Callaway and Sant'Anna (2021).

Research Fellow: Joy Huang (2027) **Concentration:** Neuroscience
Faculty Mentor: Bruce Hansen **Departments:** Psychological and Brain Sciences; Neuroscience

Title of Project: Exploring the Neural Representation of Aesthetic Preference
Funding Source: Division of Natural Sciences and Mathematics

Project Summary:

Why do people like some artworks more than others? Although aesthetics feels highly personal and subjective, it may also be reflected in patterns of brain activity. Therefore, using electroencephalography (EEG), this project aims to decode the patterns in neural signals of people viewing visual art and eventually create a multidimensional representational space of aesthetic preference, in which people could be positioned according to their neural response and used to predict their preferences for unseen artworks.

Participants viewed images from 50 categories of aesthetic experiences while their brain activity was recorded. Later, they rated each artwork across 13 aesthetic dimensions and overall liking. Individuals' ratings were correlated with their EEG data to explore whether the relationship among images in the neural signals resembles those in aesthetic ratings. If these similarity patterns match, they provide preliminary support for neural representation of aesthetic preference.

EEG data was first analyzed using Fast Fourier Transform (FFT). While traditional event-related potential (ERP) analysis focuses on immediate brain activity after stimulus onset, which is useful for rapid visual processing, aesthetic preference is unlikely to be represented by single peaks in time. Therefore, FFT was used to analyze EEG data in the frequency domain that reflect more sustained cognitive processes. Using Representational Similarity Analysis (RSA) to compare the similarity structure of neural activity after FFT with that of participants' aesthetic rating, results showed that beta and gamma activity had the strongest correlation with participants' aesthetic ratings, which indicate the useful band frequencies with meaningful information about aesthetic preferences and provide foundation for creating the 'aesthetic space'.

However, applying this method to new individuals, ideally in a museum setting, requires a more reliable and portable way of recording. Therefore, a new experiment was developed using a wireless EEG headset with the Steady-State Visual Evoked Potential (SSVEP) paradigm. It means that images were presented with a 5Hz visual flicker to evoke a synchronized brain response at the same frequency (Figure 1). This frequency-specific response is robust and has a high signal-to-noise ratio, thereby providing a reliable way to measure brain activity with portable EEG headset while allowing participants freedom of movement when viewing art.

In this experiment, one half of the image set was used to correlate with aesthetic ratings to position the participants in the 'aesthetic space'. RSA was used to examine whether participants who showed similar neural responses have similar scores in ratings; with more individual data, the space could be expanded by knowing distances of similarity or difference. Future work will use the second half of the image stimuli as an independent test to verify whether the determined aesthetic signature of participants could be generalized to unseen artworks.

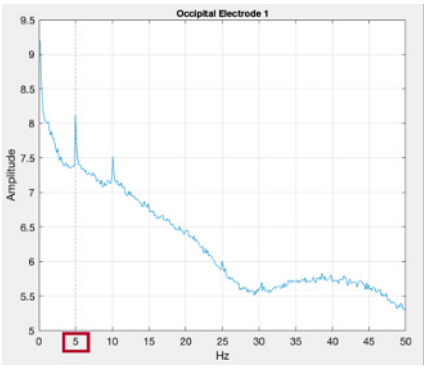


Figure 1. Frequency spectrum of the SSVEP response showing a peak at 5 Hz

Research Fellows: Maria Del Mar Icabalceta (2028) — **Concentration:** Psychological Science
Emy Pacheco Ramirez (2028) — **Concentrations:** Educational Studies; Psychological Science
Faculty Mentor: Erin Cooley — **Department:** Psychological and Brain Sciences

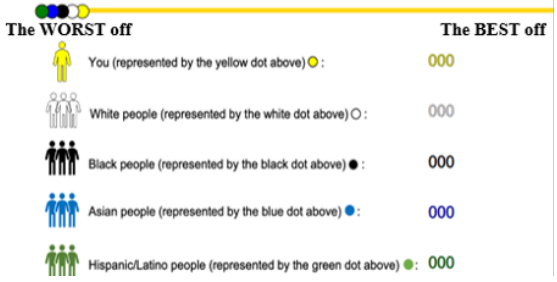
Title of Project: Subjective Within- and Between-Group Status Predicts Hispanic Americans' Political Attitudes

Funding Source: Division of Natural Sciences and Mathematics

Project Summary:

This summer, in Professor Cooley's Hierarchy, Health, and Policy Lab, we completed a manuscript centered on subjective feelings of status. U.S. economic inequality has risen in recent years and has remained disproportionately disadvantageous to minoritized racial groups. Economic inequality may also influence how people feel about their own status via more frequent status comparisons to the top 1%. Given this, we are interested in how subjective status (i.e., where individuals perceive their status relative to others) in economically unequal contexts predicts political behavior. Due to space limitations we will only summarize one of these two manuscripts here.

Figure 1



Hispanic Americans constitute a diverse population within the U.S., yet are frequently perceived as a political monolith. This diversity has become particularly salient in recent presidential elections, which brought increased attention to Donald Trump's rhetoric toward Hispanic immigrants and intensified enforcement activity by Immigration and Customs Enforcement. Despite this context, there has been a notable increase in Hispanic American support for Trump, a pattern that has surprised many (De Loera, 2025). In our first project, we explored this apparent paradox.

Across three studies, using mixed methods and multiple large, census-based, representative samples of Hispanic Americans (NTotal ~ 2,000), we tested whether subjective perceptions of one's own status within the perceived racial-economic hierarchy might help explain meaningful variability in Hispanic Americans' feelings of status threat and support for restrictive immigration policies. We assessed these perceptions using a novel measure developed by our lab (Brown-Iannuzzi et al., 2025; see Figure 1). In Studies 1 and 3, participants completed our novel measure, and we used Latent Profile Analysis (LPA) to identify 4 distinct subjective status profiles based on participants' response patterns. Two profiles reflected a perception of a "Tight" status hierarchy, in which participants clustered all racial/ethnic groups and the self closely together. The other two profiles reflected a "Dispersed" hierarchy, in which participants perceived greater separation among racial/ethnic groups and saw the self as falling between two groups often stereotyped as wealthy (White and Asian Americans) and two groups often stereotyped as poor (Black and Hispanic Americans). Next we assessed whether Hispanic Americans' subjective status profile predicted their policy attitudes. Indeed, Hispanic Americans who perceived a "Tight" hierarchy, and especially those who perceived the self as relatively close to the perceived high status of White Americans, were most likely to feel status threat from immigrants and, thus, support restrictive immigration policies—perhaps due to a desire to protect the status quo. In an interview follow-up of N = 208 participants, we asked a series of questions assessing, among other topics, beliefs in the American Dream. Preliminary analyses of responses to questions like, "What does the 'American Dream' mean to you?" revealed that Hispanic Americans who perceive themselves as doing well in a "Tight" hierarchy are also most likely to believe the American Dream is attainable for anyone as long as they work hard enough. And these strong beliefs in the American Dream and meritocracy statistically mediated this group's greater support for restrictive immigration policy. These findings are consistent with our theory that Hispanic Americans who perceive themselves as doing well in a tight U.S. racial economic hierarchy may be most motivated to maintain the economic status quo via restricting an influx of new immigrants.

Research Fellows: **Christopher Jachowicz (2028)** **Concentration: Computer Science**
Tanvi Prasad (2028) **Concentration: Philosophy**
Faculty Mentor: **Bruce Hansen** **Departments: Psychological and Brain Sciences; Neuroscience**

Title of Project: **Learning task-relevant visual features by linking brain activity to large language models and deep convolutional neural networks**

Funding Source: **Michael J. Wolk '60 Heart Foundation; Division of Natural Sciences and Mathematics**

Project Summary:

To understand how the human visual system encodes and represents the vast environmental stimuli that allow us to navigate the world, we built a novel brain-guided feed-forward convolutional neural network (CNN) that can achieve human-level classification abilities after undergoing learning. Previous lab research found that a network with 4 convolutional layers could differentiate between neural signals measured during two behavioral tasks. The neural network can classify which features–that are extracted based on increasing complexity ranging from object to sentence embeddings– were the most significant in our decision in differentiating between tasks. The critical turning point was creating Dynamic Electrode-to-Image (DETI) mapping, an EEG analysis showing that frequency-selective neural populations prioritize different image locations over time. However, this mapping was only successful when used for one experimental task and low-level encoders.

For this summer project, we began by building a two-layer brain-guided network. We created feature matrices based on participant EEG recording data, split by electrode, millisecond, feature, and task. We identified four distinct time points from a span of 600 milliseconds, one for each convolutional layer, across participant EEG recordings based on spikes in Event-Related Potential (ERP) across each of the eight features.

Using these four time points, we created a Representational Dissimilarity Matrix (RDM) for the two different experimental tasks (navigation and sitting) for images by top electrodes, time, and features. To create these RDMs, we experimented with many different tests to see whether averaging over ERPs worked. One of the tests we conducted was community detection to see whether averaging over grouped electrodes could work. We found that averaging resulted in a lot of data being missed. However, this led to our main turning point: we arranged the electrodes from highest to lowest ERP and picked the top 7 electrodes in the community with the largest number of electrodes to pass into each layer. To ensure that these electrodes were contributing to the network, we created the network nodes so that they used data from each electrode twice.

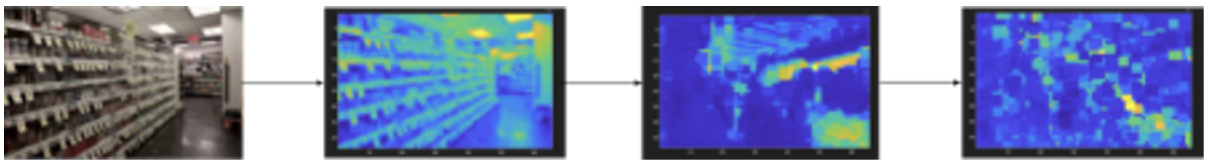


Figure 1: Example of deconvolution passes through image color correction and two convolutional layers
After we confirmed that our network had learned, we created and trained a brain-guided CNN with four convolutional layers to learn between the two tasks. The model reached a task classification accuracy score of 93.6% over 600 iterations. We conducted many analyses on the results, one of which was creating a DETI map to see how feature maps not only differed between images and time points, but also by task. In the future, we will run more iterations, conducting analysis on other methods of selecting electrodes.

Research Fellow: **Stephen Jervis (2028)** **Concentration:** **Physics**

Faculty Mentor: **Rebecca Metzler** **Department:** **Physics and Astronomy**

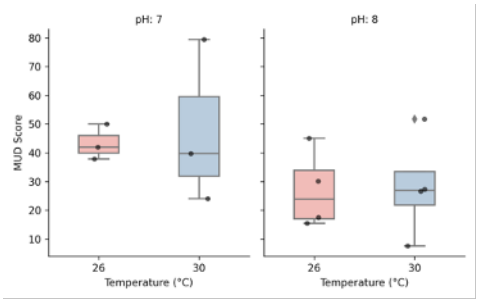
Title of Project: **Effects of Ocean Temperature on Biomineralizing Balanus amphitrite's Microstructure**

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

Project Summary:

Balanus amphitrites, a species of acorn barnacle, is a small marine organism found on coastlines all over the world. The goal of this research project was to examine different components of the protective barnacle shell to see how they may adapt to different ocean conditions. The different parts of the barnacles that we examined include the side plates, called parietal plates, and the bottom plate, called the base plate.

One aspect of the project dealt with adult barnacles. For the adult barnacle section of the project, we worked collaboratively with The College of New Jersey and Prof. Gary Dickenson. The adult barnacles that were sent to us were separated based on pH and temperature. Here at Colgate, we utilized Electron Backscatter Diffraction (EBSD) on the Scanning Electron Microscope (SEM) to try and see how different temperatures and pH conditions affect the crystal structure and crystal orientation of the barnacle shells. For the adults, both the parietal and base plates were examined. The image on the right shows one of the data sets that we created based on the MUD score of the crystal orientation. The MUD score is a measure of the randomness of the orientation of the crystals. The lower the MUD score, the more random the orientation. In this sample of parietal plates, the data trends toward a higher pH increasing randomness of orientation, but changing temperature having a minimal effect.



For another aspect of the project, we examined the barnacles in their juvenile stage, or the stage where they first settle down on their desired substrate. The barnacles were broken into groups based on the temperature of the water, and how long after settlement they were collected. First we documented, imaged, and measured many samples after being grown in incubators here at Colgate. Additionally, we began to perform EBSD analysis to see the effects of temperature and time after settlement on the crystal structure and orientation; additional samples are needed to put together a significant data set due to individual biological variability.

One last aspect of the summer research project included utilizing Photoelectron Emission Microscopy (PEEM-3) analysis at the Advanced Light Source (ALS) at UC Berkeley. The shells of the barnacles are mainly made up of the calcium carbonate polymorph calcite, but our goal was to try and find a precursor or amorphous phase of this biomineral. In other words, we were trying to look at the developing juvenile barnacles to see if any amorphous calcium carbonate (ACC) was present. We were looking for ACC because it has been found in numerous other biomineralizing organisms, but has never been found in barnacles. Unfortunately, we were unable to find significant evidence of ACC from the initial analysis of the juvenile barnacles, but hopefully future beamtime will lead to more promising results.

Overall, a main goal of this research was to see how these barnacles could be affected or adapt to climate change. Though more data is needed, some trends have definitely been developing.

Research Fellow: **Conner Jones (2027)** **Concentration:** **Chemistry**

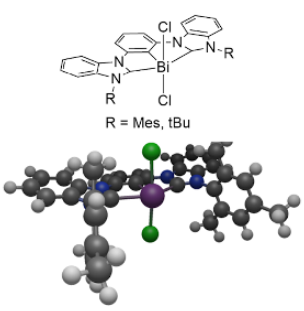
Faculty Mentor: **Gongfang Hu** **Department:** **Chemistry**

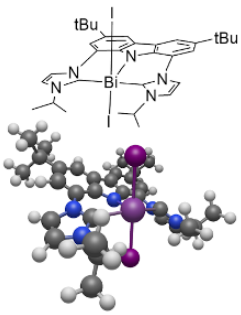
Title of Project: **Bismuth Complexes Supported by a Rigid CCC/CNC Pincer Ligand**

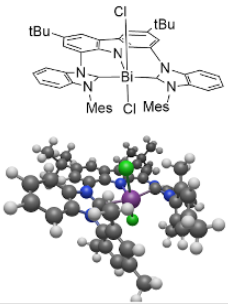
Funding Source: **Miller-Cochran Fund**

Project Summary:

In recent years, carbon-based CCC-pincer ligands have become increasingly important for developing robust catalysts, yet little research has examined the behavior of bismuth within such frameworks. This project examines the effects of inserting bismuth into one such rigid, strongly donating CCC-pincer system. Computational investigations show that the geometry of bismuth to be planar when incorporated into the CCC-pincer system. If bismuth can be successfully inserted into this framework, we gain a unique opportunity to study whether the ligand system could enable novel redox reactivity of bismuth. Currently, we are working on the synthesis and structural characterization of the CCC-pincer bismuth complex. Once isolated, extensive structural and electronic studies will be conducted to properly characterize and understand the CCC-pincer bismuth complex, to understand exactly how this rigid framework affects bismuth bonding.





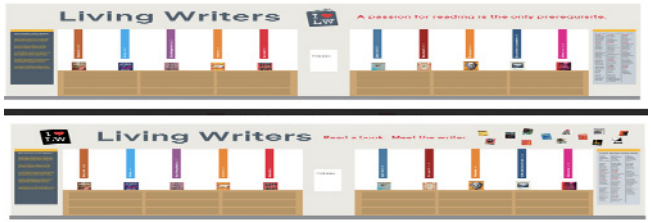


Research Fellow: **Karla Joseph (2027)** **Concentration:** **English**
Faculty Mentor: **CJ Hauser** **Department:** **English and Creative Writing**
Title of Project: **Living Writers Fellowship**
Funding Source: **J. Curtiss Taylor ’54 Endowed Student Research Fund**
Project Summary:

Living Writers is a course at Colgate, currently taught by Professor CJ Hauser, that introduces students to literary works by contemporary authors and offers the opportunity to meet and discuss writing with them. The series takes place during the fall semester, with 1 author attending each week throughout the series, totaling 10 books to be read by students. The research dates took place from June 1st to July 27th. The fellowship is dedicated to distributing the 10 books among fellows to be discussed as a group in preparation for the course in the upcoming semester.

The first two weeks of the fellowship were dedicated to setting up and working the Colgate Writers Conference. The first week was prep for the conference, with tasks including: making welcome packets for participants and faculty and making the beds in the dorms and apartments for participants and faculty. The five fellows are also assigned roles that they will fulfill the week leading up to and the week of the conference. My role was participant services, meaning I focused on communication, support, and assistance for participants of the conference. A task that was shared amongst fellows was being assigned 3 to 4 faculty members to assist throughout the conference. If the assigned faculty member was an author, writing an introduction for the author to be read aloud at the faculty readings that took place during the week. The final day of the conference was dedicated to closing tasks.

The rest of the weeks of the fellowship were spent with Professor CJ Hauser and were dedicated to Living Writers. Each fellow was assigned two books that were to be discussed on a dedicated day during the summer. The books you were assigned were to be read closely and to engage with the material of the book in order to create a meaningful understanding of the book that will contribute to how Professor Hauser engages with the book in class. The meetings took place on Tuesdays and Thursdays from 4:00 to 6:00, and revolved around a group discussion for the book that day. It was not required to read every book, but it was encouraged to further discussion. There was a document that was to be completed, which answered questions regarding the book’s themes, plot drivers, overall narrative, questions that students may have, questions that could be discussed in class, and our genuine thoughts on the book. We were also required to write the blurb that is printed on the authors’ posters as well as the blurb that went on the Living Writers website. It was encouraged for the blurbs to be engaging enough for non-Living Writers students to want to read the book or attend the author’s session. Each also had the option of choosing or creating a project to contribute to the distribution and engagement of Living Writers across campus. I chose (along with Sophie Wohlstadter) to create a Living Writers display on the fourth floor of the library. The task involved working with library staff as well as a graphic designer to establish ideas and a display mock-up for the library.



Research Fellow: **Ella Kahn (2028)** **Concentration:** **Biology**

Faculty Mentor: **Emily Ury** **Department:** **Environmental Studies**

Title of Project: **Is Phosphorus Prosperous? An Investigation into Nutrient Levels in Taylor Lake and Payne Brook**

Funding Source: **Division of University Studies**

Project Summary:

Phosphorus can indicate water quality and nutrient levels within a water system and is necessary for normal growth of organisms. In excess, phosphorus can also negatively impact aquatic species through algal blooms and decreasing dissolved oxygen levels. Healthy ponds and wetlands capture phosphorus and help improve water quality downstream. Taylor Lake may help trap phosphorus runoff from campus, the golf course and upstream farmland, which could improve water quality as far as the Chesapeake Bay.

We monitored phosphorus levels in Taylor Lake and Payne Brook in order to determine the overall phosphorus budget for Taylor Lake. This data will also serve as a baseline reference in advance of management activities such as dredging and shoreline restoration that could potentially improve water quality and phosphorus retention on campus. We used the molybdenum blue method and UV-Vis Spectroscopy to determine the concentration of orthophosphate based on absorbance values relative to a standard curve. Stream cross-sectional area and flow were also measured and used to determine discharge and phosphate flux at each sampling point. We found that the pipe (under College St.) inlet had elevated phosphate levels and that, in general, phosphate trended up over the course of the summer. Continued monitoring of these sites will help us understand how seasonality impacts phosphorus import and export from Taylor Lake and Payne Brook and inform management efforts aimed at reducing nutrient loading to downstream waterbodies.

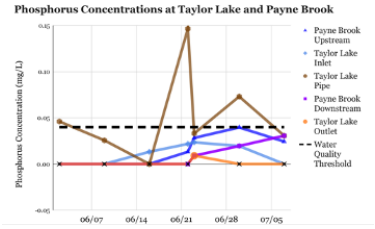


Figure 1: Phosphorus concentrations at each of the sample sites and dates.

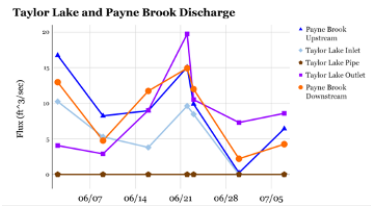


Figure 2: Discharge (in ft3/second) in the Taylor Lake system.

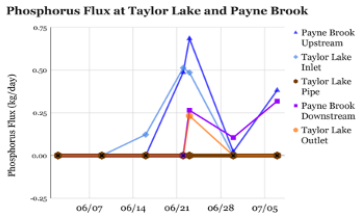
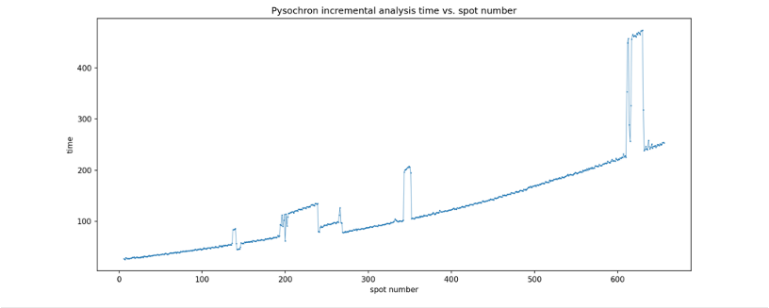


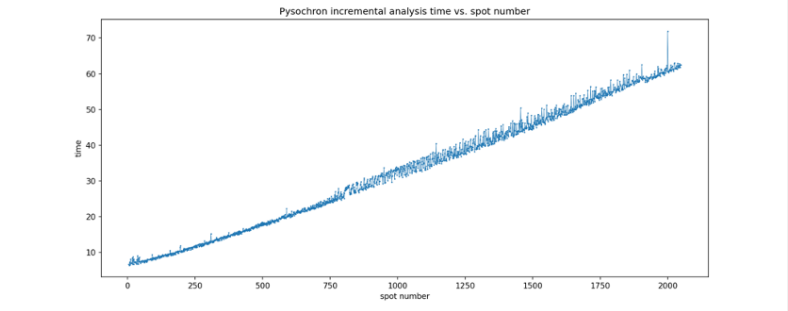
Figure 3: The flux (in kilograms per day) of phosphorus in the Taylor Lake system.

Research Fellow: Daniel Kaper-Barcelata (2028) **Concentration:** Astronomy/Physics
Faculty Mentor: Jonathan Levine **Department:** Physics and Astronomy
Title of Project: Readying Pysochron for the Moon
Funding Source: Division of Natural Sciences and Mathematics
Project Summary:

NASA's DIMPLE experiment will spend fewer than two weeks operating on the lunar surface, dating volcanic activity from isotopic measurements made in situ. With such a short window, the software that analyzes the returning data must work reliably on the first attempt. This project advanced Pysochron, the pipeline that processes isotopic data as it is transmitted from the Moon and presents results to mission scientists in real time, from a working prototype toward mission ready software. This summer, I implemented various improvements and tests that will allow Pysochron to run 2048 sample analyses without interruption. Rather than checking only that data arrived intact, Pysochron tests whether measured isotope ratios fall within the range expected, and warns scientists when a result is statistically anomalous. Because no lunar data yet exist to test against, I generated large synthetic datasets derived from the Zagami meteorite with randomized laser instrument data, allowing a full capacity runtime test along with other diagnostic tests. From these tests, I was able to identify that the runtime per sample had a quadratic relationship that needed to be reduced to linear in order to meet our requirements. The figures below show the pre- and post-fix performance per spot analyzed. I also worked on logging, monitoring, and system integration within DIMPLE's Science Operations Center to further improve the pipeline's reliability and traceability. Together, these efforts moved Pysochron toward a state in which the DIMPLE team can trust its output under the unforgiving time constraints of a lunar mission.



Quadratic spot vs. time relationship



Fixed linear spot vs. time relationship

Research Fellow: **Isabel Kats-Rodgers (2027)** **Concentration:** **Chemistry**
Faculty Mentor: **Eric Muller** **Department:** **Chemistry**
Title of Project: **Probing the Liquid-Solid Interface Through Infrared Nanospectroscopy**
Funding Source: **Warren Anderson 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 approach, a metallic atomic force microscope (AFM) tip localizes incoming light onto the sample surface (Fig. A). The resulting scattered field carries information about the local sample properties. This technique overcomes the typical limits of spatial resolution and sensitivity, enabling nanoscale IR spectroscopy and superresolution (20 nm) imaging. 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 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 spectroscopic line shapes and optical phenomena that occur with increasing tip-sample distance in both 2D and 3D.

During this project, we worked to improve our model to understand the structure of liquid water at the interface. We built and optimized a 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). We then perform a near-to-far field transformation and simulate lock-in detection to obtain the demodulated TIR s-SNOM signal. From this, we can examine the bending mode of water (at ~1650 cm^{-1}) seen in our phase and amplitude s-SNOM spectra (Fig. C). We also examine the spectra over various tip-sample distances and find a red-shift in the characteristic peak with decreasing tip-sample distance, an effect seen both in our theoretical model and in experimental data (Fig. D).

A **B** **C** **D**

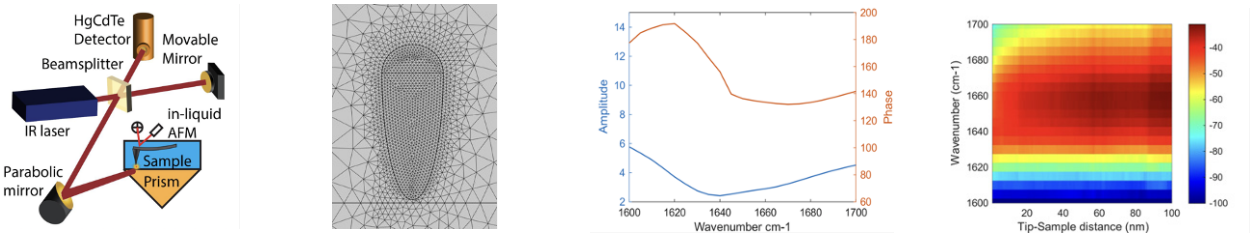


Figure: (A) Schematic of TIR IR s-SNOM showing the IR laser, prism, in-liquid AFM, and detector. (B) COMSOL mesh of the AFM tip at the ZnSe/air interface. (C) Amplitude and phase s-SNOM spectra of H2O; bending mode at 1650 cm^{-1}. (D) Contour plot of amplitude at increasing tip-sample distances; red-shift seen with decreasing tip-sample distance.

Research Fellow: **Agnes Kaumbulu (2028)** **Concentrations:** **Computer Science; Applied Math**

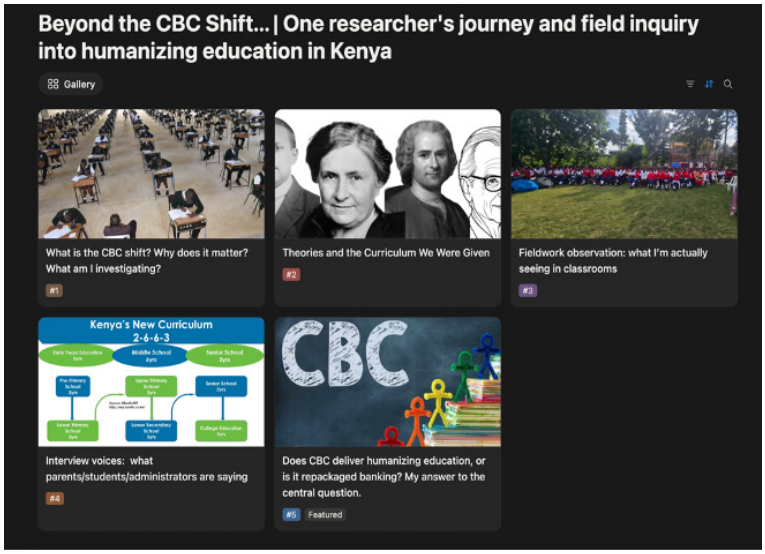
Title of Project: **Does CBC (the new Kenyan Education System) actually deliver humanizing, higher-order education, or does it simply replace one banking model with another, repackaged in progressive language?**

Funding Source: **Lampert Institute for Civic and Global Affairs**

Project Summary:

Kenya underwent yet another shift to a new education system in 2017. This is the third education reform in just 62 years in a country that continues to grapple with issues within its curriculum designs. While there have been good intentions behind these changes, educational reforms affect equity, learning outcomes, and policy implementation. I was first drawn to this topic primarily because of my direct experience with the older Kenyan education system — the 8-4-4 system. Being conditioned to a very organized, exam-based, and STEM-centric system, I was able to see the benefits and positive traits of this approach, as well as its drawbacks, especially its inflexibility and lack of focus on creativity. The 8-4-4 system was not perfect. But the question that stayed with me is whether CBC is perfect either, simply because it has moved away from the old system.

This summer, I traveled to Kenya, where I conducted literature reviews and later extensive fieldwork to gain a deeper understanding of the shift to a competency-based curriculum. Over 10 weeks, I reviewed policy documents, visited schools across Kenya, and spoke with teachers, parents, students, and administrative personnel in both primary and high schools. My research was guided by the questions: How different is this new system from the older one? Does CBC deliver humanizing education, or is it banking in progressive language? My finding is that CBC offers more benefits than the 8-4-4 system, but this will rely heavily on adequate resources, efficient teacher training, meaningful assessment frameworks, and strong collaboration across all stakeholders.



Legend: A public blog series documenting my observations, interviews, and analysis of Kenya's CBC transition — from its theoretical foundations to what it actually looks like in classrooms. https://agnes-ndanu.notion.site/7363ec9a921f8354a42081dbcead852e?v=15a3ec9a921f8359916788a2f0803398

Research Fellow: Solomon Kirby (2029) **Concentration: Undeclared**
Faculty Mentor: Julie Dudrick **Department: Upstate Institute**
Title of Project: Loving Our Country with John Brown Lives!
Funding Source: Upstate Institute
Project Summary:

As an Upstate Institute Field School Fellow, I had the privilege of working with John Brown Lives! (JBL!), a freedom education and human rights non-profit located in Lake Placid, New York. The organization operates in tandem with the John Brown Farm State Historic Site, where the famous abolitionist lived from 1849 until his execution in 1859. The site honors his legacy of radical justice through education, public programming, and regional advocacy. My core responsibility was serving as a trained "listener" for JBL!'s anthropological initiative, Loving Our Country. Through this project, I conducted individual, qualitative sit-down interviews with over thirty participants, asking each of them five structured questions regarding whether they feel affected or loved by their country, what mutual love between a citizen and nation requires, and what concrete action they were willing to commit to that day.

My primary objective was to provide a neutral, non-judgmental space where everyday people could voice their perspectives without fear of debate or pushback. In an era marked by intense political polarization, divisive elite rhetoric, and a growing sense of civilian helplessness, I found that simply listening to people without opposition had a remarkably therapeutic effect. Participants routinely left our sessions expressing deep gratitude, as modern political culture and social media platforms often talk at individuals rather than allowing them to think and speak for themselves. On any given day, I navigated extraordinary emotional range, holding space for people as they shared intimate life narratives or voiced calls for radical political change and armed revolution.

Despite the wide variation in responses, my interactions revealed that beneath the surface, the vast majority of people share a fundamental desire to prosper and see their fellow Americans do the same. While online networks grant an anonymity that fosters radicalism and convinces us that our neighbors are our enemies, face-to-face active listening proved that this hostility is far less representative of the general public than digital spaces suggest. Equally revealing, however, was the significant number of potential participants who declined to take part in the survey altogether. Despite my strict guarantees of anonymity, many individuals were paralyzed by fear of repercussions, ranging from social alienation from loved ones and professional trouble at work, to severe legal and federal anxieties among immigrants who worried their words might reach Homeland Security.

Ultimately, this experience taught me that one of the greatest resources we possess as a society is each other. When we take the time to live with and listen to one another, we realize that we largely want the same basic outcomes, even if we disagree on how to achieve them. For researchers across Colgate's campus, my fieldwork underscores the transformative potential of active listening as a qualitative tool, the necessity of rigorous ethical safeguards when studying political thought in a climate of fear, and the enduring value of face-to-face civil dialogue in counteracting modern political isolation.

Research Fellow: Lauren Klebba (2028) **Concentration:** Psychological Science

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

Title of Project: Driving Solutions for Hudson Headwaters

Funding Source: Upstate Institute

Project Summary:

Hudson Headwaters Health Network is a 501(c)(3) nonprofit and Federally Qualified Health Center (FQHC) that provides health care, mainly primary care, across seven counties in the Adirondack North Country and Glens Falls region. The majority of this region is rural and medically underserved, and individuals face significant unmet social needs. While the John Rugge Center for Community Impact (CCI) at Hudson Headwaters helps address many of these needs, patients still struggle to find reliable, affordable, and accessible transportation to their medical appointments.

Therefore, my fellowship aimed to provide a holistic view of the community's needs through conversations with Hudson Headwaters staff and community organizations, independent research, and data on patients' transportation needs. Using the qualitative and quantitative data I compiled, I identified and summarized how transportation needs are currently met and where further support is needed. Based on these conclusions, I created and presented recommendations to the John Ruggee CCI steering committee to mitigate these barriers for patients.

The results of the project indicate that addressing patient transportation challenges requires a multi-faceted approach, including expanding existing initiatives and launching pilot programs. Based on the identified need and research into rural transportation programs, I recommended implementing buses for high transportation-need areas, beginning Uber Health integration, and promoting local Taxi NEMT expansion. With the lack of reliable transportation options currently available, any of those recommendations would be a step in the direction of improving access to care for Hudson Headwaters' patients.

In addition to the specific recommendations, a main takeaway I presented to the committee is that investing in systems of transportation is investing in the futures of communities through opportunity. While the main goal of building additional transportation options is to improve patient attendance at medical appointments, an improved transportation network could contribute to expanded community access to locations like grocery stores and socialization opportunities for individuals without transportation. Additionally, investing in rideshare or taxi expansion would promote local economic growth in ways that have positive downstream effects on individuals, families, and communities. Therefore, I urged the committee to harness the community connections that Hudson Headwaters already has and to consider maximizing positive community impact in any decisions they make as they begin to consider implementing transportation programs.

Research Fellow: Tolu Ladapo (2028) **Concentration: Molecular Biology**
Faculty Mentor: Sarah McMillan **Department: Biology**
Title of Project: Confirming the interaction between SSB and SbcCD
Funding Source: Division of Natural Sciences and Mathematics
Project Summary:

Overview
This project was conducted to confirm the interaction between two DNA-interacting proteins. DNA damage happens constantly, either due to extracellular effects like radiation or just random error from the rapid replication and transcription of DNA. These cause mutations in the cell, and if unchecked, can lead to various diseases, for example, cancer. Cells have numerous ways to counter this effect, which are generally all facilitated by proteins. Our lab focuses on a single-stranded DNA-binding protein called SSB, which has a very strong affinity for binding to single-stranded DNA and is involved in numerous DNA repair processes. SSB also acts as a hub for recruiting other DNA repair proteins. SbcCD is a complex of two proteins, SbcC and SbcD, and is involved in double-stranded DNA breaks. A previous experiment was conducted that suggested there is an interaction between SSB and SbCc. My project this summer involved purifying SSB and SbcCD. Then performing an ammonium sulfate co-precipitation assay as well as a fluorescence polarization assay. Both assays test the binding of the two proteins in vitro.

SSB Purification
Purification of proteins starts with competent cells taking in a plasmid with the gene of your target protein and then causing an induction of the expression of the protein in cells. Following expression, the cells are lysed through sonication and then spinning them down in a centrifuge to produce a supernatant that only has soluble things like proteins while getting rid of insoluble things like cell debris. SSB is unique as it precipitates out at a lower concentration of salt than most other proteins. We take advantage of this to separate SSB from other proteins. Then we use a machine that uses FPLC or Fast-Protein Liquid Chromatography. It uses different columns with different properties to separate proteins. For example, a column we use is called an anion exchange column. Our protein is negatively charged, and the column is positively charged, so our protein should stick to it while other things will flow over. Then we elute our protein into fractions by running a buffer that's high in salt, and then do the same thing with the next column, which is called a size exclusion column that separates things based on size. At this point, we are left with purified SSB.

SbcCD Purification
The steps for SbcCD purification are very similar to SSB. Differences are that we don't do an ammonium sulfate cut and we add one additional column to the FPLC. This is a nickel affinity column. Our protein is his-tagged, and nickel binds very strongly to it.

Ammonium Sulfate Co-precipitation Assay
This assay is supposed to qualitatively suggest an interaction between two proteins by taking advantage of how naturally proteins precipitate out of salted solutions at differing concentrations of salt. I prepared a buffer solution that mimics the proteins' natural environment and, among numerous trials, attempted to identify the concentration of salt where SSB precipitated out but SbcCD didn't. I essentially had two tubes: one tube with both proteins and another tube with just SbcCD, both at the same concentration of salt. After centrifuging and washing three times, I did a protein gel of both the supernatants and the pellets (if one was produced) from the tubes. The results suggest a potential interaction between SSB and SbcC. In the pellet following AS addition, SbcC is present with SSB. However, the results are complicated by the fact that in some instances, some amount of SbcC is in the pellet when SSB is not also present.

Fluorescence Polarization Assay
This assay is supposed to give a more quantitative answer for whether or not our two proteins interact by quantifying the polarization of light emitted from a spinning fluorescently labeled peptide of SSB, determining whether it spins more slowly at higher concentrations of SbcCD. The idea being heavier complexes (like from being bonded to another protein) spin more slowly and emit less polarized light. Controls were designed by using a mutated version of SSB that has a deleted amino acid thought to be essential to binding with partner proteins. If comparing the results of the two peptides and the mutated version has a statistically significant difference, it could suggest the interaction between our two proteins.

Research Fellow: Seongwon Lee (2029) **Concentration:** Undeclared
Faculty Mentor: Jason Meyers **Departments:** Biology; Neuroscience
Title of Project: Zebrafish Terminal Neuromast Regeneration
Funding Source: Division of Natural Sciences and Mathematics
Project Summary:

The objective of this research was to identify whether the intensity of damage influences the regeneration ability of the sensory organs of zebrafish. Zebrafish have regenerative sensory organs called neuromasts around their body. The neuromasts, composed of mantle, support, and hair cells, are significant due to the fact that the hair cells of the neuromast are identical to the hair cells in human ears. Therefore, understanding the mechanism of the regeneration of neuromasts could lead to a better understanding of the human ear. The research specifically focused on the tail regeneration of zebrafish since the tail can rapidly regenerate multiple times even after severe damage.

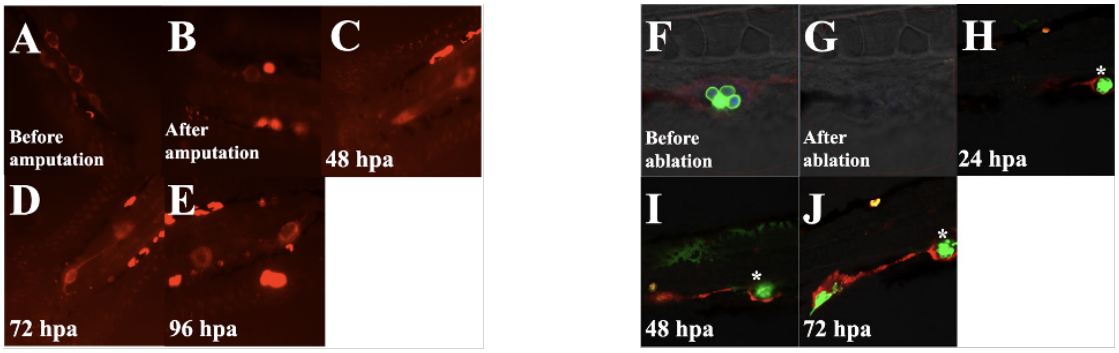


Figure 1. Amputation and ablation showed different regeneration rates. (A-E) 25 % of the fish showed neuromast regeneration in their tails around three to four days after amputation (n = 25). (F-J) 7 % of the ablated fish showed regeneration only when a large area, including the neuromast, INCs, and the nearest area, was completely ablated (n = 28). (H-J) The white asterisk indicates the nearest neuromast.

To test regeneration, the last neuromast at the tip of the tail of 3-day-old zebrafish were either amputated or photoablated. Then, the damaged region was recorded every 24 hours. Although every amputated fish showed regeneration in their tails, only 25 % of the fish regenerated their neuromasts. As the tail regenerated, the INCs elongated from the closest neuromast to the end of the tail, regardless of neuromast regeneration. The development of a new neuromast was visible by 48 hours, and a mature neuromast was observable by 96 hours.

A proportion of fish were designated to get large area ablation, which ablates the last neuromast and the area near it. Other fish were ablated only at their last neuromasts or including the INCs. Out of 28 fish, only 2 fish that had large-area ablation showed regeneration (7%). At 48 hours, budding of a new neuromast was visible, and by 72 hours, hair cells were detected. The different regeneration suggests that zebrafish might have different reaction mechanisms depending on the intensity of the damage. Further experiments must focus on identifying how the nearest neuromast contributes to the regeneration.

Research Fellow: Leo Li (2027) **Concentration: Philosophy**

Faculty Mentor: Jing Wang **Department: East Asian Languages and Literatures**

Title of Project: On the Importance of Joseph Needham and His Contemporaries

Funding Source: J. Curtiss Taylor ’54 Endowed Student Research Fund

Project Summary:

This summer, I had the honor of working for Professor Wang, with a special focus on historical research. Throughout this experience, I conducted various independent research projects centered broadly on Joseph Needham, his contributions to the history of science, and the intellectual world surrounding his work. I also had the opportunity to research Needham’s contemporaries and examine their related works and ideas.

While the content of the research was both important and interesting, one of the most valuable lessons I learned this summer was how to properly document, organize, and streamline completed work. For a researcher, materials can quickly accumulate and become difficult to locate or manage. Seemingly simple practices, such as consistently naming files and scanning books with clear records of their titles and authors, therefore become extremely important. These are only a few examples, but they demonstrate the need for researchers to remain conscious of how their work is documented and preserved. Without a proper and consistent system of documentation, research can become significantly less efficient over time. I also learned that an effective documentation framework should not simply be based on individual preferences. Communication and coordination with others are essential for establishing shared standards that remain understandable and useful over time.

The content of my research this summer was also extremely rewarding. We began by examining comparative methods across different disciplines before turning to the works of several important contemporaries of Joseph Needham. We explored major concepts in the history of science as well as the work of more modern figures such as H. G. Wells. My assignments ranged from analyzing key paragraphs and chapters to identifying and summarizing important arguments and ideas. This research was highly multidisciplinary, drawing from fields including biology, the history of science, ancient and modern philosophy, methodology, and political science. The depth of these subjects kept me engaged throughout the summer and continually introduced me to new questions and perspectives.

Looking back on my work this summer, I would first emphasize the importance of learning and adapting to a consistent framework for documentation. Although documentation may initially seem intuitive, it takes time and practice to understand the scale, consistency, and attention to detail required to maintain an effective system. At the same time, the content of my research provided me with a greater appreciation for multidisciplinary scholarship and the value of approaching historical questions from different perspectives. Most importantly, treating this research opportunity as a professional experience taught me habits and skills that I can apply directly to my future academic and professional career.

Research Fellow: Leo Liu (2027) **Concentrations:** Chemistry; Mathematics

Faculty Mentor: Stephanie Sanders **Department:** Chemistry

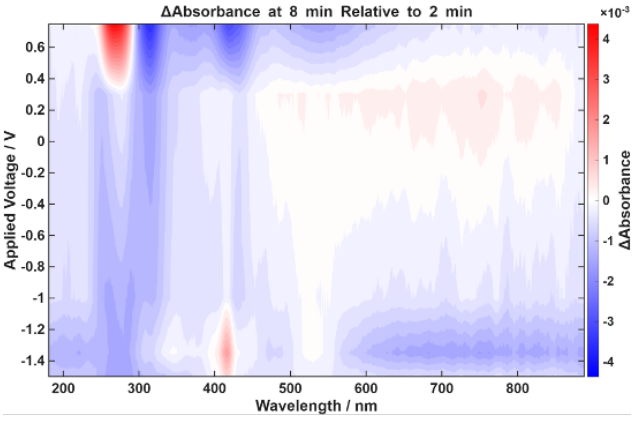
Title of Project: Photophysical characterization of bismuth–nickel complexes for photocatalytic CO2 reduction

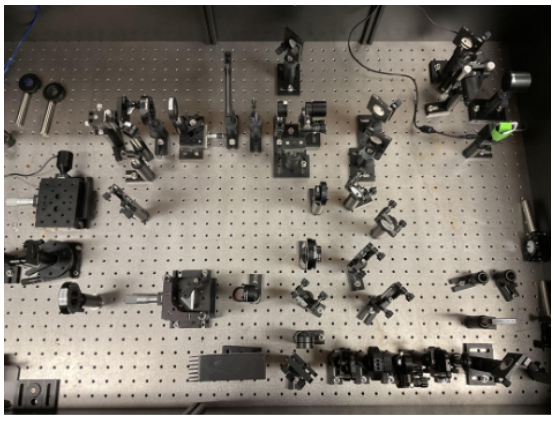
Funding Source: Division of Natural Sciences and Mathematics

Project Summary:

Current methods for the photocatalytic conversion of CO2 into energy-storing chemicals typically utilize two components: a photosensitizer and a catalyst. Efficiency and scalability is limited by the use of rare transition metals and inefficient energy transfer between system components. Our work aims to address these common pitfalls by investigating bismuth–nickel (Bi–Ni) complexes designed to combine light absorption and catalytic function within a single molecular framework using earth-abundant and cost-effective elements. By connecting spectroscopic results to the chemical structure and catalytic activity, we will examine the structure-function relationship, which is essential for optimizing photocatalytic CO2 reduction.

We conducted spectroelectrochemical characterization of one such Bi-Ni complex (GH37) by measuring the absorbance under applied voltage as a function of time. The change in absorbance under different applied voltages is shown in the figure below. When 0.75V is applied, the absorbance around 400nm decreases with time. Conversely, when -1.5V is applied, the absorbance around 400nm increases with time. These results indicate that GH37 is capable of transferring electrons and the electronic structure changes when it is oxidized or reduced, suggesting the potential for photocatalytic CO2 reduction.
To measure the excited state behavior of GH37, we are building a transient absorption spectrometer consisting of two main parts – an optical parametric amplifier (OPA) and white light generation (WLG). The OPA generates a pump pulse with a tunable wavelength, which excites the molecules into excited states, whereas the WLG creates the probe pulse to obtain the absorption spectrum of the excited populations. By controlling their relative timing, we will investigate how long the excited population of GH37 lives, and how energy is transferred between the bismuth and nickel centers. Current progress on the OPA setup is shown below. The combination of spectroelectrochemical and transient absorption measurements with photocatalytic CO_2 reactions will elucidate the structure–function relationship of the Bi–Ni complexes for photocatalytic CO_2 reduction.

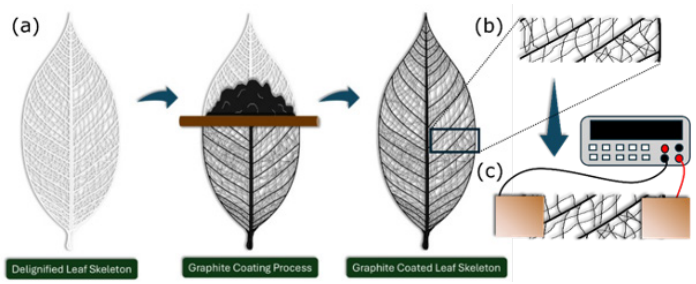




Research Fellow: Jackson Lowell (2027) **Concentration:** Physics
Faculty Mentor: Ramesh Adhikari **Department:** Physics and Astronomy
Title of Project: Humidity Sensing
Funding Source: Division of Natural Sciences and Mathematics
Project Summary:

This summer I designed and tested a humidity sensor made from rubber leaf skeletons and graphite paint. We read the electrical resistance across the device and found that it changes in correspondence to the humidity it is exposed to. This mechanism can be explained by the swelling of the leaf veins and mechanical breaking of graphite coating due to increased water particles in the air, resulting in increasing resistance as RH% increases. We used this device for fast-response measurements for a large range of humidities, as well as long-term measurements both indoors and outdoors. We also found that the device performs equally well when powered by a hydrovoltaic generator also made in the lab, creating a fully leaf-based and biodegradable system.

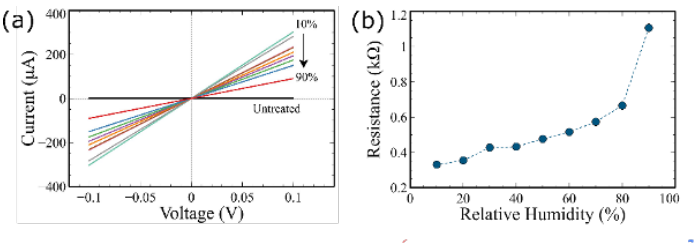
This work was done mostly using our commercial humidity chamber and a sourcemeter, a device that applies and measures currents and voltages across two or four contact points. We took leaf skeletons, cut them into 3cm x 1cm pieces, and using a method known as Doctor Blade, applied a thin coat of graphite paint to these skeletons. This creates a conductive fractal structure through which air can flow easily and quickly. We then attach copper tape to each end in order to take our measurements.



Coating Method - Leaf skeleton and graphite paint, attached to measurement source

In addition to taking electrical measurements, I also used a multitude of spectrometers and microscopes to characterize the chemical composition of the device. Using SEM imaging, I analyzed the structural difference between graphite-coated and non-coated leaves. With the help of DI Keller, I also used X-ray diffraction to confirm the existence of graphite and cellulose in the device. With the help of Professor Muller in the chemistry department, we did the same thing using Raman spectroscopy as well. I also learned how to use UV-vis and FTIR spectroscopy with his help.

Finally, in order to test functionality, we submitted this device to multiple different application tests. It was able to be used as a proximity sensor, reading different resistances based on a wet hand versus a dry glove. It was also attached to the outside of a mask and used to monitor respiration. In this example, the resistance increases as humid breath is exhaled, and we see a drop as that same moist air is inhaled, then the breath is held. Overall, the techniques and organization learned in last year's summer research allowed me to start this completely new project and finish it all within two months, while also continuing my work from the year before.



Electrical Measurements - change in current/resistence for a voltage range as RH% is swept from 10%-90%

Research Fellow: **Michal Lukaszewski (2029)** **Concentration:** **Undeclared**
Faculty Mentor: **Jason Meyers** **Departments:** **Biology; Neuroscience**
Title of Project: ***fgf3*** **and** ***wnt2*** **in situ hybridization during Epithelial Mesenchymal Transition post Neuromast Ablation**
Funding Source: **Division of Natural Sciences and Mathematics**

Project Summary:

Fgf3 and Wnt2 are known to be signals important in the development of zebrafish neuromasts. With this said, we decided to use in situ hybridization to look more closely at the specific signalling of these signals one day post neuromast support cell and hair cell ablation.

Neuromasts are sensory organs that contain hair cells. These hair cells are highly similar to those in the human ear. Zebrafish have the incredible ability to regenerate these hair cells, a trait which humans lack. Zebrafish are also easy to work with because of their translucent embryos, their ease of care, and ease of breeding. We also know that hair cell development and regeneration share many pathways, which was the basis for our research.

In our research, we are looking directly at Fgf3 and Wnt2 signalling one day after hair cell death and their surrounding support cells, which we know to be the primary means for regeneration of the hair cells. Once a neuromast undergoes this hair cell and support cell death, it undergoes a transition from an epithelial, columnar, uniform shape to a flatter, more scattered mesenchymal cell shape. We also know that some of the major signals responsible for these shifts during neuromast development are Fgf3 and Wnt2.

With this said, we decided to look at a drug known to inhibit Fgf3 and see how that would affect the Fgf3 and Wnt2 signalling within these neuromasts, as well as their epithelial-mesenchymal transition. Preliminary findings suggest that the use of PD (the Fgf3-inhibiting drug) led to a slower shift back to the epithelial rosette shape after undergoing the initial transition to the mesenchymal typology. This was seen through more flat, mesenchymal-like neuromasts in the drug-treated neuromasts when compared to the control neuromasts. We also see less Wnt2 signalling in the drug-treated neuromasts, perhaps due to the lack of Fgf3 affecting Wnt2 signalling as a byproduct.

To sum up, the use of an Fgf3 inhibitor directly affects the regeneration process of these neuromasts and their hair cells. It also directly affects the Wnt2 signalling, which we know is an important signal for growth and repair of the neuromasts. To evaluate the exact extent to which Fgf3 plays a role in this regeneration, we will have to conduct further experiments.

In the future, we would want to look at this signalling further and at different timings after neuromast ablation. This will allow us to create a better understanding of exactly how these signals work together to ensure the neuromast and hair cells regenerate completely. It will also help us understand quantitative timing differences in epithelial-mesenchymal transition and how long it takes for hair cells to regenerate under the different conditions.

Research Fellow: Sophia Luzietti (2028) **Concentrations: Peace and Conflict Studies; Geography**

Faculty Mentor: Rachel Amann-Burns **Department: Upstate Institute**

Title of Project: Toward a Second Abolition: National Abolition Hall of Fame and Museum

Funding Source: Upstate Institute

Project Summary:

This summer I worked with the National Abolition Hall of Fame and Museum (NAHOF). NAHOF is located in Peterboro, NY, the former home of influential abolitionist Gerrit Smith. As one of the largest landowners in America, Smith donated the equivalent of over $1 billion to abolitionist causes, opened his home as an Underground Railroad Station, and regularly hosted and funded significant abolitionists such as Frederick Douglass, Harriet Tubman, and John Brown. Because of Smith, Peterboro was a space of radical activism throughout the abolition movement.

Today, however, rural, upstate New York is not known for its activism. Furthermore, much of its history has gone overlooked or largely forgotten. Despite Smith's extensive influence on American history and the abolitionist movement, I'd never heard his name before this summer. To address this, NAHOF serves a two pronged mission. The first is to honor the legacies of historical abolitionists. The second is to advance the 'second abolition,': the moral conviction to end racism. All of this work is done through the lens of public education. My work this summer focused primarily on advancing the second prong.

My first assignment was to create a comprehensive guide to anti-racist resources, organizations, and museums both locally and regionally through interviews, site visits, and secondary research. In addition to documenting these resources, I was tasked with forging partnerships between NAHOF and these organizations to help NAHOF expand their local network. This research culminated in several deliverables for the museum. I created an anti-racist resource center in the entryway, a brochure that has been disseminated to hundreds of prospective visitors and museum guests, and a Geographic Information Systems map that displays our regional abolition allies. My second assignment was to create an interactive curriculum that educated middle school students on how the legacies of slavery impact modern social justice issues. This programming will help NAHOF increase its revenue and youth outreach. My last project was to create an outline for collaboration between NAHOF and Colgate's CORE Conversations department. This will hopefully help facilitate a long-term educational partnership between the university and the museum. Furthermore, it will help connect Colgate students to the immense local history that surrounds them, thereby facilitating community engagement. Thus, my work this summer contributed to broader efforts to end systemic racism and educate the public on the ongoing legacies of slavery.

Research Fellows: **Jorgen Martin (2028)** **Concentration: Neuroscience**
Devan Seidel (2028) **Concentration: Neuroscience**
Madison Stevens (2028) **Concentration: Neuroscience**
Faculty Mentor: **Anzela Niraula** **Departments: Psychological and Brain Sciences; Neuroscience**

Title of Project: **Dopaminergic Neuron Activation Precedes Microglia Activation in the Arcuate Nucleus Following Poly I:C Injection**

Funding Source: **Division of Natural Sciences and Mathematics; Michael J. Wolk '60 Heart Foundation**

Project Summary:

Poly I:C is a synthetic double stranded RNA which binds to Toll-like receptor 3 and elicits a viral immune response activated by NF-κB and type 1 interferon mediated pathways. This viral response to poly I:C involves physiological responses comparable to those of a virus, such as decreased locomotor activity, changes in appetite, and mild hypothermia. To examine the neuroimmune mechanisms that drive sickness-induced anorexia during viral infection, we administered mice with poly I:C and utilized immunofluorescence labeling to assess the neuronal and microglial activation profiles in the arcuate nucleus, a hypothalamic region critical for appetite regulation. Microglia are the primary resident immune cells of the brain, and are involved in fighting infection, clearing debris, and maintaining a healthy microenvironment. In addition, we conducted real-time qPCR to examine the expression of various cytokines, such as Tnf and Irf7, which are involved in immune signaling and sickness behavior. At 4 hours post-injection, we found no evidence of microglia activation in the arcuate nucleus (Figure 1). However, we noted an increase in activated dopaminergic neurons in the arcuate nucleus (Figure 2). At 24 hours, we saw an increase in Tnf and Irf7 gene expression in the hypothalamus. Our findings show that dopaminergic signaling occurs prior to microglia activation in the hypothalamus following poly I:C injection. The increased cytokine gene expression at 24 hours indicates a sustained immune response, which correlates with sickness-induced anorexia and weight loss.

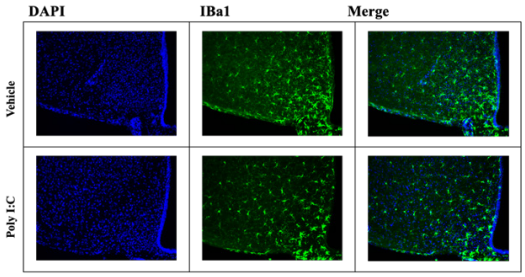


Fig. 1) Immunofluorescence labeling in the arcuate nucleus, microglia labeled with antibody against Iba-1 (green) and nuclei labeled with DAPI (blue)

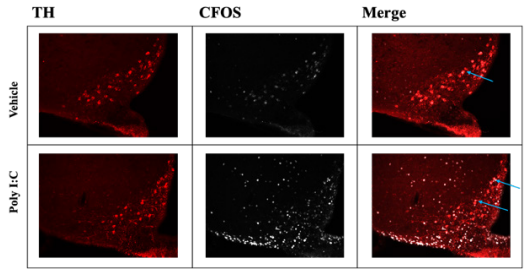


Fig 2.) Immunofluorescence labeling in the arcuate nucleus, dopaminergic neurons labeled with an antibody against Tyrosine Hydroxylase (red) and activation labeled with antibody against cFOS (white)

Research Fellow: **Pallen McArdle (2027)** **Concentration:** **Peace and Conflict Studies**
Faculty Mentor: **Julie Dudrick** **Department:** **Upstate Institute**
Title of Project: **The Making of an Exhibit: Black Experience in the Adirondacks**
Funding Source: **Upstate Institute**
Project Summary:

This summer, I interned at the Adirondack Experience, which is a historical, social, and cultural museum dedicated to representing diverse Adirondack stories. The museum is located in Blue Mountain Lake, Hamilton County. The museum acts as an educational resource to preserve past and present cultures of the Adirondacks.

In 2020, Former Executive Director David Kahn proposed a new exhibition to emphasize the contributions of Black people in the Adirondacks. With the support of the Board of Trustees, Kahn secured a multi-million dollar budget and a 2,200 square foot exhibition space for Nature of Belonging: The Black Experience in the Adirondacks permanent exhibition that is located within a gallery within Life in the Adirondacks. Nature of Belonging is set to open next Summer 2027. It is organized into three main themes: work, connections, and homeplace.

I focused exclusively on developing the upcoming Nature of Belonging: The Black Experience in the Adirondacks exhibit. My work focused on three projects. I developed 12 research profiles on Black individuals in the Adirondacks from the 18th century to the present to understand how Black people have actively shaped this place. To do this, I visited digital and physical archives including Fort Drum and Fort Ticonderoga. My profiles explored Black people's contributions to the Adirondacks. These were then transcribed in preparation for supporting the text and audio-visual media in the exhibit.

My next project concentrated on eight existing oral histories. I thematically organized these to initiate object theater progression by identifying key themes and moments that relate to homeplace as a site of resistance. This fits into our homeplace theme. The object theater is designed to be a comfortable space for visitors to sit and listen to different people's experiences in navigating the Adirondacks. It will convey hope and resistance. Additionally, I managed part of the oral history administration of paperwork and contacting participants.

Moreover, gaining feedback prior to displaying the exhibit is critical. At the Albany Public Library and on campus at the Adirondack Experience, our team conducted formative evaluations to receive feedback on sample texts, objects, and perceptions of the Black Experience in the Adirondacks exhibit.

We hope this exhibit will inspire pride and confidence, as well as recognize, celebrate, and empower communities. As my research contributes to a permanent exhibition, it will support decades of exhibition viewing, touch thousands of museum visitors, and provoke thoughtful conversations.






(From Left to Right: Nature of Belonging Exhibit Space June 30, 2026, Pallen McArdle '27 at the Albany Public Library, Nature of Belonging Exhibit Test Lab at the Adirondack Experience)

Research Fellows: Ellie McGoldrick (2027) — **Concentration:** Political Science
Lindsay Scheffler (2027) — **Concentrations:** Economics; Political Science
Faculty Mentor: Annie Benn — **Department:** Political Science
Title of Project: Congressional Responses to Executive Orders
Funding Source: Division of Social Sciences; Stickles Fund
Project Summary:

Over this summer, we analyzed and categorized congressional responses to executive orders. Under Professor Annie Benn, we challenged the assumption that executive orders are unchecked unilateral actions of the president over which Congress has minimal control. We are working to prove that this assumption is not all encompassing, and that Congress shapes the implementation and scope of these orders. Congress is able to use the oversight power of executive agencies to make agency officials, in charge of implementing the executive orders, explain their process and hold them accountable through hearings. Additionally, Congress will sometimes propose legislation that overrides an executive order or encodes it into law, or refuse to appropriate the funding necessary to fulfill an order. Executive orders are a power of the presidency that has changed and expanded over time. Our scope of interest is Congressional oversight hearing transcripts from the 1970 - 2020.

The majority of the work we did this summer consisted of reading through transcripts of Congressional hearings and identifying instances in which executive orders were mentioned. We then coded those instances based on their substance, valence, and mode. We identified if a member was asking a question or making a statement, what exactly about the order was being referenced, and if it indicated a member's support of the relevant executive order. The goal was to use the results from both coders to validate that Claude's coding of the same transcripts was correct. By proving that the data found by Claude is valid, we can then use the software to analyze larger samples which will be used in the final project. We have not yet begun to test our final sample, but we look forward to seeing this project continue.

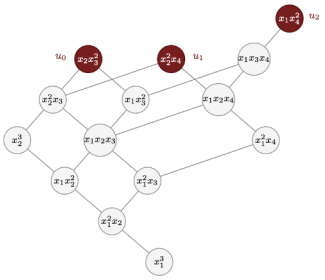
Research Fellows: Nia Mckenzie (2029) — **Concentration:** Undeclared
Hudson Miller (2029) — **Concentration:** Mathematics
Kade Santo (2027) — **Concentrations:** Mathematics; Computer Science
Faculty Mentor: Gabe Sosa Castillo — **Department:** Mathematics

Title of Project: Strongly Stable Generators of Principal Lexsegment Ideals

Funding Source: Division of Natural Sciences and Mathematics

Project Summary:

Our research concerned principal lexsegment ideals. To describe principal lexsegment ideals, we need to introduce some concepts starting with monomial ideals. A monomial ideal is an ideal within a polynomial ring that is entirely generated by monomials. For example, the monomial ideal I =(x^2_1, x_2x_3) is the subset of the polynomial ring generated by multiplying polynomials in the ring with the monomials x^2_1 and x_2x_3. So then, the polynomial $3x^2_1x_2 + 2x^2_1x^2_3 - 5x_1x_2x_3 + 7x_2x_3 = x^2_1(3x_2 + 2x^2_3) + x_2x_3(-5x_1 + 7)$ would be in the ideal I; while x_1x_2 is not an element of *I*.



Now, the lexicographic order is a monomial order that orders monomials based on a comparison of their associated exponent vectors, in a fashion similar to the way words are organized in the dictionary. Given two monomials in exponent vector form, call them α and β, we say that α is greater with respect to lex if the first nonzero entry of αβ is positive. For instance, let u and v be monomials with $u = x^3yz$ and $v = xy^2z^4$ and x > y > z, then their exponent vectors are (3,1,1) and (1,2,4), respectively. The difference between these exponents vectors is (2, -1, -3), and since the leftmost non-zero entry of this difference is positive, we say that u is greater than v. A lex ideal L is a type of monomial ideal with the property that if a monomial m is in L, then any monomial of the same degree as m, but bigger than m according to the lexicographic order, is also in L. Commutative algebraists focus on Lex ideals as a result of Macaulay's theorem, which establishes that given a monomial ideal M , there exists a Lex ideal LM with the exact same Hilbert function as M. Because of this, it is enough to study the different Hilbert functions of lex ideals.

Finally, Principal lexsegment ideals, then, are the monomial ideals that are generated by all monomials with a fixed degree that are greater than a given monomial u with respect to the lexicographic order. We denote the monomial generators of the principal lexsegment ideal by L(u).

Principal lexsegment ideals are also strongly stable. A monomial ideal I is strongly stable if given a monomial m ∈ I and a variable xi that divides it, then $(x_j/x_i)m \in I$ for all $1 \leq j \leq i$, the process of obtaining $(x_j/x_i)m$ from m is known as a Borel move. The strongly stable, or Borel, generators $g_1, g_2, \ldots,$ gs of a strongly stable ideal S are the minimal collection of monomials with the property that given a monomial m in S one can find a finite sequence of Borel moves starting with one of the g_i's and obtain a monomial divisor of m. Our research goal was to determine the number, and structure, of the strongly stable generators of a Principal lexsegment ideal if we were only given the monomial u that determined L(u). For this purpose, we developed Python code to generate data based on examples. The analysis of this data led us to a closed formula for the number of the strongly stable generators of a principal lexsegment ideal.

Theorem If $\vec{\alpha} = (\alpha_1, \alpha_2, \ldots, \alpha_n)$ is the exponent vector for the monomial u, let $u' = (u'_1, u'_2, \ldots, u'_n)$, with $u'_j = \sum_{i=j}^{n} \alpha_i$ for each $1 \leq j \leq n$, and $\mathcal{S} = \{i : i \neq 1, n, \quad u'_i - u'_n > 1, \quad \text{and} \quad u'_{i+1} \neq u'_i\} = \{r_1, r_2, \ldots, r_\ell\}$, with $r_1 > r_2 > \cdots > r_\ell$.

Then there are $\mathcal{S} + 1$ strongly stable generators of $\mathcal{L}(u)$ are exactly $u_0, u_1, \ldots, u_\ell$, with $u_0 = u$ and

$$u_j = \left(\alpha_1, \alpha_2, \ldots, \alpha_{r_j - 1} + 1, \underbrace{0, 0, \ldots, 0}_{n - r_j \text{ zeroes}}, \sum_{i=r_j}^{n} \alpha_i - 1\right).$$

Research Fellow: **Maya Mendez (2029)** **Concentration:** **Environmental Studies**

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

Title of Project: **Identifying and Assessing Best Management Practices for Invasive Species on Conservation Properties**

Funding Source: **Upstate Institute**

Project Summary:

Cazenovia Preservation Foundation (CPF) is a nonprofit land trust that protects 3,800 acres of land in conservation. Since its founding in 1967, CPF has served as a vital pillar for the Cazenovia community, maintaining 14 miles of multi-use trails across 436 acres of owned land and fostering a meaningful connection between residents and their environment. To ensure these landscapes remain resilient for future generations, CPF is embracing new mapping technologies to monitor forest health and climate resilience. My role was to help bridge the gap between technical data and field action by establishing a baseline for a new, organization-wide invasive species management plan.

My project specifically addressed the escalating threat posed by invasive species. The goal was to assess the number of invasive species on CPF property, research how best to manage each species, and test which management strategy is more effective and feasible for a nonprofit organization like CPF. I approached this work in two distinct phases. To begin, I utilized the Finger Lakes PRISM Summer 2026 Trail Survey Program, a community science initiative where I used the Survey123 mobile app to document invasive species populations while hiking local CPF trails. Second, I conducted an in-depth analysis of management strategies for Japanese Knotweed, one of the most aggressive invasive species in the region, which has established a presence along two CPF trails. By meticulously logging the person-hours required for surveying, measuring, and manually removing Japanese Knotweed, I developed a feasible model. This data-driven framework now allows CPF to predict the time and personnel hours needed to manage future patches based on their size.

Location	Person hours/acres
A	16.7
B	12.5
D1	11.4
D2	75
D3	45

In all the trail surveys that I performed, 3 species off the Finger Lakes PRISM list were identified: Japanese knotweed, wild parsnip, and beech leaf disease. To determine the best way to manage each knotweed location, I developed a chart showing the person-hours per acre required for each of the 5 locations where knotweed was removed, using data collected during my fieldwork. Using this information, I estimated how much of the volunteer workforce should be dedicated to each location, with locations D2 and D3 requiring the most attention: 3-4 volunteers a week for about an hour, starting at the beginning of the growing season. Because of the lower work density, locations A, B, and D1 may only require one volunteer a week for an hour. I also recommend that, when removing Japanese Knotweed, it be dug up to the rhizomes as close as possible, and black tarping be used after removal to solarize any new sprouts. These locations should also be monitored weekly for perimeter growth to remove new shoots and starve the plant.

Research Fellow: **Chris Mendina (2027)** **Concentration:** **Physics**
Faculty Mentor: **Kiko Galvez** **Department:** **Physics and Astronomy**
Title of Project: **Exploring Quantum Entanglement Using Polarization-Controlled Two-Photon Interference**
Funding Source: **Justus ’43 and Jayne Schlichting Student Research Fund**
Project Summary:

At the heart of quantum mechanics lies one of its most striking and counterintuitive phenomena: entanglement. When two particles become entangled, measuring one instantly reveals information about the other, regardless of the distance between them. This “spooky action at a distance,” as Einstein famously called it, is not merely a theoretical curiosity — it is a physical reality that has been demonstrated experimentally and underlies emerging technologies in quantum computing, cryptography, and communication. This project investigates entanglement through the behavior of light itself, using pairs of entangled photons to directly observe quantum interference effects that have no classical analog.

Entangled photon pairs were generated via spontaneous parametric down-conversion (SPDC) in a nonlinear Type-I beta-barium borate (BBO) crystal pumped by a 405nm laser, producing photon pairs at 810nm, both vertically polarized. The photon pairs were separated at a fiber beamsplitter and directed into two free-space interferometer arms before being recombined at a 50/50 beamsplitter. Single-photon avalanche diodes (SPADs) at each output port recorded singles and coincidence counts, with coincidence events defined by a ~40ns timing window. A motorized delay stage in one arm allowed continuous scanning of the relative arrival time of the two photons at the beamsplitter, enabling measurement of the two-photon temporal interference pattern as a function of path length difference. The Hong-Ou-Mandel effect causes photons that arrive at the beamsplitter at the exact same time, with the exact same polarization to exclusively exit out of the same port of the beamsplitter.

Each interferometer arm contained a fixed half-wave plate (HWP) oriented at 0°. The left arm additionally contained two variable birefringent quartz plates (QP1 and QP2) and the right arm contained a variable quarter-wave plate (QWP). By systematically varying the orientation angles of these birefringent elements across dozens of combinations, the polarization state of each photon was independently controlled, allowing manipulation of the joint two-photon quantum state. The coincidence rate as a function of delay stage position was recorded for each configuration, producing characteristic interference traces displaying combinations of dips and peaks at up to three distinct delay positions.

While the two outside dip positions can be accounted for, the central one remains a mystery. Due to the birefringence of the quartz, the delay between the vertical and horizontal polarizations allow for the photon in the left arm to align with photon in the right arm at different delays. This means that the vertical polarization will produce a dip and the horizontal will produce a dip, but why the dip in the middle? As the angles of the quartz plates and the QWP are varied, different arrangements of peaks and dips appear in those same positions. Future directions of this research are to explore the existence of the middle feature position and continue to improve coincidence counts through better free-space coupling efficiency.

Research Fellow: Nathan Molloy (2027) **Concentration:** Biology
Faculty Mentor: Sarah McMillan **Department:** Biology
Title of Project: Characterizing SSB/ExoIX Protein Interaction
Funding Source: Oberheim Memorial Fund
Project Summary:

My summer research project aimed to better understand the interaction between the single-stranded DNA binding protein, SSB, and the exonuclease, ExoIX. These proteins are known to interact and carry an essential function as part of DNA damage repair as SSB binds directly to sites of DNA damage and recruits ExoIX to remove incorrect base pairs on the DNA. DNA repair is essential to cells as DNA damage occurs frequently due to UV radiation or exposure to chemicals and can cause mutations that alter cell functionality which could result in the formation of cancer. Previous research located the binding site on ExoIX in which SSB binds, but further study was needed to determine the importance of the specific amino acid residues at this binding site. In order to further characterize this interaction, binding assays using wild type and mutant ExoIX were performed using purified SSB and ExoIX proteins.

The project began with the purification of SSB. The SSB was purified by lysing cell pellets with sonication and an initial polymin p precipitation followed by an ammonium sulfate precipitation. These precipitations helped to begin the purification as SSB comes out of solution at lower salt concentrations than most proteins, quickly removing many of the other molecules in the solution with the SSB protein. The protein was then further purified through the use of column filtration using fast liquid protein chromatography (FPLC). The FPLC is a method of column filtration in which the protein is bound to a column resin while other molecules are washed away from it. The protein is then able to be eluted off using salt and collected to be used in another column to remove further contaminants. The SSB purification used two types of columns, an anion exchange and size exclusion column that bound the SSB to the resin based on its charge and size.

After SSB had been successfully purified, ExoIX had to be purified. Since ExoIX is an exonuclease and removes nucleotides, expression of this protein had to be tightly regulated. In order to regulate this expression, the ExoIX gene was inserted into the pBAD plasmid that will activate transcription of the gene when arabinose is present. Cells were then transformed with this plasmid and were cloned using the Gibson Assembly. The ExoIX pBAD plasmid was then transformed into high expression cells and induced with arabinose to produce high amounts of ExoIX protein. The cells were then lysed using sonication and purified using the FPLC with a heparin column, an anion exchange column, and a size exclusion column. Plasmids to express two ExoIX mutants (K113E and R248E) were also created using site-directed mutagenesis and a KLD reaction and an identical purification process as the wild type will be used to purify these proteins.

Purified SSB and ExoIX were then used initially in wild type binding assays to establish normal binding behavior between the two proteins before mutant binding activity can be assessed. Purified SSB and ExoIX were analyzed in an ammonium sulfate co-precipitation assay where the low levels of ammonium sulfate causes SSB to come out of solution as well as any ExoIX that was bound to it.

In the near future, assays with mutant ExoIX proteins will be performed and compared to the results of the wild type assays and additional binding assays such as a SSB antibody pulldown and a fluorescence polarization assay will be performed with both wild type and mutant ExoIX to further characterize the protein interaction.

Research Fellow: Daniel Montan Jacome (2028) **Concentration:** Sociology
Faculty Mentor: Nicole Simpson **Departments:** Economics; Upstate Institute
Title of Project: Making Ends Meet: Strengthening the Programs Rural Families Need
Funding Source: Upstate Institute
Project Summary:

Across Madison, Chenango, Delaware, and Otsego counties, roughly 41.5% of households cannot afford the basic costs of living, even though many of these families work, sometimes at multiple jobs. This group is known as ALICE (Asset Limited, Income Constrained, Employed): the "working poor," who earn too much to qualify as living in poverty but too little to cover rent, food, and childcare. Because they appear to be getting by on paper, ALICE families are often overlooked by standard measures of hardship and can struggle to find or access the support already available to them. This summer, as an Upstate Institute Summer Field School Fellow, I worked with the United Way of Mid-Rural New York (UWMRNY) to help close that gap, focusing on two of the organization's community impact coalitions.

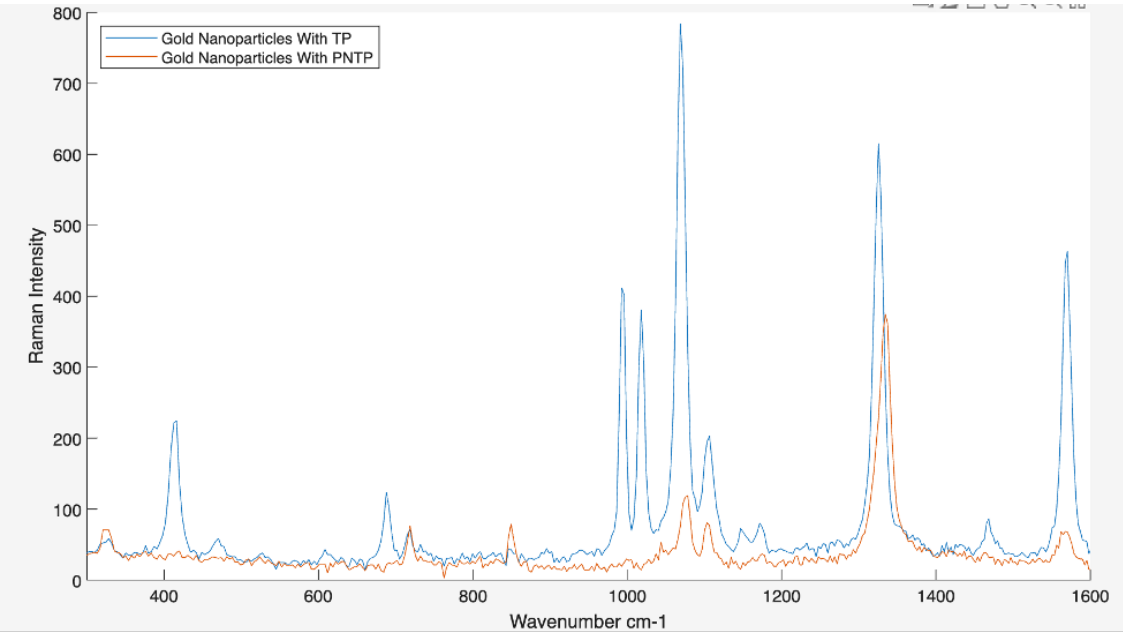
My first project supported the CA$H Coalition, which provides free tax preparation services across the region. The coalition is at an inflection point: a longtime partner is stepping back from holding the IRS grant that funds much of the coalition's work in Otsego County. I researched pathways forward and recommended two strategies: (1) pursuing new partnerships, including bringing Sidney Federal Credit Union on as a coalition partner, and (2) strengthening UWMRNY's role as the coalition's central facilitator, most notably through a centralized, four-county website that would let residents find free tax help regardless of where they live.

My second project focused on the region's hunger coalitions, which address food insecurity across the four counties. This assignment evolved over the summer, shifting from an initial study of a possible merger between two coalitions toward a more realistic question: how each coalition could strengthen its own footing and improve communication, both internally and with the public. I recommended that both coalitions ground their identity in their role as conveners, organizations that connect existing resources and partners, rather than as direct service providers, and that they prioritize closing the information gap around benefit programs, such as informing farmers market vendors and shoppers about SNAP acceptance.

Neither project concluded with a single finished deliverable. Instead, both are positioned as works in progress: recommendations meant to guide decisions over the coming years, particularly as the CA$H Coalition navigates a genuine transition in how it sustains critical services. As a sociology and geography major who studies poverty, inequality, and space, this fellowship gave me the chance to see those concepts operate in real decisions affecting real families. My hope is that this research helps UWMRNY and its coalition partners move the needle on the challenges facing Mid-Rural New York.

Research Fellow: Cooper More (2029) **Concentration:** Undeclared
Faculty Mentor: Eric Muller **Department:** Chemistry
Title of Project: Surface Plasmon Induced Reactivity
Funding Source: Justus '43 and Jayne Schlichting Student Research Fund
Project Summary:

This summer, I looked at plasmonic reactions. Plasmonic reactions are catalyzed by waves of electron gas plasma, kick-started on a metal surface by incident light such as a laser or by applying an 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 metal surface. The plasmonic reaction we studied was that of para-nitrothiolphenol (PNTP) on gold surfaces. The way we did this was by setting up a nanoparticle-on-mirror geometry. We examined the differencesIn pntp and how plasmonic reactions occur based on the physical environment and disease either Gold nanoparticle or gold substrate. The first part of this was creating the nanoparticles. With trisodium citrate and gold chloride, AuNPs were synthesized according to the Frens-Turkevich method. Then UV-Vis spectroscopy was used to measure the size of the Nanoparticles By finding the wavelength at which absorption was at its maximum. The next part of the construction was creating the film surface on which the nanoparticles were placed. This was done by template stripping the gold. Finally, solutions of PNTP and a different Self-Assembled monolayer (SAM) were made through a series of dilutions. Then we call it either the gold nanoparticles or the gold substrate when the different self-assembled monolayers are finally put together on mirror geometry. We then used a 532nm incident light laser to examine these samples. Raman spectroscopy happens when light strikes a sample. Instead of reflecting back entirely, at certain energy levels, reflection matches the resonance of a bond, and from there, the bond can be examined and identified. From this, we were able to prove that we successfully coated the PNTP nanoparticles



This is a graph of gold nanoparticles covered in different SAMs. The peak shift at 1350 cm^{-1} corresponds to the pntp coded nanoparticles. The peak shifting and around a thousand nanometers there are two definite Peaks for the thiophenyl coded nanoparticles those correspond to the Raman signal.

Research Fellow: **Leah Nemi (2028)** **Concentration:** **Molecular Biology**

Faculty Mentor: **Engda Hagos** **Department:** **Biology**

Title of Project: **Investigating the Role of Krüppel-like Factor Four (KLF4) in Regulating Lipid Metabolism**

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

Project Summary:

Krüppel-like factor 4 (KLF4) is a transcription factor involved in the regulation of cellular growth, differentiation, autophagy, and more. KLF4 acts in a context-dependent manner as both a tumor suppressor and an oncogene in cancer cells. It has been found to reduce genomic instability through the regulation of the DNA damage response and cell cycle, and regulate metabolic homeostasis by enhancing the efficiency of energy production and increasing autophagy in response to glucose starvation. However, little is known of KLF4's role in regulating lipid metabolism, as shifting between glycolysis and fatty acid oxidation (FAO) may also promote cancerous growth. Preliminary data suggests that KLF4-null cells may exhibit greater metabolic shifting, allowing for survival under metabolic stress. This study aims to investigate KLF4's role in regulating lipid metabolism in relation to maintaining genomic stability and metabolic homeostasis.

In order to assess KLF4's role in regulating lipid metabolism, +/+ (wild-type) mouse embryonic fibroblasts (MEFs) and -/- MEFs (KLF4-null) were compared under metabolic stress. Flow cytometry was performed to assess cell viability under glycolytic inhibition using 2-Deoxy-D-Glucose (2-DG and FAO inhibition using Etomoxir. It was found that +/+ MEFs were more vulnerable to glycolytic inhibition, while -/- MEFs were more vulnerable to FAO inhibition (Fig. 1). FAOBlue fluorescent staining was used to detect levels of FAO in +/+ and -/- MEFs following glucose starvation. It was found that -/- MEFs increased FAO when glucose starved at 0% glucose and had significantly higher FAO fluorescence at 0% glucose than +/+ MEFs (Fig. 2). Western blotting was performed to investigate changes in protein expression. It was found that -/- MEFs have higher basal lipid metabolism protein expression than +/+ MEFs, that they increase lipid metabolism expression at 2 mM 2-DG, and that they conversely decrease lipid metabolism expression when FAO is inhibited. These results suggest that KLF4 downregulates lipid metabolism in +/+ MEFs and limits their ability to shift between glucose and lipid metabolism in response to stress. Further studies will continue to investigate the shift between glucose and lipid metabolism under stress and study the mechanism by which KLF4 may regulate lipid metabolism.

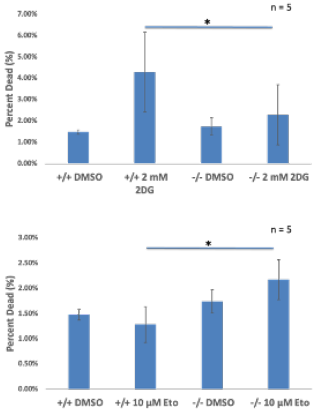


Figure 1. (Left) KLF4-null MEFs exhibit reduced sensitivity to glycolysis inhibition and greater sensitivity to FAO inhibition. (A) Flow cytometry analysis of KLF4-WT and KLF4-null MEFs treated with 2mM 2-DG indicates that KLF4-WT MEFs are significantly more vulnerable to glycolytic inhibition ($p = 0.033$). (B) Flow cytometry analysis of KLF4-WT and KLF4-null MEFs treated with 10 µM Etomoxir indicates that KLF4-null MEFs are significantly more vulnerable to FAO inhibition ($p = 0.036$).

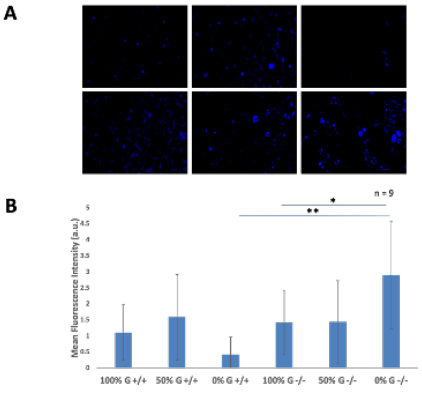


Figure 2. (Right) KLF4-null MEFs exhibit increased levels of FAO upon glucose starvation compared to KLF4-WT MEFs. (A) FAOBlue dye staining was used to assess FAO activity in glucose-starved KLF4-null and KLF4-WT MEFs. (B) Quantification of mean fluorescence intensity indicated a significant increase in FAO activity in KLF4-null MEFs between 100% glucose and 0% glucose ($p = 0.042$), while KLF4-WT MEFs showed no significant change ($p = .066$). FAO activity was also significantly higher in KLF4-null MEFs than in KLF4-WT MEFs under 0% glucose conditions ($p = 0.002$).

Research Fellow: **Alex Osteen (2028)** **Concentration:** **Natural Sciences**

Faculty Mentor: **Krista Ingram** **Department:** **Biology**

Title of Project: **Facial Recognition and eDNA Analysis of Harbor Seal Social Networks Provides Insight into Population Dynamics of Wild Pinnipeds**

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

Project Summary:

Wild populations of elusive marine mammals are naturally difficult to study. Luckily, harbor seals spend lots of time on haul-out sites during molting and pupping seasons. Time spent above water offers perspectives into population dynamics and diversity via two complementary analysis methods - Facial Recognition and Environmental DNA.

In order to establish a baseline from which to conduct facial recognition, a photo gallery of the original seals has to be gathered. Since this project's inception roughly 7 years ago, the Ingram Lab has built the gallery up to about 630 harbor seals prior to this year, where it now sits at about 800. SealNet 2.0, the facial recognition program based on software originally created in collaboration with Professor Ay and his lab, trains on this large gallery so that every new picture taken can be fed in as a probe for comparison to seals we already know (Hall, 2026). The program uses certain facial landmarks such as inter-pupil distance in order to mathematically differentiate between seals. Their pelts change colors and patterns constantly during molting season, so the safest metric to make facial matches with is through machine learning. This summer, we analyzed seal photographs from 2024 - and we are currently working on processing this alongside data from 2025. Preliminary results from work this summer include 101 new seals added to our database over 4 days of analysis across 2 haul-out sites.

Environmental DNA, or eDNA for short, consists of material such as skin, waste, fur, hair, etc shed from macroorganisms into their surrounding environments. This type of DNA is fairly new to the science world, and due to the nature of collection (water sampling), there is no guarantee that DNA of a specifically desired animal will be present when testing. DNA extraction and concentration starts the lab process post collection, with samples then going through qPCR amplification in order to identify positive and negative results. Samples that generate positive results are then passed through PCR with specifically tailed primers in order to isolate parts of the genetic matrix that are specific to our intended animal. They are then put through gel electrophoresis and prepared to be sent for Next Gen Sequencing. Samples analyzed yielded mostly positive results, with a standout finding showing that passive filtering captures solid eDNA. 40 water samples across 11 dates were processed (30 active, 10 passive) with positive qPCR amplification of 9 samples (4 active, 5 passive).

The culmination of our summer as a lab was spent conducting field work in coastal Maine over a two week period. As a group, we took lots of HD photographs of seals seen at both Grassy and Branning ledges - the two centralmost sites that this project is focused on. While on the boat to take pictures, water samples were also collected through manual bottle filling and deployment of the underwater drone "Daisy". These 10 cumulative samples were then filtered and frozen to be analyzed in the Colgate lab.

Research Fellow: Olivia Pearre (2027) **Concentrations:** Chemistry; Mathematics

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

Title of Project: Defining Pnictogen-Specific Control of Palladium Catalysis through a PPnP Pincer Series (Pn = N, P, Sb, Bi)

Funding Source: Division of Natural Sciences and Mathematics

Project Summary:

Modern chemical synthesis is driven by catalysis, which serves two purposes: efficiency and practicality. Chemists can use miniscule amounts of a catalyst in order to speed up reactions, some of which would essentially never occur in practical timescales. They can thus forgo the need for large quantities of expensive chemicals and reduce experimental waste. Although catalysts can accelerate a wide range of transformations, one of the most fundamental reactions is carbon-carbon (C-C) bond formation, which allows for the construction of complex molecular frameworks required for industry (such as polymers), technology (dyes), and even health (pharmaceuticals). Of the C-C bond-forming reactions, one of the most vital is the aldol reaction; however, despite its usefulness, aldol reactions are typically limited due to poor selectivity and the need for harsh, highly basic conditions. As a result, there has been a longstanding need for a catalyst that can drive an aldol reaction quickly, selectively, and under mild conditions.

While catalyst design conventionally focuses on tuning the transition metal using classical non-metal ligands, growing evidence shows that heavy main-group ligands can reshape catalytic energy landscape profoundly. We have previously studied a bismuth-supported palladium compound $BiPd^{Cl}$ as a catalyst for an aldol reaction between aldehydes and isocyanoacetate with unprecedented efficiency. However, controlled comparison across Group 15 in a constant ligand scaffold is unexplored. We here report on the investigation of an analogous catalyst supported by an antimony ligand, $SbPd^{Cl}$, whose structure was fully characterized by XRD and NMR spectroscopy. of $SbPd^{Cl}$ from quantitative to 75% under the identical condition. In particular, kinetics experiments demonstrated that the reaction rate shows a zero-orderdependence on the concentration of $SbPd^{Cl}$, in contrast to the first-order-dependence for $BiPd^{Cl}$, implying a unique but less understood pnictogen effect. Further stoichiometric studies of SbPdCl in addition to systematic comparison with analogous complexes supported by phosphorus and nitrogen ligand, PPd^{Cl} and NPd^{Cl} are in progress. These results will guide the design of future efficient catalysts using heavy main-group elements.

Research Fellows: Gabe Pollock-O'Dorisio (2028) **Concentration:** Chemistry
Dev Sethi (2027) **Concentration:** Biochemistry
Faculty Mentor: Anne Perring **Department:** Chemistry
Title of Project: Black Carbon Measurements During NASA INSPYRE Field Campaign
Funding Source: Warren Anderson Fund; Division of Natural Sciences and Mathematics
Project Summary:

Wildfires can influence the atmosphere well beyond the regions in which they occur. In addition to releasing large amounts of smoke, more intense fires can also generate their own clouds through a process known as pyroconvection. These clouds are known as pyrocumulus (PyroCu) and pyrocumulonimbus (PyroCb). As they develop, these systems can transport smoke to high altitudes where it can travel long distances and affect atmospheric composition, radiation, and climate. We worked with Dr. Anne Perring as part of the INjected Smoke and PYRocumulonimbus Experiment (INSPYRE), a NASA field campaign focused on understanding wildfire smoke, pyroconvection, and the processes that control how smoke is transported through the atmosphere. Our work looks at refractory black carbon (rBC) which is created through incomplete combustion and is commonly found in wildfire smoke. Refractory black carbon is important to study because it strongly absorbs sunlight, representing a positive radiative forcing that contributes to climate warming, and can have very detrimental health effects. We measured rBC using a Single Particle Soot Photometer (SP2), a laser-based instrument that detects individual black-carbon-containing particles. As particles transit the laser they first scatter laser light in proportion to their optical size and then heat to the point of incandescence when they emit visible light proportional to their rBC mass. The SP2 thus determines rBC mass and identifies the presence of coatings on rBC particles.

We spent the first half of the summer at Colgate preparing for the mission and practicing important skills for data analysis. Working with atmospheric datasets from previous airborne missions, we learned about how the SP2 works and the data products it provides, and we developed our computational and coding skills using IgorPro scientific analysis software. This work primarily focused on NOAA and NASA's 2019 Fire Influence on Regional to Global Environments and Air Quality (FIREX-AQ) campaign, which focused on atmospheric impacts of fires across North America, using plume-scale analysis similar to what is appropriate for use during the INSPYRE mission.

We then traveled to the National Center for Atmospheric Research (NCAR) Research Aviation Facility (RAF) in Broomfield, Colorado where we worked to prepare the SP2 for data operation during the science flights. During the field campaign, we helped prepare and maintain the instrument between flights, such as monitoring its performance, troubleshooting any issues, and looking at data on a flight by flight basis. Our instrument was on the Gulfstream V (GV) that flew through targeted wildfire smoke associated with different stages and intensities of pyroconversation.

The 2026 INSPYRE deployment will conclude in September, with some additional data collected in 2027 from a remote-sensing platform, the NASA ER2 (not including an SP2). Future rBC analyses for this project will involve the use of data from other instruments, as well as satellite observations, and atmospheric models. Together, these datasets will help researchers better understand and predict when wildfire smoke is transported into the atmosphere and what conditions allow fires to produce stronger pyroconvection.

Research Fellow: Malia Porter (2028) **Concentration:** Computer Science

Faculty Mentor: Ahmet Ay **Departments:** Biology; Mathematics

Title of Project: Words, Voice, and Face: How an Explainable AI Detects Depression and PTSD

Funding Source: Mind, Brain, and Behavior Faculty Grant

Project Summary:

Depression and post-traumatic stress disorder (PTSD) substantially overlap, yet their diagnosis relies on clinical assessments susceptible to subjectivity and reporting bias. Recorded interviews offer three behavioral signals—words, voice, and face—but multimodal models may capture general distress rather than disorder-specific markers. We applied explainable AI (XAI) techniques to a high-performing multimodal deep learning model to identify robust features associated with depression and PTSD.

Using 275 clinical interviews from the Extended Distress Analysis Interview Corpus (E-DAIC), we trained BiLSTM-LWTA models on 40-second windows of text, audio, and video. Language dominated performance, with text-based models achieving 0.79–0.90 AUC versus 0.52–0.70 for voice and face alone. Word-level attribution identified clinically relevant vocabulary and medication names but no reliable lexical distinction between disorders (Figure 1). Comparing the ten highest-ranked voice and facial features under GradientSHAP and occlusion revealed nearly identical voice features between disorders (9 of 10 in common) but largely distinct facial features (3 in common). Depression was associated with reduced jaw movement and greater eye-region variability, while PTSD showed reduced brow, upper-lid, and lip-tightening variability. Thus, voice primarily reflected shared patterns, while facial features showed greater disorder-specificity. For PTSD, seven of the ten highest-ranked acoustic features also differed significantly between groups after Benjamini-Hochberg correction; all seven showed the same direction in depression but were nonsignificant. Shapley interaction analysis identified 414 robust feature interactions, 70% cross-modal; cross-modal interactions were more often complementary than within-modal interactions (45% vs. 36%) (Figure 2). Together, these results provide a predictive model and candidate shared and disorder-specific multimodal biomarkers that could ultimately support clinicians in detecting and distinguishing depression and PTSD.

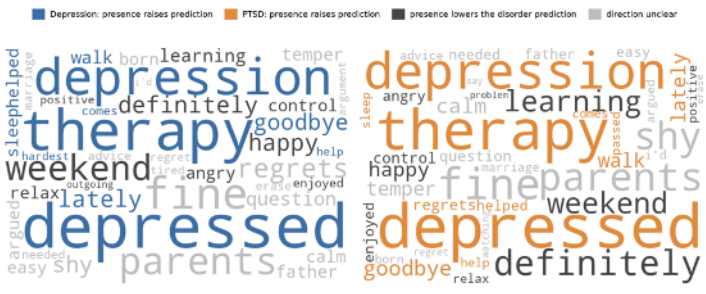


Fig. 1. Recurring lexical markers (word-level occlusion): top-40 words used by at least 10 participants, sized by mean |occlusion attribution| (3 seeds), colored by direction.



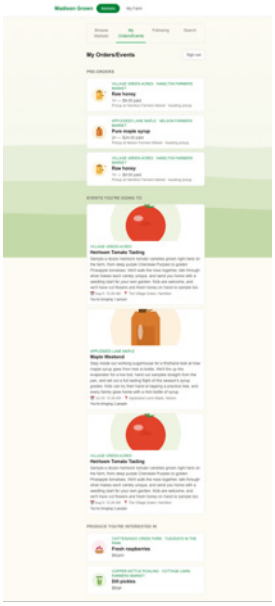
Fig. 2. Interacting measurement pairs in the joint model, depression below the diagonal and PTSD above; grey is overlapping information, color is complementary.

Research Fellow: **Tejas Prakash (2028)** **Concentration:** **Economics**
Faculty Mentor: **Julie Dudrick** **Department:** **Upstate Institute**
Title of Project: **Madison Grown: Madison County's Online Food Market App**
Funding Source: **Upstate Institute**
Project Summary:

Madison Grown is an online food market app created in partnership with the Cornell Cooperative Extension of Madison County (CCE Madison) specifically to support both producers and consumers in Madison County. The app has low barriers to entry, requiring no subscriptions or intricate sign-up processes. Farmers can post produce across all five farmers' markets in the county, as well as promote their own farm events for which consumers can directly RSVP through the app. The platform allows for flexible marketing tactics, as farmers have the option to post pictures, weights, and prices of their products if needed, but not required. To further promote efficient marketing while still being effective, the platform allows producers to repost produce in a matter of seconds that they plan to bring to the markets that week so consumers can see up-to-date product availability every week. Farmers also have the ability to track all their sales and inventory across all goods they produce, allowing them to assess business performance easily, as producers can see what goods are performing better at each market or their own farm stand. Consumers have the ability to browse goods and pre-order ahead of time, reducing consumer search costs while promoting local businesses.



A mixed-methods research study was conducted on Madison County consumers and farmers to gain a better understanding of consumers' spending patterns and farmers' willingness to adopt new online marketing technologies. 135 survey responses were collected across multiple farmers markets and local food events, allowing CCE Madison to gain insight into age demographics, what consumers are purchasing, why consumers may not come to markets, how often consumers are attending markets, how people hear about local food offerings, and whether consumers are open to learning about local food offerings through an online platform. Key results featured an older demographic, with 67% of respondents stating they were 46 years of age or older. Fruits and vegetables were the most purchased goods at markets, according to the survey. The most often identified barriers to local food access were convenience and a lack of knowledge of local food offerings. A literature review on the benefits of online food markets in rural communities, as well as informal interviews at markets, brought insight into the ability of Madison County stakeholders to adopt an online food market app, and results further showed the Madison Grown mobile app could be impactful in boosting small business sales and support in Madison County.



Research Fellows: **Andrew Prosnitz (2029)** **Concentration: Undeclared**
Micahra Semper (2028) **Concentration: Biochemistry**
Faculty Mentor: **Jacob Goldberg** **Department: Chemistry**
Title of Project: **Incorporation of Fluorinated Amino Acids into Proteins**
Funding Source: **Justus ’43 and Jayne Schlichting Student Research Fund; Michael J. Wolk ’60 Heart Foundation**

Project Summary:

Fluorine is largely absent in biological systems. Its absence proves to be a favorable characteristic for imaging techniques including MRI, PET, and 19F NMR. The ability to site-specifically incorporate fluorine labels into proteins introduces the ability to investigate interactions and structural changes. Our laboratory incorporates fluorinated amino acids into proteins in E. coli through genetic code expansion. We successfully incorporated fluorinated amino acids into proteins using an orthogonal amino-acyl amber suppressor tRNA and synthetase pair.

Several fluorinated amino acids have been synthesized and successfully incorporated into proteins to date. Our work focuses on difluoromethylphenylalanine (dfmF) and trifluoromethylphenylalanine (tfmF). We incorporated this unnatural amino acid into the protein Carbonic Anhydrase II. We chose CA II as it is a well documented protein, thus any changes to the structure/stability that the incorporation of tfmF or dfmF will bring we will know about.

We used Genetic Code Expansion as our incorporation method. In contrast to codon reassignment methods, genetic code expansion techniques rely on orthogonal amber suppressor tRNA and synthetase pairs to reprogram a stop codon for a non-canonical amino acid.

Following cell transformation, cells were grown through primary and secondary inoculations with arabinose autoinduction to promote protein production. The expressed proteins were purified using affinity column chromatography after cell lysis and protein extraction, and successful purification was evaluated by SDS-PAGE gel electrophoresis.

Future work on this project will focus on incorporating tfmF and dfmF to determine their influence on the thermostability of CA II. By comparing the thermal stability of wild-type and modified proteins using techniques such as circular dichroism spectroscopy, it will be possible to assess whether these fluorinated amino acids enhance or reduce resistance to heat- induced unfolding.

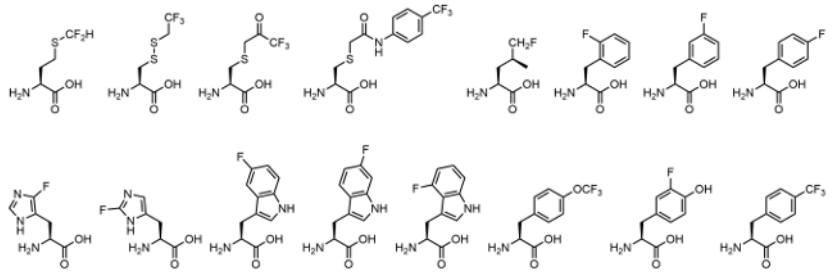


Figure 1. Synthesized fluorinated amino acids; some have difluoromethyl phenylalanine (dfmF) or trifluoromethyl phenylalanine (tfmF).

Research Fellow: **Summer Raimondo (2028)** **Concentration:** **Classical Studies**
Faculty Mentor: **Julie Dudrick** **Department:** **Upstate Institute**
Title of Project: **Hamilton Historic Commission**
Funding Source: **Upstate Institute**
Project Summary:

Every day, the Hamilton Historical Commission strives to keep the village's rich past alive by sharing its archive and library exhibit space with over 4,000 residents and curious visitors alike. As society increasingly moves online, the Commission has embarked on a digital transformation to make Hamilton's history, which stretches back to the 1790s, accessible to everyone both in person and virtually.

To support these efforts, I spent the summer as an Upstate Institute Field School Fellow working as a research assistant and exhibit creator for the Commission. In light of the United States' 250th anniversary, my research focused on uncovering and highlighting the stories of Hamilton's early founders and their Revolutionary War service. I curated a public exhibit housed in the Hamilton Public Library and built a foundational database documenting key biographical and military details of local Revolutionary War veterans. Along the way, I uncovered deep historical ties between the village's original settlers and the founding of Colgate University, bridging local community history directly with campus heritage.

My work serves as the first phase of an ongoing three-phase project by the Commission to digitize and publish these records for public access, enabling descendants to trace their family histories and helping community members honor local Revolutionary War figures. As a pre-law Classical Studies student, conducting deep archival research and managing complex historical data sharpened the exact analytical and investigative skills I will rely on when examining legal records and court archives in law school. Working alongside dedicated board members gave me a meaningful way to serve my college town, preserve local memory, and grow as a researcher.

Research Fellow: Kyle Reece (2028) **Concentration:** Physics

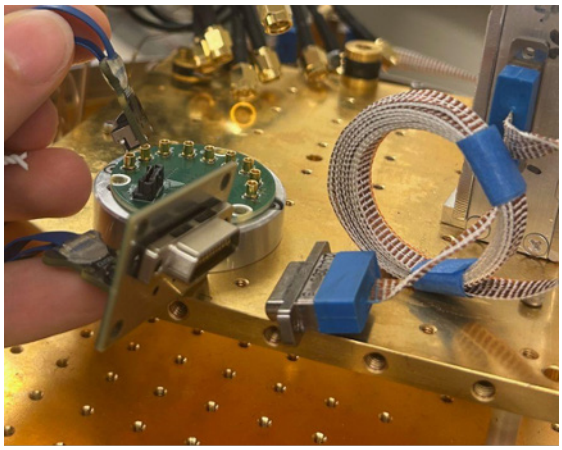
Faculty Mentor: Ken Segall **Department:** Physics and Astronomy

Title of Project: Artificial Neural Networks using Superconductors

Funding Source: Great Sky Grant

Project Summary:

Over the course of the summer, we learned and practiced many technical skills and gained a working understanding of a cutting-edge topic we did not know of. In our first week, we were given numerous articles and a lecture by Professor Segall in order to gain a baseline understanding of the research we were doing. Our first week's duties included soldering various components, familiarizing ourselves with the lab equipment, learning the coding language IGOR, which we would use for our experiments, and preparing to collect data the following week. Over the course of the summer, we learned how to collect experimental data on various chips and how to analyze said data. We learned how to operate and understand readings from "The Fridge," which is our ~2.8K cryostat chamber. In addition to experimenting, we also frequently modeled and tested simulated configurations of chips using Colgate's Supercomputer and would often present our findings to Professor Segall and the startup responsible for the production of the chips we were experimenting on, Great Sky.



In addition to collecting experimental and simulated data, we were also given numerous projects to work on. Some of these projects were based on theoretical knowledge that we had built up over the summer and in Physics courses from previous semesters. Other projects were technical projects where we were responsible for the creation or implementation of some process or critical component that needed replacing or updating. One of these projects was replacing the Dsub to Samtec converter (pictured to the left) that broke after a previous experiment. This converter allows us to connect the inputs we send into the fridge to the circuit of the chip; without this, we would be unable to collect data. Since we had no experience with surface mounting, we first had to research the process. As opposed to the soldering type we had done previously with solid solder and a soldering iron, where you put the pins of the chips through holes in the board and connect them on the other side, surface mounting involves applying solder in a paste onto the same side that the chip is on and attaching the chip as you would when gluing something to paper. To do this, we first had to create a system of multiple hot plates to heat the solder to the right temperatures at the right times. This process took many iterations of attempting, evaluating, and refining until we ended with the Samtec port attached. Then, we used the traditional method to solder the D-sub connector to the custom board to complete the converter. For a more theoretical project, we were tasked with calculating the number of transistors and wires used to create a typical two-input neuron in a transistor digital network and comparing it to that of a superconducting analog network like the one we were using for a presentation. To do so, we broke the digital network into adder, multiplier, and comparator circuits, and those further into Logic gates, and then wires/transistors. As a result, we were able to determine the number of transistors, wires, and power used for an n-bit digital network and compare it to that of an n-bit analog superconducting network. This was then presented, along with figures we created, at a TechX presentation later in the summer.

Research Fellow: Nelson Rice (2029) **Concentration:** Undeclared
Faculty Mentor: Amy Leventer **Department:** Earth and Environmental Geosciences
Title of Project: Eucampia antarctica diatom research: Reconstructing the history of sea ice
Funding Source: Hackett-Rathmell 1968 Memorial Fund
Project Summary:

Over the past decade, sea ice concentration around Antarctica has been decreasing. This is concerning given the role of sea ice in global climate, through its impact on ocean-atmosphere heat and carbon dioxide exchange, and on global albedo. However, satellite-based, instrumental records of sea ice extend back over only ~50 years. In this study, we tested the use of the polar marine diatom species Eucampia antarctica as a tool to reconstruct the history of sea ice in the Denman-Shackleton region of Antarctica, using a sediment core to extend our record back farther in time. Diatoms are microscopic, single-celled algae with a siliceous, or glass, shell. They can be found in nearly all aquatic habitats, including the ocean surrounding Antarctica, where their shells are exceptionally well preserved at the sea floor. Each diatom species prefers specific environmental conditions, allowing scientists to use fossil diatom assemblages in sediments to interpret past environmental conditions. Eucampia antarctica forms colonies, or chains, through asexual reproduction, when there is adequate light for photosynthesis. The presence of winter sea ice reduces light availability, thus limiting chain length. Chain length can be estimated based on the proportion of terminal valves to interior valves within a chain; these forms can be distinguished easily based on light microscopy. Longer chains, with more interior valves, are thought to reflect times of greater open water, when more light is available for photosynthesis. Earlier formation of sea ice in the autumn is recorded by shorter chains of Eucampia and a greater proportion of terminal valves.

Kasten Core 02 (NUY2025_V03_37_KC02) is a high resolution, continuously laminated sediment core from the Denman-Shackleton region of East Antarctica. The 395 cm long core likely preserves a decadal to century scale record of past sea ice conditions. Quantitative microscope slides were made via a random settling technique and counted at 10 cm intervals throughout the core, and at 2 cm intervals in the upper and lower 20 cm of the core. A total of 100 specimens of Eucampia were counted on every slide, using an Olympus BX41 microscope at 400X magnification. The valves were recorded based on whether they were flat (interior) or pointy (terminal). A valve was counted if more than half of the valve was present in the field of view. The data document high variability in the estimated chain length on shorter times scales. This high variability is overprinted on a longer term trend of decreasing sea ice toward the present. The next step in this study will be to develop a chronology for the sediment core, using a combination of two radiometric dating tools, Pb-210 and radiocarbon, so that the changes observed in this core can be used to place recent observational changes into a longer term perspective.



Research Fellow: Grant Ricks (2028) **Concentration:** Geography
Faculty Mentor: William Meyer **Department:** Geography
Title of Project: Urban, Suburban, or Rural Origins of American Appellate-Court Judges
Funding Source: Division of Social Sciences
Project Summary:

The importance of fair representation among holders of public office is becoming widely recognized, as ensuring that political power is not unevenly possessed and exercised by different groups. Although most studies have focused on race, gender, and religion, geographic background also deserves attention, especially as ideological polarization among American urban, suburban, and rural populations is considerable and appears to be increasing. Previous studies have found that city-dwellers are over-represented in legislative- and executive-branch positions. Possible biases in the personnel of the judicial branch, especially of appellate-level courts, however, have been little explored. Accordingly, we sought to determine which justices of the most important such court, the United States Supreme Court, have come from urban, suburban, or rural backgrounds and whether any particular background has been over- or under-represented.

To answer this question, we drew on available biographical and United States Census data to classify individual justices geographically, based on where they spent the majority of their pre-adult (0-16) and their adult pre-appointment years. We then compared the Court's personnel over ten-year periods, from the beginning of the nineteenth century onward, to the geographic makeup of the United States population. We first used the standard Census definition of "urban" places as politically incorporated ones having a population of 2,500 or more, and "rural" as all others. For a second part of the study, beginning at the end of the nineteenth century, we used three categories: "urban," embracing cities of 50,000 or more within county-based metropolitan areas; "suburban," the rest of the metropolitan area; and "rural," or non-metropolitan. In each ten-year period, centered on a federal Census year, we calculated the character of the Court's membership by the percentage of the total years during that decade served by the justices from each geographic background. For comparison, national percentages of urban, suburban, and rural residents were calculated from Census data. Our analysis indicated that American urban populations have generally been overrepresented on the Court throughout its history, while rural and suburban residents have been underrepresented. Further research might examine the reasons for the pattern and the effects that it may have had.

Research Fellows: **Lana Rinkin (2029)** **Concentration: Undeclared**
Isaiah Ruffin (2028) **Concentration: Molecular Biology**
Shep Sorenson (2027) **Concentration: Molecular Biology**
Faculty Mentor: **Priscilla Van Wynsberghe** **Department: Biology**
Title of Project: **Exploring Lin-42 & Kin-20 Interactions in *C. elegans***
Funding Source: **Division of Natural Sciences and Mathematics; Michael J. Wolk '60 Heart Foundation**

Project Summary:

This summer, the Van Wynsberghe lab explored the interaction of two circadian rhythm proteins within the context of the model organism *C. elegans*. *C. elegans* is a small nematode that serves as an effective model organism due to the speed at which they mature and the ease with which it can be cultured and reproduced. The proteins of interest we studied were LIN-42 and KIN-20, which are homologs of the mammalian circadian rhythm proteins period and CK1, respectively. LIN-42 is a transcription factor that also controls the molting timing of *C. elegans*, and when it is interrupted, the worms go through the four molting stages in an uncoordinated manner. To function properly, LIN-42 requires KIN-20 to bind and phosphorylate it to allow LIN-42 to carry out its functions as a circadian clock protein. The region where KIN-20 interacts with LIN-42 is referred to as the CK1 binding domain, and to study the interaction between KIN-20 and LIN-42, we partially deleted this binding domain to create a mutant strain of *C. elegans*, which we refer to as the 3sdel deletion. Overall, in this project we sought to determine the effects of the 3sdel mutation on LIN-42 and to determine if there is a physical interaction between LIN-42 and KIN-20 in vivo.

We performed western blotting to analyze LIN-42 protein levels. We also performed immunoprecipitations to test if LIN-42 and KIN-20 were physically interacting. According to our preliminary results, we found evidence of physical interaction between LIN-42 and KIN-20. The Western blot showed that when LIN-42 was pulled out of the solution by antibodies, KIN-20 came with it, which suggests that there is a physical interaction in place. Based on the Western blotting experiments, we found that 3sdel affects LIN-42 protein levels. In conclusion, significant progress was made this summer in the pursuit of developing a better understanding of the relationship between LIN-42 and KIN-20, which in turn furthers our comprehension of the function and regulation of mammalian CK1 and Period proteins.

Research Fellows: **Lana Rinkin (2029)** **Concentration: Undeclared**
Isaiah Ruffin (2028) **Concentration: Molecular Biology**
Shep Sorenson (2027) **Concentration: Molecular Biology**
Faculty Mentor: **Priscilla Van Wynsberghe** **Department: Biology**
Title of Project: **Molecular Analysis of Development in *C. elegans***
Funding Source: **Division of Natural Sciences and Mathematics; Michael J. Wolk '60 Heart Foundation**

Project Summary:

LITE-1 is a seven-transmembrane photoreceptor that absorbs UV-A and UV-B and is required for *C. elegans* to detect and respond to light. While one might expect LITE-1 to be homologous to a photo- or light receptor, LITE-1 is instead a member of the invertebrate gustatory receptor family, whose receptors allow animals to detect and 'taste' chemical compounds in the environment. To date, researchers have demonstrated that *C. elegans* possesses 24-hour rhythms in movement, response to smells, and metabolism that require light to operate properly, suggesting that LITE-1 plays a role in *C. elegans* circadian rhythm. In addition to detecting light, LITE-1 is needed for *C. elegans* to detect and avoid hydrogen peroxide.

In humans, photoreceptors and opsin proteins entrain circadian rhythms by influencing the expression and activity of proteins that regulate the circadian clock. However, little is known about whether or how LITE-1 interacts with proteins involved in the regulation of circadian rhythm in *C. elegans*, such as LIN-42, the period protein homolog, which is an essential member of the circadian clock.

To continue, the first goal we had was to determine if LIN-42 was involved in the same pathways as LITE-1. To test this, we performed experiments with UV light. Worms were placed (LIN-42, WT N2, LITE-1, LITE-1; LIN-42) onto agar plates, and a portion of the plate was subjected to a wide beam of UV or green light. Then, the number of worms in the UV or green light after 45 seconds, 5 minutes, and 10 minutes was recorded. The results showed that the LITE-1; LIN-42 strain presented the most UV avoidance. Moreover, the LIN-42 strain demonstrated a similar reduction in UV avoidance as the LITE-1 strain relative to N2, suggesting that LIN-42 also plays an important role in *C. elegans* response to UV light.

Our second goal was to determine what phenotypes LITE-1 influenced in *C. elegans*. The first phenotype we observed the effects of LITE-1 on related to this process called "bursting," which involves a microRNA called let-7. MicroRNAs are short RNA molecules that regulate gene expression by binding to mRNA sequences and preventing their translation into protein. Let-7 is a microRNA that functions as a tumor suppressor in humans and results in a bursting phenotype in *C. elegans*, involving the expulsion of internal organs from their body. LIN-42 mutations inhibit this let-7 bursting, meaning that any protein which influences LIN-42 levels may affect levels of bursting. We analyzed the LITE-1 impact on let-7 bursting by tracking let-7 mutant worms' bursting levels through worm counting after 48 and 51 hours on control, LIN-42, or LITE-1 RNAi agar plates. We found no statistically significant results of earlier bursting to suggest that LITE-1 inhibits LIN-42. We also saw that LIN-42 bursts significantly less on average than LITE-1 worms. However, our trials weren't consistent.

The second phenotypic trait we examined in our LITE-1 strain was body length. The reason for this is that certain mutations in LIN-42 are known to result in a shorter, "dumpier" phenotype relative to wild type. Therefore, one could imagine that LITE-1 may influence body length as well. To test this, a worm assay was performed with varying strains (LIN-42, N2, LITE-1, LITE-1; LIN-42) by measuring worm length through Nikon microscope pictures and through NIS software. The results show the worm strains without LITE-1 are longer in length on average.

To conclude, our interest in the role of LITE-1 in the *C. elegans* circadian clock arises from the lack of an established pathway connecting LITE-1 and circadian clock proteins. Further research on this gene would help uncover the various mechanisms and complex functions of this photoreceptor of *C. elegans*. In the context of our research specifically, we wanted to determine morphology, UV avoidance, and mechanisms (inhibition of LIN-42) to grow closer to understanding LITE-1.

Research Fellow: **Thomas Rivier (2028)** **Concentration:** **Political Science**

Faculty Mentor: **Rachel Amann-Burns** **Department:** **Upstate Institute**

Title of Project: **Helping Refugees Attain Citizenship: Evaluating the Updated 2025 Naturalization Exam**

Funding Source: **Upstate Institute**

Project Summary:

Becoming a United States citizen is the final step in an immigrant or refugee's journey and provides them all of the same benefits as somebody born in the country. Lawful permanent residents must pass the naturalization interview, which tests English and knowledge of US civics and history. On October 20th, 2025, US Citizenship and Immigration Services (USCIS) under the Trump administration implemented a new, more challenging naturalization civics exam, replacing the 2008 exam, while also issuing new policies that expanded officer discretion, authorized neighborhood investigations of applicants, and introduced the possibility that a denied application could trigger deportation proceedings. Together, these changes significantly changed what it means to apply for citizenship in the United States, and raised urgent questions for organizations like the Mohawk Valley Resource Center for Refugees (The Center) in Utica, New York, which helps hundreds of refugees through the naturalization process every year.
This research examined the 2025 naturalization exam and its surrounding policy environment, evaluated The Center's current citizenship preparation program, and identified recommendations for how the program could continue serving clients effectively. Data sources included a comparative analysis of the 2008 and 2025 civics question banks, national USCIS naturalization outcome data, The Center's own client records from January 2024 through June 2026, interviews with citizenship and ESOL teachers, observations of two citizenship classes, and a review of best practices in adult education, refugee naturalization, and similar organizations.

Despite no clients at The Center having taken the 2025 exam by the end of summer 2026, several key findings emerged. The 2025 exam nearly triples the proportion of questions requiring conceptual reasoning, asking applicants to explain why and how the American government works rather than simply recall facts, confirmed by a Center client who passed her interview in June 2026 and noted that officers rephrased questions differently than they appear in the study materials. Nationally, the denial rate nearly doubled from approximately 8% to over 18% between mid-2025 and April 2026, driven in part by new USCIS policy that took effect before the exam itself. Despite this, The Center's program has remained highly effective: 96.8% of decided cases were approved from January 2024 through June 2026, far above the national average. Teacher interviews revealed a dedicated staff teaching civics for conceptual understanding, conducting individual mock interviews, and running a Karen-specific class consistent with research-based best practices.

Through my research, I proposed four potential enhancements: increasing citizenship class frequency; establishing a shared curriculum framework; formalizing communication between ESOL teachers and citizenship coordinators; and prioritizing one-on-one tutoring for clients who have previously failed their interview.

As clients begin taking the new exam in the coming months, tracking interview outcomes, pass rates, and which components clients struggle with will be essential for understanding its real impact and adjusting the program accordingly.

Research Fellow: **Antonius Robello (2029)** **Concentration:** **Theater**
Faculty Mentor: **April Sweeney** **Department:** **Theater**
Title of Project: **A Midsummer Night's Dream**
Funding Source: **Storytelling Fund; Division of Arts and Humanities**
Project Summary:

During the summer, I spent ten weeks in Freiburg, Germany, working under the guidance of Professor April Sweeney on a production of William Shakespeare's A Midsummer Night's Dream. I went into the experience interested in how different cultures and communities make theatre. We worked with an English-speaking troupe, The ManiACTS. This gave me the opportunity to experience a theatrical process outside of the United States. It also made me think more deeply about how we tell stories to audiences who may not share the same language or cultural background.

I worked on the production as Assistant Director, Co-Costume Designer, and Production Stage Manager. Each role gave me a different perspective on the production. As Assistant Director, I was involved in rehearsals and helped develop the blocking of scenes. As Co-Costume Designer, I thought about how our visual choices could help communicate character and story. Being the Production Stage Manager showed me the organizational side of bringing a production together. Moving between these roles helped me understand how much each part of a production depends on the others.

The language barrier became one of the most interesting parts of the experience for me. Even though we were performing in English, we were performing for a community where English was not necessarily everyone's first language. Shakespeare can already be difficult for modern English-speaking audiences to understand. Because of this, I began thinking much more carefully about what we were communicating beyond the words themselves.

I learned that I could not take the audience's understanding for granted. Our blocking needed to make the relationships between characters clear. Movement could communicate something that an audience member might miss in the dialogue. Costume design could give the audience information about a character before they even spoke. Dramaturgy helped us understand what needed to be communicated for the larger story to make sense. If an audience member missed a line or did not understand a word, I still wanted them to be able to follow what was happening onstage.

My time in Freiburg ultimately changed the way I think about making theatre. I came away from the project much more aware of the audience. I also became more conscious of how many different tools we have to communicate with them. Working within a different community reminded me that theatre cannot rely only on what is said onstage. What an audience sees matters just as much. What they understand from the performers' bodies matters too. Moving forward, I want to be more intentional about making choices that invite an audience into the story, even when language might create a barrier between us.

Research Fellow: Kiernan Robinson (2028) **Concentration:** Astrogeophysics

Faculty Mentor: Jonathan Levine **Department:** Physics and Astronomy

Title of Project: Testing the DIMPLE Instrument for its Flight to the Moon

Funding Source: Division of Natural Sciences and Mathematics

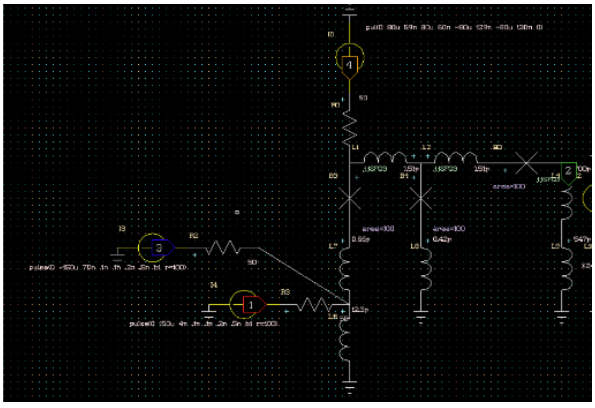
Project Summary:

During my summer research fellowship in 2026, I helped the team prepare the DIMPLE payload for its mission to the Moon, by analyzing data and assisting team members as they adjusted the machinery. The overarching goal of the DIMPLE project is to send a probe to the moon that will use a system of lasers to break off particles from rocks present on an irregular patch of the moon's surface and send those particles to a detector which will sort the particles by arrival time to show what elements and compounds are present on the surface. By specifically looking at the relationship between the relative abundances of Rubidium and Strontium, the DIMPLE team can determine the age of these rocks and by extension, determine the age of an irregular mare patch of the moon named Ina. Currently, the system is still being tested and fine-tuned to get the full functionality the team is looking for, and my job was to help them in this process. My primary task was to analyze data collected from testing the system to see what the machine was detecting and comparing that to the composition of the sample material it's looking at. If there was any discrepancy between the two, it meant something wasn't working as intended along the way, and the system needed to be adjusted. The process of making these adjustments often went faster with multiple people, so I visited the DIMPLE laboratory at the Southwest Research Institute in Boulder, Colorado, where I acted as an extra set of hands during calibrations, replacing components, and other changes that came up during my time there.

Research Fellow: **Chad Ruggiero (2028)** **Concentration:** **Physics**
Faculty Mentor: **Ken Segall** **Department:** **Physics and Astronomy**
Title of Project: **Research on Superconducting Neural Networks**
Funding Source: **Division of Natural Sciences and Mathematics**
Project Summary:

Over the course of my summer, I have familiarized myself with the primary concepts of artificial intelligence, and have researched the potential for a promising new revolution in its underlying infrastructure. Today, artificial intelligence is a well-known technology that has transformed life profoundly in countless ways, whether it appears in the form of a chatbot like ChatGPT, or providing control for self-driving cars. Underneath its impressive capabilities, these systems all rely on neural networks, a basic artificial model of the human brain. Artificial intelligence relies on a digital, binary-based system, to operate. While it is a 'simpler' solution than alternatives, its power usage, training time, and compute time all scale up as the neural network's complexity increases. This issue leads to real world problems, like energy and water consumption for cooling. In Professor Segall's lab, we worked with Great Sky AI, a company that is forging a new path of longevity for AI, using the physics of superconductivity. This physics principle can allow a circuit to exhibit no power usage while running, as long as it is kept at an extremely low temperature of ~3 Kelvin (-454º F). Using some ingenuity and the Josephson junction, a superconducting circuit component, Great Sky has been well on the path towards neural networks that are faster and more energy efficient than conventional systems.

In my research this summer, I have been grateful to be able to interact and improve upon many different processes. On the experimental side, I have learned to properly load and operate the cryostat, prepare for experimentation, run and edit programs using Igor Pro, and synthesize data results. One of the steps in preparing for experiments was to ensure that two of the shields within the cryostat highly reduced the impacts of magnetic fields on the chip inside. Over a couple weeks, I invented a compact device that took data on these shields automatically. Using an Arduino, a stepper motor, C++ code, a 3D printer, and many other parts, I was able to have it successfully take measurements and output them into an easy-to-use text file.



One of the other major projects was a deep analysis of the programmable memory loop circuit. In the neural network, neurons are summed, thresholded, and multiplied, a similar process to the brain. In the multiplication process, a value is multiplied by a weight that is determined by training the AI model. This weight is stored in the memory loop. At the start of this endeavor, my lab coworkers and I took experimental data on a memory loop, but found unexpected results. Thus, a long investigation was launched into this phenomenon. After running countless simulations using WRSpice, a circuit analyzing tool that used the Colgate Supercomputer, many discoveries were made. About 60 Google Docs pages of observations, data, and graphs were made on different versions of the circuit, providing necessary insights. Ultimately, some versions of the circuit were found to eliminate most of the issues that were causing issues. This project gave me a deep dive into the detail necessary to make the neural network fully operational.

Research Fellow: Penelope Schenkel (2028) **Concentration:** Chemistry

Faculty Mentor: Anthony Chianese **Department:** Chemistry

Title of Project: Continued Study of Kinetics of Ruthenium-catalyzed Hydrodehalogenation Reactions

Funding Source: Division of Natural Sciences and Mathematics

Project Summary:

Understanding the kinetics of a chemical reaction can provide useful information about the mechanism by which a reaction operates, as well as how the rate of a reaction relates to other relevant factors such as substrate concentration, catalyst concentrations, etc. This project, initiated last summer, aims to increase our understanding of the reaction kinetics that occur when using Milstein's catalyst. A catalyst is a substance that assists in other chemical reactions; our research with Milstein's catalyst focuses on hydrogenation and dehydrogenation reactions.

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. Milstein proposed that the catalyst operated through a radical mechanism and published preliminary NMR data on the catalytic species active during the reaction.

To further examine the reaction mechanism, kinetic experiments at Colgate utilized gas chromatography; tetradecane was used as an internal standard. As in the aforementioned paper, 1-bromodecane was used as a substrate, with sodium tert-butoxide (NaOtBu) as a base and isopropanol (iPrOH) as the solvent. Kinetic experiments were performed at 50° C with varying concentrations of substrate, base, and catalyst. The reaction appears to be first order in catalyst and NaOtBu. The reaction kinetics of the substrate appear to be more complex; at low concentrations of bromide the reaction is first order, and as substrate concentration increases the order approaches zero.

Sodium bromide (NaBr) was added in a later experiment to assess potential product inhibition. The reaction appears to slow over time, and we postulated that this was because NaBr, which forms throughout the reaction, was preventing product formation. Results did not indicate that this was the case, and we conducted further trials with cryptand, a multidentate ligand that sequesters cations (Na^+). This trial resulted in high substrate conversion with a low product yield, and we were unsuccessful in reducing side products, which has previously been an issue in experiments.

Trials using the radical traps TEMPO and DMPO resulted in substrate conversion into side product, with no formation of product. Samples were taken at different time points then analyzed with 1H-NMR and 31P-NMR, and it appears that the catalytic species changes over the course of the reaction. Future research will focus on analyzing the catalytic species present to assess if a radical trap adduct forms to prevent product formation.

Research Fellow: Olivia Schlegel (2027) **Concentrations:** Applied Math; Economics
Faculty Mentor: Nick Moore **Department:** Mathematics
Title of Project: High Fidelity Numerical Simulation of Rogue Waves
Funding Source: Office of Naval Research Grant
Project Summary:

Rogue waves are a rare and extreme phenomenon that occur in the ocean, appearing suddenly and with great intensity. Although they seem to arise randomly, their formation may be influenced by underlying physical mechanisms. The Korteweg–de Vries (KdV) equation has been used for years to mimic real wave behavior and propagate waves through time. By solving the KdV equation, we can gain insight into the propagation of nonlinear wave structures and explore potential factors that contribute to the emergence of rogue waves.

Rogue waves can be modeled using the KdV equation, which propagates nonlinear waves: ut + C3uux + C2uxxx = 0.

To solve KdV, we use the Taylor Method with an exponential integrator. Solving KdV numerically is difficult because the linear part of the equation is stiff, meaning numerical solvers must take extremely small steps to find an accurate solution. Adding an exponential integrator to the solver handles the linear term exactly, removing this issue. The Taylor method then takes a chain of time derivatives of the wave and uses them to Taylor expand the equation forward by one time step, which tells us where the wave sits in physical space a moment later. Using recursion formulas to take derivatives, it becomes very easy to take more derivatives and increase the order of the accuracy of the method. Tested against two independent measures of error, the method converged as expected with near machine precision. Additionally, it was more accurate than other solvers such as the general Taylor method without an exponential integrator and a second order Runge-Kutta method.

Once we were confident in our solver, we were able to run ensembles of wave samples and see how they changed over time and what we could find in common amongst larger waves. We first looked to find if there is something we can measure at the start of the wave that may give a higher likelihood of a rogue wave forming. We found waves that had a high initial skewness had a higher likelihood of developing into large waves and 40% of the variation in the largest wave an ensemble produced is determined by the skewness at the initial condition. We also saw interesting behavior in the spectrum of large waves. As we approach a rogue wave, the slope of the spectrum flattens. A steep initial spectrum that flattens over time may itself be a predictor of a rogue wave.

We also began looking into how depth changes can affect the statistics of a wave, particularly the wave's skewness and excess kurtosis. As expected from Professor Moore's previous research, when depth becomes shallower, skewness, excess kurtosis, and wave height all increase. However, something interesting happened when we returned to the initial depth: wave statistics do not simply return to where they started before the shallow depth. Skewness drops straight through its original level and settles near zero, while kurtosis and wave height both settle slightly above their original values. All three are also more volatile in the final deep phase than they were in the first, swinging around noticeably more than before the wave entered shallow water, suggesting crossing into shallow water permanently changes the shape of a wave.

Research Fellow: **Madeline Shingleton (2028)** **Concentration: Biology**
Faculty Mentor: **Jason Meyers** **Departments: Biology; Neuroscience**
Title of Project: **FGF Signaling May Be Restricted to Central Support Cell Populations During Neuromast Regeneration**
Funding Source: **Michael J. Wolk '60 Heart Foundation**

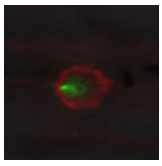
Project Summary:

Zebrafish, unlike humans, possess the ability to regenerate their sensory hair cells which are found in small volcano-shaped sensory organs known as neuromasts. Neuromasts are made up of mantle cells, support cells, and hair cells, with support cells differentiating into hair cells in response to damage. Fibroblast growth factor (FGF) signaling is known to promote a transition from mesenchymal to epithelial cell morphology during neuromast formation, and we hypothesized that this transition is also important during hair cell regeneration. To investigate this, we used the drug PD 166866 to inhibit FGF signaling in regenerating neuromasts after a UV-light laser lesion and used antibodies targeting Stat3 and phosphorylated Erk, downstream effectors of FGF signaling, to visualize the pathway's spatial activity during regeneration.

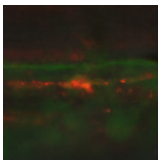
Inhibiting FGF signaling with PD 166866 prevented hair cell regeneration relative to DMSO-treated control larvae at three days post lesion (dpl) (Fig. 1). PD-treated neuromasts showed a persistent "flat neuromast" phenotype even after several days of regeneration, while DMSO-treated controls were able to regain the typical round phenotype.

To spatially visualize FGF pathways in regenerating neuromasts we developed an immunohistochemistry staining protocol for an antibody targeting phosphorylated Erk after an initial antibody targeting Stat3 proved unsuccessful. In DMSO-treated neuromasts at three dpl, staining revealed a "lattice" pattern focused around the central part of the neuromast with the unstained "holes" of the lattice seeming to correspond with the positions of hair cells (Fig. 2). In PD-treated neuromasts, the staining instead showed a flat, undifferentiated shape seemingly mirroring the flat mantle cell phenotype. These results suggest that during normal neuromast regeneration, phosphorylated Erk is localized around the center-most population surrounding the newly formed hair cells.

Together, these results suggest that FGF signaling drives re-epithelialization of newly differentiated hair cells, and that this process depends on FGF pathway activity in the adjacent central support cell population.

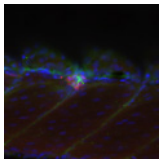


DMSO-treated, 3 dpl

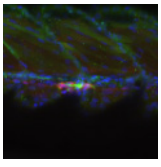


PD-treated, 3 dpl

Fig. 1. FGF inhibition disrupts re-epithelialization during regeneration. Neuromasts treated with the FGF inhibitor PD 166866 (right) fail to reform a normal rosette structure by three dpl. DMSO-treated controls (left) regain a normal structure by three dpl.



DMSO-treated,
Erk antibody, 3 dpl



PD-treated,
Erk antibody, 3 dpl

Fig. 2. FGF pathway activity is localized to central support cells during normal regeneration. Phosphorylated Erk concentrates centrally in DMSO controls, with gaps corresponding to hair cells (left). PD-treated neuromasts show a flattened Erk pattern mirroring Fig. 1 (right).

Research Fellow: Georgia Sones (2027) **Concentrations:** Geography; Computer Science
Faculty Mentor: William Meyer **Department:** Geography
Title of Project: Urban, Suburban, or Rural Origins of American Appellate-Court Judges
Funding Source: Division of Social Sciences
Project Summary:

The importance of fair representation among holders of public office is becoming widely recognized, as ensuring that political power is not unevenly possessed and exercised by different groups. Although most studies have focused on race, gender, and religion, geographic background also deserves attention, especially as ideological polarization among American urban, suburban, and rural populations is considerable and appears to be increasing. Previous studies have found that city-dwellers are over-represented in legislative- and executive-branch positions. Possible biases in the personnel of the judicial branch, especially of appellate-level courts, however, have been little explored. Accordingly, we sought to determine which justices of the most important such court, the United States Supreme Court, have come from urban, suburban, or rural backgrounds and whether any particular background has been over- or under-represented.

To answer this question, we drew on available biographical and United States Census data to classify individual justices geographically, based on where they spent the majority of their pre-adult (0-16) and their adult pre-appointment years. We then compared the Court's personnel over ten-year periods, from the beginning of the nineteenth century onward, to the geographic makeup of the United States population. We first used the standard Census definition of "urban" places as politically incorporated ones having a population of 2,500 or more, and "rural" as all others. For a second part of the study, beginning at the end of the nineteenth century, we used three categories: "urban," embracing cities of 50,000 or more within county-based metropolitan areas; "suburban," the rest of the metropolitan area; and "rural," or non-metropolitan. In each ten-year period, centered on a federal Census year, we calculated the character of the Court's membership by the percentage of the total years during that decade served by the justices from each geographic background. For comparison, national percentages of urban, suburban, and rural residents were calculated from Census data. Our analysis indicated that American urban populations have generally been overrepresented on the Court throughout its history, while rural and suburban residents have been underrepresented. Further research might examine the reasons for the pattern and the effects that it may have had.

Research Fellow: Yaroslav Spytskyi (2028) **Concentration:** Chemistry
Faculty Mentor: Anthony Chianese **Department:** Chemistry
Title of Project: Ru-catalyzed Hydrodehalogenation
Funding Source: Division of Natural Sciences and Mathematics
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.

This is my second summer working on the project. During the first summer, I focused on developing the scope and limitations of the reaction. I tested a variety of organohalides with different functional groups. At the end of the summer, I produced a table of compounds that underwent hydrodehalogenation with high yields (most yields were above 90%). In the beginning of this summer, I finished working on the scope of the reaction and began the next stage of the research, where I conducted the mechanistic study of the reaction.

The first step in the mechanistic study was to determine the intermediates present in the reaction, which would give hints to possible mechanistic pathways. I used hydrogen and phosphorus NMR to study catalyst intermediates. Milstein's catalyst has distinctive peaks in hydride and aromatic region of the hydrogen NMR. If the catalyst undergoes changes during the reaction, the peaks would shift slightly indicating a new catalyst species present. Once I identified the new catalyst species using NMR, I started synthesizing pure catalyst species to obtain their crystal structures using X-ray crystallography.

X-ray crystallography uses a beam of x-rays to shoot at the crystalline sample of a substance. The electron density in the molecule deflects the incident x-ray beam and the machine records deflection angle, which allows it to construct the molecular structure of the sample. Preparing samples for x-ray crystallography included synthesis of organometallic compounds, isolation and recrystallization techniques.

One of the challenges for the study was the reaction conditions of using pressurized hydrogen gas to 30 bar. Since glass NMR tubes are charged with a sample of reaction, they cannot be pressurized to 30 bar and had to be pressurized to only 1 bar of hydrogen.

Next steps for my research include finishing the mechanistic study of the reaction and starting the kinetic study.

Research Fellow: Catherine Stevens (2027) **Concentrations:** Biology; Middle Eastern and Islamic Studies

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

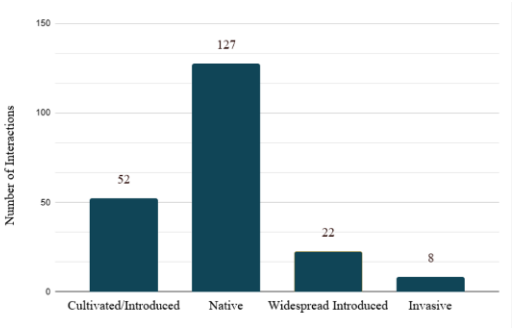
Title of Project: Documenting Native Pollinator Diversity at Rogers Center

Funding Source: Upstate Institute

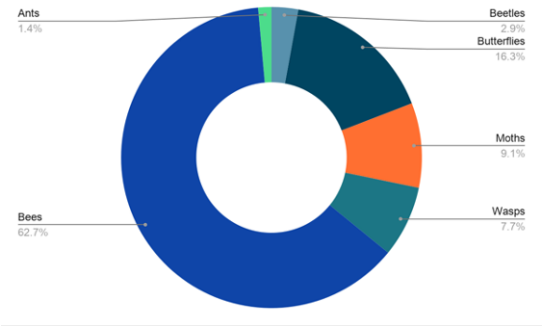
Project Summary:

This summer, I assisted with Rogers Center's Great Pollinator Project, where I documented native pollinator species present at Rogers by taking photographs and uploading them to iNaturalist, where they were preliminarily identified. In addition to iNaturalist, the photographs were organized in a separate spreadsheet that included information such as coordinates, the type of pollinator, and which plant the pollinator was seen interacting with.

I documented 209 pollinator observations of 61 pollinator species. 21 species were bees, 13 were butterflies, 12 were moths, 8 were wasps, 4 were beetles, and 3 were ants. Bees made up 62.7% of observations, as seen in the figure below (right). Of the 61 species observed, 3 are classified as vulnerable by the International Union for Conservation of Nature (IUCN). These are the Monarch, Yellow-Banded Bumble Bee, and Golden Northern Bumble Bee. Finding these species at Rogers shows how the Center contains vital habitat for decreasing pollinator species. As well as examining the pollinators observed, I also looked at the plants they were observed interacting with. As seen in the figure below (left), just over 60% of the plants that native pollinators interacted with were native plants. The information about which species were interacted with will be useful for Rogers as they continue their pollinator habitat restoration.



Number of Interactions by Plant Nativeness



Percentage of Total Observations for Each Type of Species

Another aspect of the Great Pollinator Project at Rogers Center is community science, soI got the chance to learn about community science initiatives and to interact with community members, assisting them with getting started on data collection for the project. In addition to teaching people about pollinator photography techniques and the pollinator observation side of pollinator conservation, I also worked with volunteers to restore habitat and educated summer campers about pollinators. A big part of Rogers Center's mission is to make nature, science, and education accessible to everyone, and I was lucky enough to witness and take part in that this summer. The Great Pollinator Project on iNaturalist contains 590 observations of 122 species made by 28 observers, and I am grateful to be part of that legacy as it continues to grow and inform pollinator habitat restoration at Rogers Center.

Research Fellow: **Megan Sweatt (2028)** **Concentration:** **Environmental Geology**

Faculty Mentor: **Amy Leventer** **Department:** **Earth and Environmental Geosciences**

Title of Project: **First high-resolution late Holocene paleoceanographic record, Dibble Glacier region, East Antarctica: A diatom-based approach**

Funding Source: **Norma Vergo Prize**

Project Summary:

Our understanding of modern, anthropogenic climate change and future changes relies on the context of climate changes throughout geologic history, which we can learn about by studying the microscopic fossils of a type of phytoplankton called diatoms. Diatoms live in surface waters around the world, including around Antarctica, and when they die they sink to the bottom of the ocean, where, in certain conditions, their silica remains are preserved in the sediment. Scientists can then collect pieces of this geologic record by coring into the ocean floor. Each diatom species has different habitat/environmental preferences, so how many and where they show up in the core tells us about what the environment was like at that time. We then use diatom species' environmental preferences to reconstruct paleoclimate and learn more about how the climate has changed over time.

I spent this summer in the micropaleontology lab studying diatoms in a marine sediment core collected by the 2026 COOKIES research team on the R/V Investigator to research the first paleoceanographic record of the Dibble Glacier region in East Antarctica. The core I studied, Kasten Core 12 (IN2026_V01_D56_KC12), is a high-resolution late Holocene core from the Dibble Glacier Basin and has a total length of 268 cm. Microscope slides were made and counted at 2 cm intervals for the upper 20 cm of the core and at 5 cm intervals throughout the remainder of the core, with additional slides made in areas of interest.

Slides were made from approximately 25 mg of dry sediment, or 50 mg if the first slide had a low diatom abundance. Measured sediment samples were then treated with hydrogen peroxide and settled onto slides following the methods described by Warnock and Scherer (2014). Slides were then analyzed using a BX50 light microscope at 1000x magnification. A minimum of 400 diatom valves were counted per slide using snaking transects. A valve was counted if more than half of the valve was present and visible within the field of view, or for centric diatoms, if the center was present.

Some of the initial trends we have observed from the quantitative diatom data include an overall decrease in absolute diatom abundance (ADA) upcore, with possible cycling. The abundance of Fragilariopsis kerguelensis slightly increases upcore, with a particularly large increase between approximately 130 and 150 cm. Fragilariopsis curta remains relatively constant throughout the core and is inversely correlated with Fragilariopsis kerguelensis. Other less significant trends were observed in other species, and together with these major trends, we will be able to interpret them further and establish a more comprehensive paleoclimate record once we do radiocarbon AIOM dating, which we recently requested. Future work will include further quantitative diatom analysis of other kasten cores collected in the Dibble Glacier region to continue to build out the regional paleoenvironmental record.

Research Fellow: Ava Thur (2027) **Concentrations:** Educational Studies; Peace and Conflict Studies

Faculty Mentor: Rachel Amann-Burns **Department:** Upstate Institute

Title of Project: How do the Barriers to Postpartum Care in Rural New York Influence the Health of Birthing People?

Funding Source: Upstate Institute

Project Summary:

This summer I worked with NYSARH (New York State Association of Rural Health). My research focused on the shortages of obstetrical units in rural New York State and where these promising strategies, including non-traditional health care workers and additional policy changes, are being utilized. I focused on postpartum care because the weeks following childbirth are crucial for establishing the long-term health and well-being of both the birthing person and infant. One of my projects was to develop an issue brief and to outline the existing literature by taking an objective approach to the issue. I worked to understand the current analysis of data with respect to rural New York State and identified NYSARH policy positions that are relevant to the issue. My research included setting up various interviews, panel discussions, and conversations with relevant stakeholders on postpartum care. These conversations allowed me to gain insight into the direct experience of rural health care providers and how they believed postpartum care could be accessible to all birthing people. The other half of my work this summer included hosting a webinar as a part of the organization's webinar series. The webinar was titled: The "Fourth Trimester": Postpartum Care in Rural New York and the Health of Birthing People. It addressed the barriers that rural birthing people face during the postpartum period and some recommendations for the future.

More than 2 million women of childbearing age across the United States live in maternity care deserts, areas without access to birthing facilities or maternity care providers. In rural areas across New York, 47.6% of birthing people live over 30 minutes from a birthing hospital compared to 3.8% living in urban areas. This directly impacts the postpartum period, as the physical and mental changes following childbirth can create long-term health and wellness challenges. A lack of postpartum care, in the most extreme instances, can lead to maternal mortality. In the United States, according to a CDC maternal mortality review board, 53% of death-related pregnancies occurred between 7 days and 1 year after birth. Approximately 80% of these deaths are considered preventable with proper care and access. During my research, I highlighted a few potential solutions for New York State to provide access to adequate postpartum care.

A few of the most prominent solutions include: providing resources and educational opportunities to the birthing person during discharge such as a birth kit during/directly after hospital stay, lactation and breastfeeding consultants for every hospital or birthing center, and access to postpartum support groups. In addition, integrating community healthcare workers into hospital settings and community organizations will also help with postpartum care. NYHealth's Primary Care initiative attempts to strengthen the primary care workforce through an integrated Community Healthcare Worker (CHW) model. This approach can be adapted for rural communities to improve maternal care during the postpartum period. Lastly, by expanding nurse-family partnerships (NFP) programs, there will be less of a transportation barrier as well as a lower risk of postpartum emergencies. NFP is designed to improve families' economic self-sufficiency and maternal life course development as well as maternal health and birth outcomes. These suggestions can lead the way towards creating equitable access to rural maternal care.

Research Fellow: Nathan Walsh (2028) **Concentrations:** Physics; Computer Science
Faculty Mentor: Ramesh Adhikari **Department:** Physics and Astronomy
Title of Project: Leaf-Based Salinity Gradient for Power Generation
Funding Source: Division of Natural Sciences and Mathematics
Project Summary:

Differences in salt concentration contain usable energy. When fresh and salt water mix, ions naturally move from the concentrated solution toward the dilute solution. If a membrane allows positive and negative ions to move at different rates, this motion can produce a difference in charge, which can be used as an electrical voltage to generate current. The world's oceans contain approximately 2.6 terawatts of this osmotic energy. However, conventional ion-selective membranes can be harmful to the environment and difficult to manufacture, motivating interest in abundant biological materials. Leaves are especially promising because their naturally formed microchannels transport water and ions throughout the plant. This project investigates whether leaf tissue can serve as a low-cost, biodegradable membrane for harvesting energy from salinity gradients and examines how membrane treatment, device geometry, electrodes, and salt type affect the measured electrical output.

Fallen leaves were collected from the northern red oak (Quercus rubra) tree on campus, rinsed and soaked in a hot NaOH bath. This aimed to induce ion-selectivity by functionalizing the leaf surface with hydroxyl ions. After another rinse, these samples were mounted between two liquid chambers containing potassium chloride solutions with concentration ratios of up to 1000:1. Several different tests were conducted centered around improving the device's maximum power density. This included testing different device geometries, NaOH treatment times, electrode type and concentration. In each test an I-V Graph was recorded along with the open-circuit voltage (VOC) and short-circuit current (ISC) VS time. Control experiments included equal-concentration solutions and non-treated leaf samples.

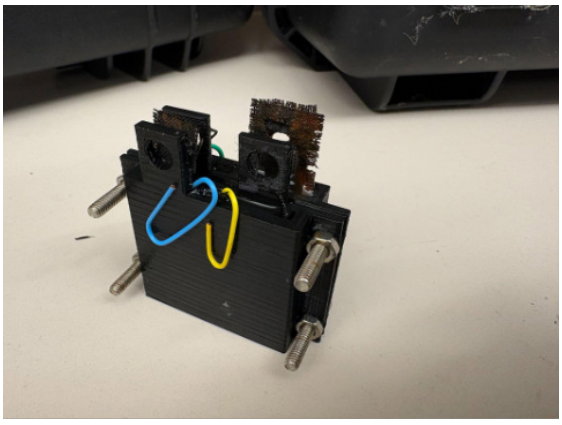


Figure 1 - Device Setup

Preliminary measurements show the device configuration above (Figure 1), with carbon fabric electrodes, produced the apparent maximum open-circuit voltage of 507 mV and short-circuit current 0.6 mA. This correlates to a max power density of approximately 1 wm^{-1} . In the future, we hope to continue to boost the maximum power density as well as experiment with applications for our device. We hope to test the device with various load resistances, salt types and effective areas to continue to gather data and explore the nuances of how our device works.

Research Fellow: **Allison Wen (2028)** **Concentration:** **Physics**
Faculty Mentor: **Rebecca Metzler** **Department:** **Physics and Astronomy**
Title of Project: **Effects of Rising Sea Surface Temperature on the Microstructure and Crystal Orientation in Nucula proxima in the Gulf of Mexico**
Funding Source: **Justus '43 and Jayne Schlichting Student Research Fund**

Project Summary:

Anthropogenic climate change is affecting the oceans globally. The northern Gulf of Mexico is currently facing a variety of changes in water conditions, including increasing sea surface temperatures (SSTs) and decreasing dissolved oxygen (hypoxia). These changes can impact biomineralization and might be observed through changes in the crystal microstructure of calcifying marine organisms. To understand the impacts of a changing climate on coastal environments, we investigated changes in the microstructure of Nucula proxima, a deposit-feeding bivalve, geographically and over time. Previous work by other researchers found that warmer sea surface temperatures positively correlated with thicker nacre tablets and greater crystal disorder in more acidic conditions.

In our research, we have been using two different types of microscopy to observe the microstructure of Nucula: scanning electron microscopy (SEM) and electron backscatter diffraction microscopy (EBSD). The shells that we are using have been sampled from off the coasts of Louisiana, Alabama, and Florida in the Gulf of Mexico. Using SEM images, we have been measuring the crystal tablet thickness in the nacre layer of Nucula proxima shells. From our data, we have found that there is a positive correlation between larger tablet thickness and areas with warmer water, like Florida. Furthermore, we have observed that Live collected specimens tend to have thicker tablets than their dead collected counterparts (Fig.1). Using EBSD, we are most interested in the shells that were collected live and shells that are dated to be alive >150 years before the present, before the Industrial Revolution. From EBSD scans of Nucula proxima cross-sections, we have been observing Multiples of Random Density (MUD) scores to consider how misorientation of the crystals is different across Live and Dead collected samples and also from Louisiana, Alabama, and Florida. Thus far, we have noticed that the outer nacre (internal) and outer prismatic (external) layers of the shell have both shown that there is less misorientation in samples from Florida, and have the most misorientation in Louisiana.

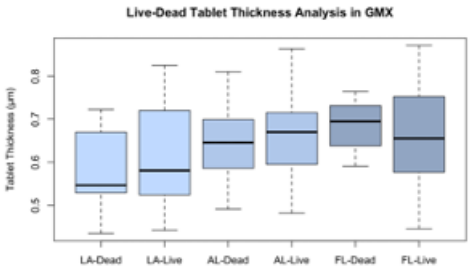


Figure 1: Overall Median TT data from Live and Dead Nucula proxima from Louisiana, Alabama, and Florida (n=133)

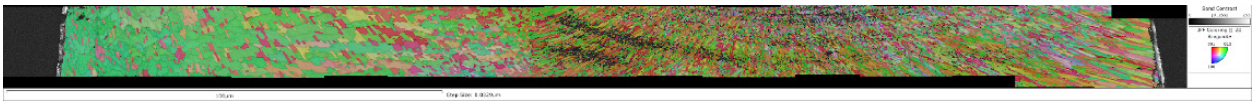


Figure 2: Euler angle with Inverse Pole Figure coloring map of Dead Florida Nucula proxima cross-sections from the outer nacre (left) to the outer prismatic (right)

Research Fellow: **Brendan Werries (2027)** **Concentrations:** **History; Native American Studies**
Faculty Mentor: **Julie Dudrick** **Department:** **Upstate Institute**
Title of Project: **Developing a Custom Photographic Archival and Metadata System for Public Communications**
Funding Source: **Upstate Institute**
Project Summary:

Every day, the Madison County Public Information Office (PIO) works against the clock to keep residents informed, whether that means broadcasting urgent weather warnings, announcing road closures, or promoting local health clinics. Over the years, the team built up a massive library of tens of thousands of photos capturing local landmarks, public events, and community moments. But without a unified system to organize them, finding the right photo for a fast-breaking post was like searching for a needle in a haystack, creating real bottlenecks when public outreach needed to happen instantly.

To solve this challenge, I spent my summer as a Field School Fellow collaborating with the PIO team to build a streamlined digital archive tailored to their fast-paced workflow. I spent weeks sifting through their vast image collection, building a intuitive folder hierarchy organized by county departments, recurring events, and regional locations. To make searching even faster, I tagged photos with rich descriptive metadata, capturing not just where a photo was taken, but how it could be best used across different social platforms. Beyond sorting through existing archives, I also got out into the field to take new photos across the county, while helping establish practical criteria for which images to keep, curate, or discard.

The resulting organizational system has transformed how the PIO operates, drastically cutting down retrieval times so staff can find and publish the exact visuals they need in crucial moments. As a History and Native American Studies major, working on this project gave me a hands-on look at how modern institutional archives are actually built. Deciding which moments to preserve made me appreciate how much thought goes into shaping a public record, and just how challenging it is to capture the full story of a community.

Research Fellow: **Charlotte Wilke-Olsen (2029)** **Concentration: Astronomy/Physics**

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

Title of Project: **Using Bayesian Neural Networks to find Dark Star candidates in JWST photometric data**

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

Project Summary:

Though making up approximately five times more of the universe than baryonic matter, dark matter has yet to be directly detected and its properties remain unknown. Once properties of dark matter particles can be identified, we can gain a much deeper understanding of the universe and open up new areas of study in astrophysics. There are many theories for the structure of dark matter particles and the ways dark matter interacts with baryonic objects in the universe, and one of these is the theory of dark stars. These objects are stars at high redshifts, z, that are powered by the annihilation of a type of self-interacting dark matter particle called Weakly Interacting Massive Particles (WIMPs). When WIMPs annihilate, they release energy that powers the star. This is distinctly different from typical stars, which are powered by nuclear fusion, and therefore have different properties that make them potentially identifiable in data sets that contain observations from high z (data sets with observations z>8). If dark stars can be detected, then for the first time the properties of dark matter can be identified and confirmed. The James Webb Space Telescope (JWST) has been able to provide photometric and spectroscopic data for objects of z>8 for the first time since its launch in 2021. Using JWST photometric data from the NIRCam and MIRI cameras, specifically the JADES data set, we can search data sets for dark stars with machine learning algorithms. In this study, we use Bayesian Neural Networks (BNN), a type of machine learning, to analyze the data. Based on generated training data sets and corresponding parameters, neural networks predict actual parameters from JWST data. In addition to this, the BNNs predict uncertainty in the parameters. The JADES data set contains information about the flux of high z objects, and the parameters predicted by the BNNs are mass and z. The BNNs also produce spectral energy density (SED) fit curves. From there, we analyze the best fit plots using a $X2$ goodness of fit test. This study found 89 candidates for dark stars out of 2230 objects in the JADES data set using BNNs and the goodness of fit test. These results importantly support the existence of dark stars, therefore support the WIMP theory. The candidates can be further investigated using spectroscopic data, potentially leading to the first discovery of dark stars and confirmation of the structure of dark matter.

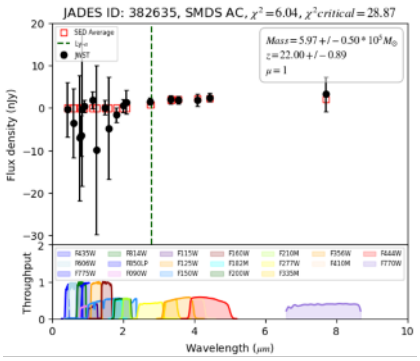


Fig. 1
Object from JADES data that is a strong candidate for a dark star. The SED data from JADES (black dots) matches closely with the predicted SED curve from the BNN (red squares). The goodness of fit test shows the $X2$ value is much less than the $X2$ critical value, indicating a strong fit with the dark star model.

Research Fellow: **Arden Williamson (2028)** **Concentration:** **Political Science**
Faculty Mentor: **Rachel Amann-Burns** **Department:** **Upstate Institute**
Title of Project: **More Than Graves: What the Oneida Community Cemetery Can Tell Us**
Funding Source: **Upstate Institute**
Project Summary:

This summer, I worked for the Oneida Community Mansion House (OCMH), located in Oneida, New York. The OCMH is a non-profit organization that functions as a museum, a National Historic Landmark, a historic inn, and a residence. The museum's mission is to tell the story of the Oneida Community (OC) (1848-1880) from its height as a radical utopian society, known for its practices of free love and socially advanced ways of living, to its transformation into the successful silverware manufacturer, Oneida Limited (1881-2006).

My primary project was to reimagine the OC Cemetery Tour by presenting a personal understanding of life in the Community and creating a more engaging tour. Through three layers of research, writing first-person scripts, and incorporating live interpreters, I transformed the tour into an immersive experience that brings the lives behind the gravestones to life. My three layers of research included general information about the OC, a deep dive into my seven chosen Community members, and then placing their stories in a broader historical context by comparing Oneida funerary and mourning practices with those of mainstream America.

My first two layers of research included reading Community diaries/reflections of life, books published by descendants and OC scholars, Community newspapers, and visiting the Syracuse University Special Collections. These primary resources included accounts directly from my seven chosen Community members and offered a personal look into life in the Community. My last layer of research involved reading Last Rites: The Evolution of the American Funeral, by Todd Hara. This book introduced funerary practices from the Roman and Egyptian eras to the modern push towards green burials, illustrating the expanse of American history through a new lens.

I focused on funerary practices during the prime of the Oneida Community in the 19th century to compare Americans' mourning practices with those in the Community. In the 19th century, American funerary practices were influenced by Queen Victoria's intense mourning for her husband; women and men followed elaborate mourning rituals that reflected deep grief and social expectations of the period. The Oneida Community's outlook stood in sharp contrast to Victorian America, and their religious beliefs were highly influential in their approach. The Community believed that people never truly died, as they would come back in the second resurrection. This created a positive, cheerful attitude towards funerals, believing they would see the "dead" again soon.

From my research, I took away that cemeteries are valuable historical records, funerary practices offer a lens into evolving American values, and live interpretation can bring historical research to life for the public. Ultimately, this experience showed me that historical research does not have to remain on the page; when thoughtfully interpreted, it can bring the past to life and create new connections between history and the public.

Research Fellow: Ryan Wilson (2028) **Concentrations: Environmental Economics; Philosophy**

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

Title of Project: Informing the Impact Investing Program of Adirondack Community Foundation

Funding Source: Upstate Institute

Project Summary:

The role of a community foundation is to direct charitable assets from donors into a defined geographic "service region." To fulfill this purpose, community foundations use a portion of their charitable assets to make grants to local nonprofits and establish pooled funds with the remaining assets to be invested for future grantmaking. Traditionally, these investments are made into public securities, which carry favorable returns, but have no positive impact on the local community. Impact investing, however, directs a community foundation's investments into their service region through private transactions. By providing additional financing options for local small businesses, nonprofits, and individuals, impact investing increases a community foundation's ability to positively impact their service region. Adirondack Community Foundation has completed five years of impact investing. This summer, I conducted two research projects to develop actionable recommendations and insights for Adirondack Community Foundation's impact investing program.

For my first project, I benchmarked the impact investing programs of peer community foundations to develop a comprehensive summary of best practices and innovations. I performed desk research on over 40 community foundations, and I held leadership interviews with 13 of these foundations. During the interviews, I aimed to develop a comprehensive understanding of the peer community foundation's impact investing program. I collected data on how they fund their impact investing, their governance structure, the types of investment structures they employ, their expectations for financial and social returns, and how they source investment opportunities. To analyze this data, I categorized the peer community foundations by size—based on their assets under management—, the maturity of their impact investing program, and the geography of their service region (rural, statewide, urban). After identifying key trends, I drew a comparison to Adirondack Community Foundation's impact investing program and made recommendations accordingly. An important finding from this benchmarking study was the conclusion that, in many ways, Adirondack Community Foundation's impact investing program aligns with the programs of other community foundations.

For my second project, I identified credit unions that could deliver low-interest loans to ALICE (Asset-Limited, Income-Constrained, Employed) families supported by an impact investment from the Foundation. To begin this project, I mapped the geographic footprint of Adirondack Community Foundation's impact investing program to identify local gaps in their coverage. Following this, I used U.S. Census Bureau data to identify areas of need within these local gaps. These areas of need were indicated by high poverty levels or low employment levels. I compared this with the coverage of regional credit unions to create a list of the five credit unions that were best-suited to serve these areas of need. To begin conversations regarding potential partnerships, I contacted these five credit unions to request an introductory discussion about the program that Adirondack Community Foundation aims to develop.

Research Fellow: Han Xiao (2029) **Concentration:** Undeclared

Faculty Mentor: Ahmet Ay **Departments:** Biology; Mathematics

Title of Project: Discovering Parkinson's Disease Biomarkers with Explainable AI

Funding Source: Sonya Lee-Chung '85, P'21 Endowed Research Fund

Project Summary:

Parkinson's disease is a neurodegenerative disease defined by insufficient dopamine production in the brain that leads to a characteristic tremor, muscle rigidity, and slowed movement. Parkinson's is one of the fastest growing neurological disorders in the world, with cases projected to reach over 25 million by 2050. Diagnosis has traditionally relied on the progression of motor symptoms and takes on average 2.75 years. By the time motor symptoms become evident, up to 85% of motor neurons in the brain could have experienced irreversible cell death. This causes many treatment methods to be ineffective. Newer diagnostic methods such as the Alpha-Synuclein Seed Amplification Assay, skin biopsy test, and brain imaging are being incorporated into clinical practice. However, these methods require tissues that are difficult to obtain like cerebrospinal fluid and are not specific to Parkinson's disease. In this study, we propose interpreting machine learning (ML) and deep learning (DL) models with explainable AI methods as a less invasive and quicker diagnostic measure.

This project uses data from the Parkinson's Precision Medicine Initiative. We used demographic data, non-motor clinical data, genetic variations, rna-sequencing data, and methylation data from healthy and Parkinson's disease subjects. The intersection of patients with all five data types totaled to 401 patients. Fifteen different 60/20/20 training, test, and validation splits were produced from those patients.

Demographic and clinical measurement columns missing in more than 20% of participants were dropped. Other columns were imputed by multivariate imputation by chained equations (MICE) and MissForest. All omics data were corrected for confounding factors like blood composition, age, and smoking. Omics feature selection was performed on each training partition using a ranking system according to the Minimum Redundancy Maximum Relevancy algorithm and included known Parkinson's factors.

We used three models: XGBoost, a gradient boosting tree method, Hybrid Early-fusion Attention Learning Network (HEALNet), a transformer-adjacent deep learning method, and Data Integration Analysis for Biomarker discovery using Latent cOmponents (DIABLO). XGBoost, HEALNet, and DIABLO achieved PR-AUCs of 0.86, 0.87, and 0.86, respectively. XGBoost and HEALNet were probed using Faith Shapley for features. DIABLO feature contributions are calculated by multiplying the model's modality weights by the distance of a feature from the healthy population's average.

Robust Rank Aggregation (RRA) was applied to obtain the average ranking across all partitions per model. We analyzed the individual features that reached the top 100 of at least two of the three models. Feature pair combinations were analyzed if they were ranked in more than one model and above 500 in at least one model.

Thirty-three individual features met the criterion. Twenty-two are clinical, which measure cognition through memory, processing speed, and visuospatial judgement, or demographic, which encode sex, education level, and number of children.

Five of six features from the Parkinson's autonomic symptom questionnaire fell within the gastrointestinal section. Gastrointestinal symptoms are an established early feature of Parkinson's disease and appear before motor symptoms. The convergence of the models on both gastrointestinal and cognitive measures is consistent with published work linking constipation to cognitive decline. Two features are methylation probes located in the NOD1 and VPS28 regions. VPS28 is a component of the ESCRT complex, which helps cells degrade misfolded alpha-synuclein, and IP6K2 regulates mitochondrial energy production, but neither gene has an established link to Parkinson's disease and are worth exploring. Twelve feature pairs were ranked by XGBoost and HEALNet, and 3 were ranked by DIABLO and XGBoost. One of the feature interaction pairs that relates to the individual features above links SCAU6, a gastrointestinal item, to ANXA4. ANXA4 is expressed in epithelial cells concentrated in the secretory epithelia of the stomach and intestine and regulates chloride transport. The feature pairing connects a gastrointestinal symptom to a gene governing ion transport in the tissue that causes the symptom. ANXA4 points to the epithelium even though constipation in Parkinson's is usually attributed to loss of enteric neurons. A peripheral, tissue-accessible marker tied to the earliest phase of the disease is a useful direction for a novel diagnostic.

Research Fellow: Tony Xu (2028) **Concentration:** Computer Science

Faculty Mentors: Ay Ahmet **Departments:** Biology; Mathematics

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

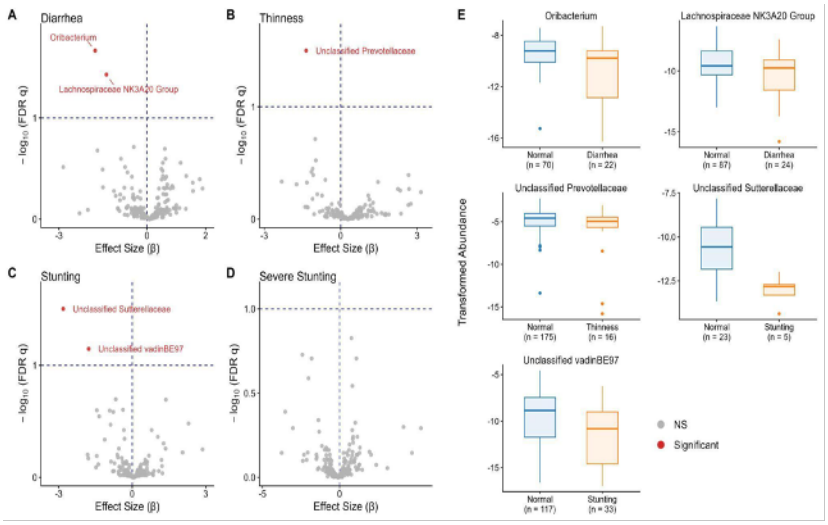
Title of Project: Gut Microbiome, Diarrhea, Stunting, and Thinness in School-Age Ethiopian Children: A Cross-Sectional 16S rRNA Gene Sequencing Study

Funding Source: Mind, Brain, and Behavior Faculty Grant

Project Summary:

Impaired growth, underweight, and diarrheal disease are major childhood health burdens in low- and middle-income countries, and the gut microbiome is a plausible link between them.With the available 16S rRNA sequencing and survey data from 198 Ethiopian school children in this study, we were able to investigate the associations between gut bacteria taxa and recent diarrhea, thinness, moderate stunting, severe stunting—through five analytical layers of alpha/beta diversity, differential abundance, predicted pathways, co-occurrence networks, and machine learning classifiers.

We found that diarrhea was associated with overall gut microbiome composition (permutational multivariate analysis of variance, $R^2 = 0.008$, $p = 0.03$); Simpson diversity was higher in children reporting diarrhea and in thin children (Wilcoxon rank-sum test, $p < 0.01$). Abundances of specific genera were significantly depleted ($q < 0.1$) across exposures: Oribacterium and Lachnospiraceae NK3A20 group with diarrhea, an unclassified Prevotellaceae lineage with thinness, and two unclassified lineages with moderate stunting; none with severe stunting. Predicted functional pathways were associated with all four exposures, but only the mycothiol biosynthesis pathway depleted in diarrhea cases has clear biology interpretations; network topology was largely preserved in exposure groups while only hub taxa and specific genus associations shifted. Diarrhea did not mediate microbiome–growth associations. Microbiome features predicted diarrhea and thinness (mean area under the receiver operating characteristic curve 0.729 and 0.671) but added nothing beyond demographic and clinical features (all $p > 0.05$). Our findings suggest that gut microbiome composition is only weakly associated with diarrheal and nutritional status in these children and does not substitute for routinely collected demographic and clinical data. Longitudinal and shotgun metagenomic studies are needed.



Genus-level differential abundance by exposure Volcano plots of the effect size (β coefficient) against −log10 q-value for (A) diarrhea, (B) thinness, (C) moderate stunting, and (D) severe stunting. taxa above the threshold are coloured and labelled.(E) Box plots show the total sum scaling and log transformed abundance of every taxon meeting the threshold in the reference and affected groups

Research Fellow: David Ye (2027) **Concentration:** Chemistry

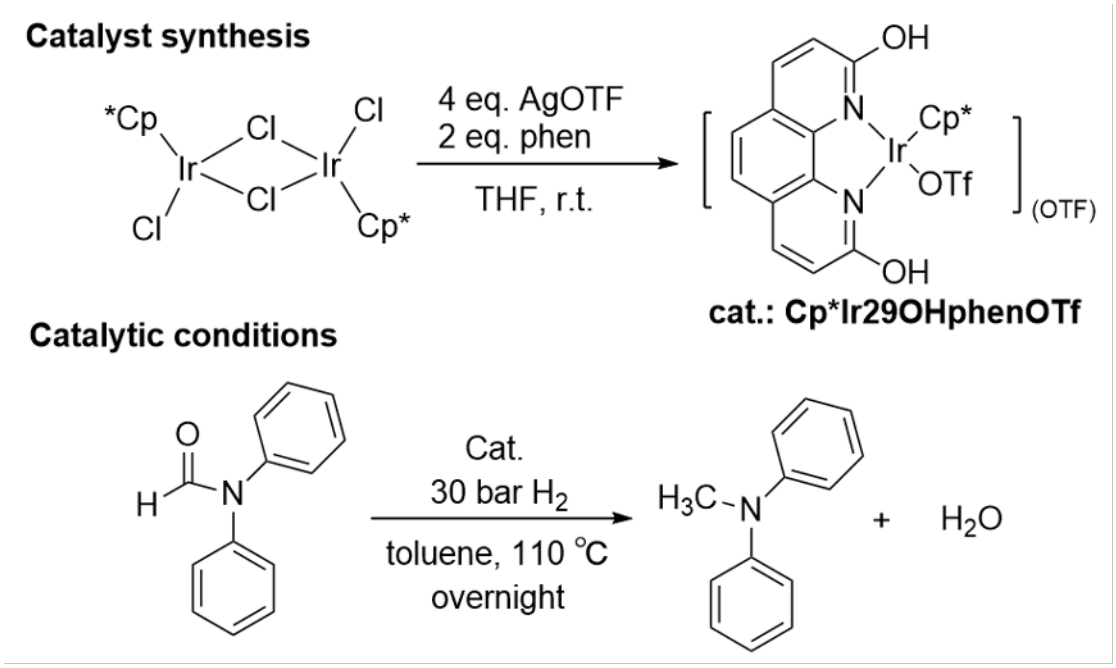
Faculty Mentor: Anthony Chianese **Department:** Chemistry

Title of Project: Mechanistic Studies and Optimization of Switchable Amide Hydrogenation Catalysts Selective for C–O and C–N Bond Cleavage

Funding Source: National Science Foundation Grant

Project Summary:

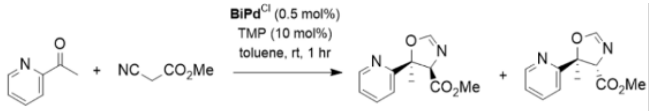
This project aimed to study the mechanisms of C-O and C-N bond cleavage of amide hydrogenation. Hydrogenation stands for a substrate reacting with hydrogen to form the product with the presence of catalysts. We synthesized a few catalysts and tested their reactivity for diphenyl formamide hydrogenation. Then we selected the most active catalyst to conduct a series of kinetic experiments and computational analysis by doing DFT (density functional theory) calculations.



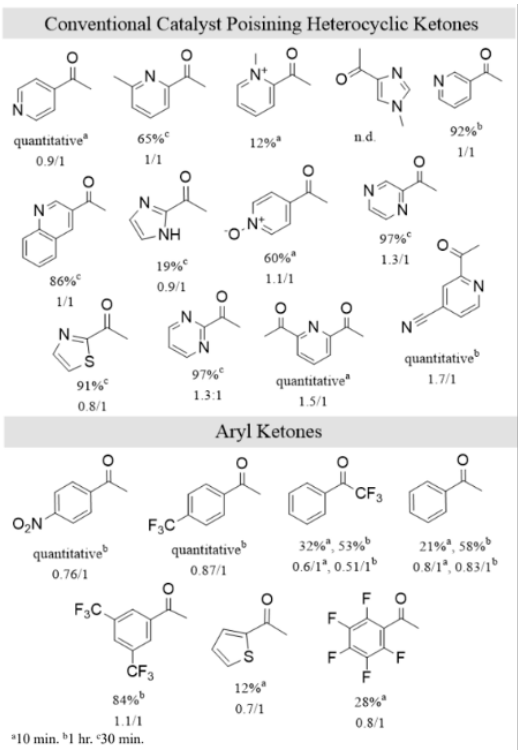
Research Fellow: Kyle Yoon (2029) **Concentration:** Undeclared
Faculty Mentor: Gongfang Hu **Department:** Chemistry
Title of Project: Role of Bismuth in Catalyzing Challenging Ketone Reactions
Funding Source: Division of Natural Sciences and Mathematics
Project Summary:

Palladium catalysts have revolutionized the efficiency of large-scale chemical reactions and are highly valued in pharmaceutical and materials industries. However, they are limited due to their reliance on a high temperature, air-free environment, long reaction time, and high cost, so creating more efficient catalysts has been an ongoing problem. In our lab's previous studies, we found that the BiPdCl catalyst offered unusually high and rapid yields for reactions between methyl isocyanoacetate and aldehydes while circumventing the limitations faced by palladium catalysts. So in this project, we sought to determine whether this bismuth catalyst would also work with heterocyclic ketone substrates, which are less reactive and can poison many palladium catalysts.

To determine the effectiveness of the bismuth catalyzed reactions, we varied the mole percent of BiPdCl, the specific ketone substrate, and replaced BiPdCl with various palladium catalysts. Under ambient conditions, we found that the BiPdCl had relatively high or moderate yields for a variety of substrates while the palladium catalysts experienced no reaction at all. We also found that BiPdCl successfully catalyzed a variety of different ketone substrates, albeit with varying success, that would otherwise poison most palladium catalysts. In the future, we plan to continue examining the scope of the BiPdCl, especially in comparison to palladium.



Entry	Variation	Yield[b]	trans/cis[d]
1	none	84%	1.2/1
	Catalyst		
2	no **BiPd^{Cl}**	n.d.[e]	—
3	0.25 mol% **BiPd^{Cl}**	79%	1.4/1
4	1.0 mol% **BiPd^{Cl}**	83%	1.4/1
5	1.5 mol% **BiPd^{Cl}**	79%	1.3/1
6	1.5 mol% **BiPd^{Cl}** (10 min under Ar)	97%	
7	$Pd_2(dba)_3$	n.d.	
8	$Pd(OAc)_2$	n.d.	
9	$Pd(dppf)Cl_2$	n.d.	
10	$[Pd(NCMe)_4][BF_4]_2$	n.d.	
11	$Pd(TFA)_2$	n.d.	
12	$Pd(PPh_3)_4$	n.d.	
13	$Pd(PPh_3)_4 + BiCl_3$ (1:1)	n.d.	
14	$BiCl_3$	n.d.	



Research Fellow: **Lezhi Zhang (2028)** **Concentration:** **Chemistry**
Faculty Mentor: **Stephanie Sanders** **Department:** **Chemistry**

Title of Project: **Solvent-Dependence of the Electronic and Photophysical Properties of Bi-Ni and Sb-Ni Complexes**

Funding Source: **Picker Interdisciplinary Science Institute Grant**

Project Summary:

Photoredox catalysis utilizes electronically excited complexes whose redox behavior and excited-state reactivity are strongly shaped by solvent coordination. Heterobimetallic pnictogen-nickel complexes provide a platform for tuning excited-state properties by adjusting metal-metal interactions and the local coordination environment.

My goal was to investigate the solvent-dependent electronic and photophysical behavior of the bismuth-nickel complexes GH37 and GH38, along with the antimony-nickel complex GH101, in three solvents: acetonitrile (MeCN), tetrahydrofuran (THF), and toluene. I used UV-vis absorption spectroscopy, Beer-Lambert analysis, and excitation-emission mapping to assess how solvent choice and concentration affect the electronic structure of complexes.

The absorption spectra of GH37 were highly dependent on the solvent. In figure 1, its absorbance-concentration relationship was nonlinear, and a concentration-dependent red shift emerged, pointing to solvent-driven speciation effects, such as aggregation, dimerization, or coordination equilibria. By contrast, GH37 followed linear Beer-Lambert behavior in both THF and toluene. When chloride was replaced by coordinating MeCN in GH38, the resulting blue shift suggests that ligand-field and frontier-orbital energies at nickel are being perturbed. GH101 also displayed linear Beer-Lambert behavior in THF and toluene, but unlike its Bi-Ni counterpart, the absence of the far-red emission signal by replacing bismuth with antimony suggests potential phosphorescence in bismuth-nickel complex due to bismuth heavy atom effect (figure 2 and figure 3).

Together, these results demonstrate that solvent coordination plays a real role in shaping the electronic structure and emission behavior of Bi-Ni and Sb-Ni complexes. Future work will examine excited-state lifetimes, coordination equilibria, photostability, and quenching behavior in greater detail.

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: **192**

Distribution of Students by Concentration (students with double majors are included twice)

Africana and Latin American Studies	1
Anthropology	1
Applied Math	4
Art History	2
Asian Studies	2
Astrogeophysics	3
Astronomy/Physics	6
Biochemistry	7
Biology	9
Chemistry	15
Classical Studies	5
Computer Science	12
Computer Science/Mathematics	1
Economics	10
Educational Studies	6
English	9
Environmental Biology	3
Environmental Economics	1
Environmental Geography	4
Environmental Geology	2
Environmental Studies	3
French	1
Geography	4
Geology	1
German	2
History	7
International Relations	9
Mathematical Economics	1
Mathematics	6
Middle Eastern and Islamic Studies	2
Molecular Biology	9
Native American Studies	1
Natural Sciences	2
Neuroscience	10
Peace and Conflict Studies	8
Philosophy	6
Physics	13
Political Science	12
Psychological Science	11
Russian and Eurasian Studies	1
Sociology	2
Spanish	1
Studio Arts	1
Theater	2
Undeclared	27
Women, Gender, and Sexuality Studies	1

Distribution of Students by Concentration (students with double majors are included twice)

Arts and Humanities	**29**
Art History	2
Classical Studies	5
English	9
French	1
German	2
Philosophy	6
Spanish	1
Studio Arts	1
Theater	2
Natural Sciences and Mathematics	**109**
Applied Math	4
Astrogeophysics	3
Astronomy/Physics	6
Biochemistry	7
Biology	9
Chemistry	15
Computer Science	12
Computer Science/Mathematics	1
Geology	1
Mathematics	6
Molecular Biology	9
Natural Sciences	2
Neuroscience	10
Physics	13
Psychological Science	11
Social Sciences	**52**
Anthropology	1
Economics	10
Educational Studies	6
Geography	4
History	7
International Relations	9
Mathematical Economics	1
Political Science	12
Sociology	2
University Studies	**29**
Africana and Latin American Studies	1
Asian Studies	2
Environmental Biology	3
Environmental Economics	1
Environmental Geography	4
Environmental Geology	2
Environmental Studies	3
Middle Eastern and Islamic Studies	2

Native American Studies	1
Peace and Conflict Studies	8
Russian and Eurasian Studies	1
Women, Gender, and Sexuality Studies	1
Undeclared	**27**

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	**16**
Art	3
Classics	1
East Asian Languages and Literatures	1
English and Creative Writing	5
German	1
Philosophy	2
Romance Languages and Literatures	1
Theater	2
Natural Sciences and Mathematics	**127**
Biology	24
Chemistry	27
Earth and Environmental Geosciences	8
Mathematics	14
Neuroscience	11
Physics and Astronomy	24
Psychological and Brain Sciences	19
Social Sciences	**25**
Economics	5
Educational Studies	3
Geography	2
History	3
International Relations	1
Political Science	8
Sociology and Anthropology	3
University Studies	**12**
Africana and Latin American Studies	2
Environmental Studies	8
Global Public and Environmental Health	1
Russian and Eurasian Studies	1
Other	**52**
Kraynak Institute for the Study of Freedom and Western Traditions	15
Lampert Institute for Civic and Global Affairs	19
Upstate Institute	18

Distribution of Students by Funding Source:

Internal	**137**
Division of Arts and Humanities	3
Division of Natural Sciences and Mathematics	62
Division of Social Sciences	13
Division of University Studies	4
Kraynak Institute for the Study of Freedom and Western Traditions	15
Lampert Institute for Civic and Global Affairs	19
Living Writers Program	3
Upstate Institute	18
Endowed	**54**
Alexander V. Wasson Fund	1
Doug Rankin ’53 Endowment-Appalachian Research	2
Doug Rankin ’53 Endowment-Geology Research	2
Hackett-Rathmell 1968 Memorial Fund	2
J. Curtiss Taylor ’54 Endowed Student Research Fund	3
John C. Cochran Endowed Fund for Undergraduate Research	1
Justus ’43 and Jayne Schlichting Student Research Fund	11
Michael J. Wolk ’60 Heart Foundation	12
Miller-Cochran Fund	2
Mind, Brain, and Behavior Faculty Grant	2
Mind, Brain, and Behavior Scholars Award	2
Norma Vergo Prize	2
Oberheim Memorial Fund	2
Picker Interdisciplinary Science Institute Grant	1
Sonya Lee-Chung ’85, P’21 Endowed Research Fund	1
Stickles Fund	1
Storytelling Fund	2
Sylvia Ellins Fund	1
Walter Broughton ’63 Research Fund	2
Warren Anderson Fund	2
External	**8**
Great Sky Grant	1
National Science Foundation Grant	5
Office of Naval Research Grant	1
Organic Syntheses PUI Summer Research Grant	1

Total Number of Participating Faculty: **75**

(Numbers below may be greater than total number of participating faculty due to faculty joint appointments)

Distribution of Faculty by Division and Department:

Arts and Humanities	**9**
Art	2
Classics	1
East Asian Languages and Literatures	1
English and Creative Writing	1
German	1
Philosophy	1
Romance Languages and Literatures	1
Theater	1
Natural Sciences and Mathematics	**50**
Biology	9
Chemistry	10
Earth and Environmental Geosciences	3
Mathematics	6
Neuroscience	4
Physics and Astronomy	11
Psychological and Brain Sciences	7
Social Sciences	**14**
Economics	3
Educational Studies	1
Geography	1
History	1
International Relations	1
Political Science	6
Sociology and Anthropology	1
University Studies	**7**
Africana and Latin American Studies	1
Environmental Studies	4
Global Public and Environmental Health	1
Russian and Eurasian Studies	1
Other	**18**
Kraynak Institute for the Study of Freedom and Western Traditions	10
Lampert Institute for Civic and Global Affairs	5
Upstate Institute	3

Distribution of Faculty by Funding Source
(Faculty with more than one funding source are counted multiple times)

Internal	**66**
Division of Arts and Humanities	2
Division of Natural Sciences and Mathematics	35
Division of Social Sciences	8
Division of University Studies	2
Kraynak Institute for the Study of Freedom and Western Traditions	10
Lampert Institute for Civic and Global Affairs	5
Living Writers Program	1
Upstate Institute	3
Endowed	**48**
Alexander V. Wasson Fund	1
Doug Rankin ’53 Endowment-Appalachian Research	1
Doug Rankin ’53 Endowment-Geology Research	2
Hackett-Rathmell 1968 Memorial Fund	2
J. Curtiss Taylor ’54 Endowed Student Research Fund	3
John C. Cochran Endowed Fund for Undergraduate Research	1
Justus ’43 and Jayne Schlichting Student Research Fund	9
Michael J. Wolk ’60 Heart Foundation	10
Miller-Cochran Fund	2
Mind, Brain, and Behavior Faculty Grant	2
Mind, Brain, and Behavior Scholars Award	2
Norma Vergo Prize	2
Oberheim Memorial Fund	2
Picker Interdisciplinary Science Institute Grant	1
Sonya Lee-Chung ’85, P’21 Endowed Research Fund	1
Stickles Fund	1
Storytelling Fund	1
Sylvia Ellins Fund	1
Walter Broughton ’63 Research Fund	2
Warren Anderson Fund	2
External	**6**
Great Sky Grant	1
National Science Foundation Grant	3
Office of Naval Research Grant	1
Organic Syntheses PUI Summer Research Grant	1

COLGATE