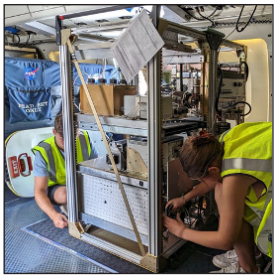
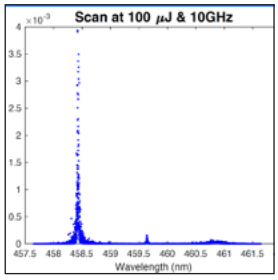
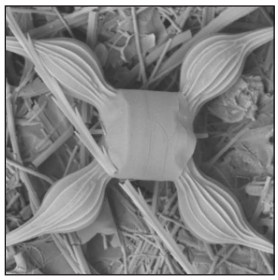
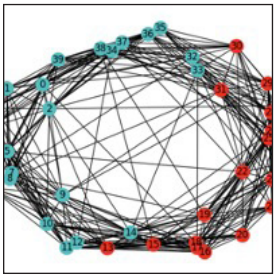
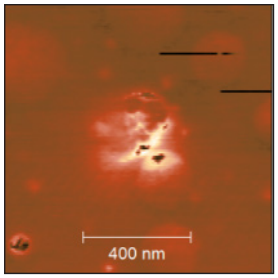
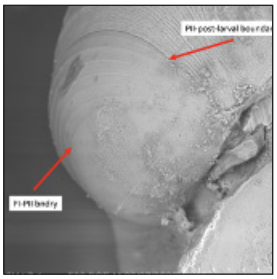
COLGATE UNIVERSITY

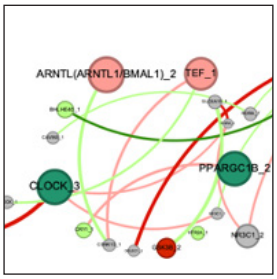
SUMMER UNDERGRADUATE RESEARCH DIRECTORY

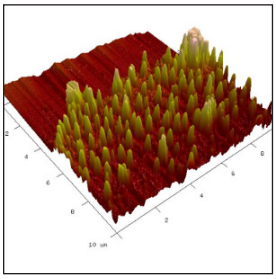


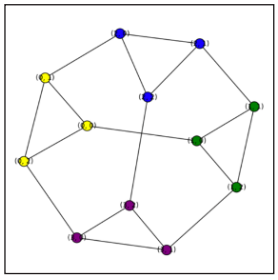











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2023

Cover photos: Each of these images was taken from student abstracts found in this 2023 Directory (Balsan, Berberich & Usselman; Aspinwall & McGrath; Berwanger & Tjan; Bonino & Kim; Bujiashvili; Chamria; Cryan & Hoogstra; D'Errico, Farbstein, Powell, Russo & York; Elacqua; Ghasemi, Khan & Minbay; Frank; Harrington; Wilder, Wu; Child & Samal; Qian).

A special thanks to Mona Dunn for creating the front cover and for compiling the research directory.

Colgate University Summer Undergraduate Research Directory

Volume 30
2023

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

List of Participants

DIVISION OF THE ARTS AND HUMANITIES (AHUM)

Department of Art and Art History

Research Fellow: Nizak Abdou 2026 (Computer Science; Art and Art History)
Faculty Mentor: Margaretha Haughwout (Art and Art History)
Title of Project: *Cosmic Conversations with Flora*
Funding Source: AHUM Division

Research Fellow: Claire Prall-Freedman 2023 (History; Peace and Conflict Studies)
Faculty Mentor: Carolyn Guile (Art & Art History)
Title of Project: *The Spatial Imprint of Fascism in Vichy France*
Funding Source: Center for Freedom and Western Civilization, James Madison Fellow

Research Fellow: Wendy Wu 2025 (Art and Art History)
Faculty Mentors: Padma Kaimal (Art and Art History)
John Crespi (East Asian Languages and Literatures; Asian Studies)
Title of Project: *Motion in the Art During the Han Dynasty*
Funding Source: AHUM Division

Department of the Classics

Research Fellow: Jamie Anderson 2024 (Russian and Eurasian Studies; Classical Studies)
Faculty Mentor: Daniel Tober (Classics)
Title of Project: *Julius Caesar and the Western Military Tradition*
Funding Source: Center for Freedom and Western Civilization, James Madison Fellow

Department of East Asian Languages and Literatures

Research Fellow: Wendy Wu 2025 (Art and Art History)
Faculty Mentors: Padma Kaimal (Art and Art History)
John Crespi (East Asian Languages and Literatures; Asian Studies)
Title of Project: *Motion in the Art During the Han Dynasty*
Funding Source: AHUM Division

Department of English

Research Fellow: Tess Dunkel 2024 (English)
Faculty Mentor: Jennifer Brice (English)
Title of Project: *Living Writers Fellow*
Funding Source: AHUM Division

Research Fellow: Dulcie Lou Morris 2024 (English)
Faculty Mentor: Jennifer Brice (English)
Title of Project: *Living Writers Fellow*
Funding Source: AHUM Division

Research Fellow: Talia Troy 2025 (English)
Faculty Mentor: Ariel Martino (English)
Title of Project: *Flowers and Spiders: Faith Through Figurative Language in Puritan Literature*
Funding Source: AHUM Division

Research Fellow: David Xiu 2024 (English; Philosophy)
Faculty Mentor: Peter Balakian (English)
Title of Project: *Bei Dao's exile poems: the hermetic imagery of secrecy and alienation*
Funding Source: J. Curtiss Taylor '54 Endowed Student Research Fund

Department of Philosophy

Research Fellow: Mostafa Mohamed 2024 (Philosophy; Economics)
Faculty Mentor: Joseph Stenberg (Philosophy)
Title of Project: *Immanent Realism in the Medieval Era: Islamic and Christian Discussions*
Funding Source: Center for Freedom and Western Civilization, James Madison Fellow

Research Fellow: Kevin Nguyen 2024 (Philosophy; English)
Faculty Mentor: David Dudrick (Philosophy)
Title of Project: *The Ethics of Human Desire: Levinas in Conversation with Lacan and Girard*
Funding Source: Center for Freedom and Western Civilization, James Madison Fellow

Department of Religion

Research Fellow: Louis Rosuck 2024 (Political Science; International Relations)
Faculty Mentor: Benjamin Stahlberg (Religion)
Title of Project: *The Life of Virtue in Maimonides and Aristotle*
Funding Source: Center for Freedom and Western Civilization, James Madison Fellow

Department of Theater

esearch Fellow: Jorge Rochet 2025 (Theater; Environmental Studies)
Faculty Mentor: April Sweeney (Theater)
Title of Project: *'Ni Una Bomba Más': Accounts of the US Navy's Impact on Culebra and Vieques, Puerto Rico*
Funding Source: J. Curtiss Taylor '54 Endowed Student Research Fund

DIVISION OF NATURAL SCIENCES AND MATHEMATICS (NACS)

Department of Biology

Research Fellow: Hadeel Al Qoronz 2025 (Biology; Sociology)
Faculty Mentor: Engda Hagos (Biology)
Title of Project: *Investigating the Role of KLF4 in DNA Damage and Epigenetic Changes*
Funding Source: Michael J. Wolk '60 Heart Foundation

Research Fellow: Porter Comstock 2026 (Undeclared)
Faculty Mentor: Eddie Watkins (Biology)
Title of Project: *Exploring Physiological Variability and Plasticity in Hybrid Wood Ferns*
Funding Source: National Science Foundation

Research Fellow: Joseph Coolidge 2024 (Biology)
Faculty Mentor: Therese Frauendorf (Biology)
Title of Project: *How much hippo dung do invertebrates eat?*
Funding Source: NASC Division

Research Fellow: Kyleigh Frank 2024 (Biology)
Faculty Mentor: Tim McCay (Biology; Environmental Studies)
Title of Project: *Effects of Slope and Vibration on Jumping Worm Movement and Distribution*
Funding Source: Northeastern States Research Cooperative Grant

Research Fellow: Ali Ghasemi 2025 (Computer Science)
Faculty Mentor: Ahmet Ali Ay (Biology)
Title of Project: *Computational Analysis to detect Circadian related genotypes associated with Depression*
Funding Source: Michael J. Wolk ‘60 Heart Foundation

Research Fellow: Jadan Hand 2024 (Biology; Biology)
Faculty Mentor: Priscilla Van Wynsberghe (Biology)
Title of Project: *Identifying genes involved in kin-20 pathway in C. elegans through forward genetic screening*
Funding Source: National Institutes of Health

Research Fellow: Noelle Harrington 2024 (Philosophy; Biology)
Faculty Mentor: Krista Ingram (Biology)
Title of Project: *Non-invasive Conservation: eDNA and Facial Recognition for Harbor Seals in Casco Bay, Maine*
Funding Source: Oberheim Memorial Fund

Research Fellow: Carson Hobler 2024 (Molecular Biology)
Faculty Mentor: Priscilla Van Wynsberghe (Biology)
Title of Project: *Investigating the relationship between lite-1 and lin-42 in C. elegans*
Funding Source: Michael J. Wolk ‘60 Heart Foundation

Research Fellow: Joan Jatto 2025 (Biology)
Faculty Mentor: Priscilla Van Wynsberghe (Biology)
Title of Project: *Molecular Analysis of Development in C. elegans*
Funding Source: NASC Division

Research Fellow: Ayub Khan 2025 (Computer Science)
Faculty Mentor: Ahmet Ali Ay (Biology (Computer Science)
Title of Project: *Computational Analysis to detect Circadian related genotypes associated with Depression*
Funding Source: NASC Division

Research Fellow: Matt Leopold 2026 (Undeclared)
Faculty Mentor: Eddie Watkins (Biology)
Title of Project: *Exploring Physiological Variability and Plasticity in Hybrid Wood Ferns*
Funding Source: National Science Foundation

Research Fellow: Adam Limoges 2024 (Environmental Biology)
Faculty Mentor: Tim McCay (Biology; Environmental Studies)
Title of Project: *Impact of Jumping Worms on Leaf Litter Decomposition Rates of Prominent Tree Species in Northern Forests*
Funding Source: NASC Division

Research Fellow: Mete Minbay 2024 (Computer Science)
Faculty Mentor: Ahmet Ali Ay (Biology)
Title of Project: *Computational Analysis to detect Circadian related genotypes associated with Depression*
Funding Source: NASC Division

Research Fellow: Tilly Morris 2025 (Biology)
Faculty Mentor: Tim McCay (Biology; Environmental Studies)
Title of Project: *The Effect of Invasive Earthworms on Northern Forest Tree Growth: A Mesocosm Study*
Funding Source: NASC Division

Research Fellow: Etiosa Ojefua 2026 (Undeclared)
Faculty Mentor: Frank Frey (Biology; Environmental Studies)
Title of Project: *Antibiotic resistance in Uganda*
Funding Source: Michael J. Wolk ‘60 Heart Foundation

Research Fellow: Zack Pelland 2024 (Neuroscience)
Faculty Mentor: Ken Belanger (Biology)
Title of Project: *Subconcussive head impacts sustained in American football alter gut microbiome diversity and composition*
Funding Source: NASC Division

Research Fellow: Bronwen Rees-Wiedemann 2024 (Molecular Biology)
Faculty Mentor: Priscilla Van Wynsberghe (Biology)
Title of Project: *Investigating how let-7 microRNA levels are impacted by lite-1 and lin-42 in C.elegans*
Funding Source: Michael J. Wolk ‘60 Heart Foundation

Research Fellow: Will Russel 2024 (Molecular Biology)
Faculty Mentor: Ahmet Ali Ay (Biology)
Title of Project: *Identifying morphological and genetic predictors of heat dissipation in athletic dogs*
Funding Source: NASC Division

Research Fellow: Joy Tang 2026 (Undeclared)
Faculty Mentor: Tim McCay (Biology; Environmental Studies)
Title of Project: *Isotopic Niches of Invasive Asian Jumping Worms*
Funding Source: NASC Division

Research Fellow: Benito Vlassis 2025 (Molecular Biology)
Faculty Mentor: Therese Frauendorf (Biology)
Title of Project: *How much hippo dung do invertebrates eat?*
Funding Source: NASC Division

Research Fellow: Cole Zeh 2025 (Molecular Biology)
Faculty Mentor: Engda Hagos (Biology)
Title of Project: *KLF4 Positively Regulates Ferroptosis Related Genes in Mouse Embryonic Fibroblasts and Colorectal Cancer Cells*
Funding Source: NASC Division

Department of Chemistry

Research Fellow: Obsidian Ammons 2026 (Undeclared)
Faculty Mentor: Anthony Chianese (Chemistry)
Title of Project: *Milstein's Catalyst Kinetics*
Funding Source: National Science Foundation

Research Fellow: Ekaterina Balsan 2025 (Chemistry; Classical Studies)
Faculty Mentor: Anne Perring (Chemistry)
Title of Project: *Ambient Aerosol Measurements at Colgate University*
Funding Source: Justus '43 and Jayne Schlichting Student Research Fund

Research Fellow: Emmerson Bartels 2025 (Biochemistry)
Faculty Mentor: Jacob Goldberg (Chemistry)
Title of Project: *In Vivo Incorporation of 4-Difluoromethylphenylalanine in Proteins*
Funding Source: Michael J. Wolk '60 Heart Foundation

Research Fellow: Joe Berberich 2024 (Geography; Chemistry)
Faculty Mentor: Anne Perring (Chemistry)
Title of Project: *Ambient Aerosol Measurements at Colgate University*
Funding Source: NASC Division

Research Fellow: Abbey Bonino 2025 (Chemistry)
Faculty Mentor: Anthony Chianese (Chemistry)
Title of Project: *Epoxide Hydrogenolysis Catalyzed by a Ruthenium Pincer Complex*
Funding Source: NASC Division

Research Fellow: Henry Burdorf 2026 (Undeclared)
Faculty Mentor: Jenny Peeler (Chemistry)
Title of Project: *Investigating AMPylation Activity of SelenoproteinO Homologs*
Funding Source: Michael J. Wolk ‘60 Heart Foundation

Research Fellow: Giovanni Cavalli 2024 (Molecular Biology)
Faculty Mentor: Jacob Goldberg (Chemistry)
Title of Project: *In Vivo Incorporation of 4-Difluoromethylphenylalanine in Proteins*
Funding Source: NASC Division

Research Fellow: Div Chamria 2023 (Chemistry; Physics)
Faculty Mentor: Eric Muller (Chemistry)
Title of Project: *Infrared near-field microscopy at the shot-noise limit*
Funding Source: NASC Division

Research Fellow: Camden Di Carlo 2024 (Biochemistry)
Faculty Mentor: Ernie Nolen (Chemistry)
Title of Project: *Temporary Silyl Tether and Ring-Closing Metathesis Approach to Tn Antigen Mimics*
Funding Source: Justus ‘43 and Jayne Schlichting Student Research Fund

Research Fellow: Abby Getz 2024 (Biochemistry)
Faculty Mentor: Jenny Peeler (Chemistry)
Title of Project: *Investigating AMPylation Activity of SelenoproteinO Homologs*
Funding Source: NASC Division

Research Fellow: Harlan Greenberg 2025 (Computer Science)
Faculty Mentor: Jacob Goldberg (Chemistry)
Title of Project: *In Vivo Incorporation of 4-Difluoromethylphenylalanine in Proteins*
Funding Source: Picker Interdisciplinary Science Institute

Research Fellow: Carlson Hang 2025 (Biochemistry)
Faculty Mentor: Gongfang Hu (Chemistry)
Title of Project: *Developing Metal Complexes Containing Z-type Ligands for Electrocatalytic Reduction of Phosphorus Oxides*
Funding Source: Warren Anderson Fund

Research Fellow: Diane Kim 2024 (Biochemistry)
Faculty Mentor: Anthony Chianese (Chemistry)
Title of Project: *Epoxide Hydrogenolysis Catalyzed by a Ruthenium Pincer Complex*
Funding Source: NASC Division

Research Fellow: Zachary Laster 2024 (Molecular Biology)
Faculty Mentor: Jacob Goldberg (Chemistry)
Title of Project: *In Vivo Incorporation of 4-Difluoromethylphenylalanine in Proteins*
Funding Source: Research Council

Research Fellow: Faye Liu 2026 (Undeclared)
Faculty Mentor: Anthony Chianese (Chemistry)
Title of Project: *Enhanced Catalyst Development for Non-Racemizing Epoxide Hydrogenolys*
Funding Source: National Science Foundation

Research Fellow: Frankie McLaughlin 2024 (Biochemistry)
Faculty Mentor: Ernie Nolen (Chemistry)
Title of Project: *Synthesis of Metabolically Stable Tn Antigen Mimics with Conformational Integrity*
Funding Source: Justus ‘43 and Jayne Schlichting Student Research Fund

Research Fellow: Bryan Palaguachi 2024 (Physics; Chemistry)
Faculty Mentor: Eric Muller (Chemistry)
Title of Project: *Infrared nano-spectroscopy of aqueous mixtures*
Funding Source: Justus ‘43 and Jayne Schlichting Student Research Fund

Research Fellow: Ryan Park 2024 (Biochemistry)
Faculty Mentor: Rick Geier (Chemistry)
Title of Project: *Synthesis of an N-Confused Dipyrromethane for the Preparation of an N-Confused Porphyrin Bearing Ferrocene Substituents*
Funding Source: Warren Anderson Fund

Research Fellow: Ethan Riggs 2025 (Biochemistry)
Faculty Mentor: Jenny Peeler (Chemistry)
Title of Project: *Investigating AMPylation Activity of SelenoproteinO Homologs*
Funding Source: Justus ‘43 and Jayne Schlichting Student Research Fund

Research Fellow: Sarah Sexton 2026 (Undeclared)
Faculty Mentor: Jacob Goldberg (Chemistry)
Title of Project: *In Vivo Incorporation of 4-Difluoromethylphenylalanine in Proteins*
Funding Source: Miller-Cochran Fund

Research Fellow: Lauren Spina 2025 (Neuroscience)
Faculty Mentor: Ernie Nolen (Chemistry)
Title of Project: *Preparation of Molecular Components for the Synthesis of a Tn Antigen Mimic*
Funding Source: NASC Division

Research Fellow: Morgan Usselman 2024 (Chemistry)
Faculty Mentor: Anne Perring (Chemistry)
Title of Project: *Ambient Aerosol Measurements at Colgate University*
Funding Source: NASC Division

Research Fellow: Katherine Wand 2024 (Biochemistry)
Faculty Mentor: Eric Muller (Chemistry)
Title of Project: *Nanoscale Structure and Folding of Ice-nucleating proteins*
Funding Source: NASC Division

Research Fellow: Yuhao Wang 2025 (Biochemistry)
Faculty Mentor: Gongfang Hu (Chemistry)
Title of Project: *Developing Metal Complexes Containing Z-type Ligands for Electrocatalytic Reduction of Phosphorus Oxides*
Funding Source: NASC Division

Research Fellow: Sophia Wlodek 2025 (Biochemistry)
Faculty Mentor: Ernie Nolen (Chemistry)
Title of Project: *Preparation for a Cross-Metathesis Reaction to Synthesize a Tn Antigen Mimic*
Funding Source: NASC Division

Research Fellow: Rebecca Zhu 2024 (Biochemistry)
Faculty Mentor: Gongfang Hu (Chemistry)
Title of Project: *Electrocatalytic Hydrogen Evolution Using a Bimetallic Palladium Complex Containing a Bismuth-Based Ligand*
Funding Source: NASC Division

Department of Computer Science

Research Fellow: Jaanhvi Agarwal 2025 (Computer Science)
Faculty Mentor: Aaron Gember-Jacobson (Computer Science)
Title of Project: *Illuminating the practices of Internet service providers*
Funding Source: NASC Division

Research Fellow: Amanda Anowi 2024 (Computer Science)
Faculty Mentor: Aaron Gember-Jacobson (Computer Science)
Title of Project: *Illuminating the practices of Internet service providers*
Funding Source: Tom and Liz Brackett Endowed Fund for Diversity, Equity, and Inclusion in Computer Science

Research Fellow: Aryaman Chobey 2025 (Computer Science)
Faculty Mentor: Grusha Prasad (Computer Science)
Title of Project: *Can targeted modifications of training data improve neural networks' ability to predict human sentence processing difficulty?*
Funding Source: NASC Division

Research Fellow: Sarah Cryan 2025 (Computer Science)
Faculty Mentor: Georgiana Haldman (Computer Science)
Title of Project: *Exploring Pedagogical Devices for Difficult Computer Science Concepts*
Funding Source: NASC Division

Research Fellow: Omar Fargally 2025 (Computer Science)
Faculty Mentor: Grusha Prasad (Computer Science)
Title of Project: *Investigating The Impact of Online Experimental Platforms on The Magnitude of Psycholinguistic Effects*
Funding Source: NASC Division

Research Fellow: Greta Hoogstra 2025 (Computer Science)
Faculty Mentor: Georgiana Haldman (Computer Science)
Title of Project: *Exploring Pedagogical Devices for Difficult Computer Science Concepts*
Funding Source: NASC Division

Research Fellow: Oliver Smith 2024 (Computer Science)
Faculty Mentor: Grusha Prasad (Computer Science)
Title of Project: *Can targeted modifications of training data improve neural networks' ability to predict human sentence processing difficulty?*
Funding Source: NASC Division

Research Fellow: Anzi Wang 2025 (Philosophy; German)
Faculty Mentor: Grusha Prasad (Computer Science)
Title of Project: *Can targeted modifications of training data improve neural networks' ability to predict human sentence processing difficulty?*
Funding Source: Holden Fund

Department of Earth and Environmental Geosciences

Research Fellow: Ian Andrews 2025 (Astrogeophysics; Geology)
Faculty Mentor: Joe Levy (Earth and Environmental Geosciences)
Title of Project: *Polar and Planetary Research: Water track sediment chemistry and Mars landform evolution*
Funding Source: NASC Division

Research Fellow: Jose Arriaza 2025 (Geography)
Faculty Mentors: Karen Harpp (Earth and Environmental Geoscience; Peace and Conflict Studies)
Meg Gardner (Educational Studies)
Title of Project: *The Virtual Galápagos: Building an Interactive, Interdisciplinary STEM-Learning Website for Elementary Children*
Funding Source: NASC Division

Research Fellow: Rylie Berwanger 2026 (Geology)
Faculty Mentor: Amy Leventer (Earth and Environmental Geosciences)
Title of Project: *Antarctic Paleoclimate Research*
Funding Source: Hackett-Rathmell 1968 Memorial Fund

Research Fellow: Ryan D'Errico 2025 (Geology)
Faculty Mentor: Paul Harnik (Earth and Environmental Geosciences)
Title of Project: *Live-Dead Analysis of Marine Bivalves in the Gulf of Mexico*
Funding Source: Doug Rankin '53 Endowment - Geology Research Fund

Research Fellow: Ryan D'Errico 2025 (Geology)
Faculty Mentor: Alison Koleszar (Earth and Environmental Geosciences)
Title of Project: *The Eruptive Personality of Augustine Volcano*
Funding Source: National Science Foundation

Research Fellow: Riley Farbstein 2024 (Environmental Geology; Art and Art History)
Faculty Mentor: Paul Harnik (Earth and Environmental Geosciences)
Title of Project: *Live-Dead Analysis of Marine Bivalves in the Gulf of Mexico*
Funding Source: Norma Vergo Prize; NASC Division

Research Fellow: Aidan Guller 2025 (Astrogeophysics)
Faculty Mentor: Joe Levy (Earth and Environmental Geosciences)
Title of Project: *Polar and Planetary Research: Water track sediment chemistry and Mars landform evolution*
Funding Source: Norma Vergo Prize

Research Fellow: Flannery Hogan 2026 (Astrogeophysics)
Faculty Mentor: William Peck (Earth and Environmental Geosciences)
Title of Project: *Origin of Iron Deposits in the Adirondack Mountains*
Funding Source: Doug Rankin'53 Endowment - Appalachian Research

Research Fellow: Andrew Lass 2025 (Computer Science)
Faculty Mentors: Karen Harpp (Earth and Environmental Geoscience; Peace and Conflict Studies)
Meg Gardner (Educational Studies)
Title of Project: *The Virtual Galápagos: Building an Interactive, Interdisciplinary STEM-Learning Website for Elementary Children*
Funding Source: NASC Division

Research Fellow: Pierce Leclerc 2025 (Geology)
Faculty Mentor: Aubreya Adams (Earth and Environmental Geosciences)
Title of Project: *Deep Earth Imaging of the Alaskan Subduction Zone*
Funding Source: Doug Rankin '53 Endowment - Geology Research Fund

Research Fellow: Henry Lin 2024 (Astrogeophysics; Economics)
Faculty Mentor: William Peck (Earth and Environmental Geosciences)
Title of Project: *Origin of Iron Deposits in the Adirondack Mountains*
Funding Source: Doug Rankin'53 Endowment - Appalachian Research

Research Fellow: Stella Miao 2025 (Geology)
Faculty Mentor: Karen Harpp (Earth and Environmental Geoscience; Peace and Conflict Studies)
Title of Project: *A Geochemical Investigation of the Galapagos Mantle Plume*
Funding Source: National Science Foundation

Research Fellow: Mary Thomas Powell 2026 (Environmental Studies)
Faculty Mentor: Paul Harnik (Earth and Environmental Geosciences)
Title of Project: *Live-Dead Analysis of Marine Bivalves in the Gulf of Mexico*
Funding Source: Norma Vergo Prize

Research Fellow: Grace Reilly 2026 (Undeclared)
Faculty Mentors: Karen Harpp (Earth and Environmental Geoscience; Peace and Conflict Studies)
Meg Gardner (Educational Studies)
Title of Project: *The Virtual Galápagos: Building an Interactive, Interdisciplinary STEM-Learning Website for Elementary Children*
Funding Source: NASC Division

Research Fellow: Tom Richards 2024 (Biochemistry)
Faculty Mentor: Karen Harpp (Earth and Environmental Geoscience; Peace and Conflict Studies)
Title of Project: *A Geochemical Investigation of the Galapagos Mantle Plume*
Funding Source: Justus ‘43 and Jayne Schlichting Student Research Fund

Research Fellow: Alexa Russo 2025 (Geology)
Faculty Mentor: Paul Harnik (Earth and Environmental Geosciences)
Title of Project: *Live-Dead Analysis of Marine Bivalves in the Gulf of Mexico*
Funding Source: NASC Division

Research Fellow: Gisele Tjan 2026 (Undeclared)
Faculty Mentor: Amy Leventer (Earth and Environmental Geosciences)
Title of Project: *Antarctic Paleoclimate Research*
Funding Source: Doug Rankin ‘53 Endowment - Geology Research Fund

Research Fellow: Regan Todd 2024 (Environmental Biology)
Faculty Mentors: Karen Harpp (Earth and Environmental Geoscience; Peace and Conflict Studies)
Meg Gardner (Educational Studies)
Title of Project: *The Virtual Galápagos: Building an Interactive, Interdisciplinary STEM-Learning Website for Elementary Children*
Funding Source: NASC Division

Research Fellow: Maxwell Walker 2026 (Undeclared)
Faculty Mentor: William Peck (Earth and Environmental Geosciences)
Title of Project: *Zinc Oxide Search in Mesoproterozoic Grenville Province Marble Samples*
Funding Source: Doug Rankin ‘53 Endowment - Geology Research Fund

Research Fellow: Jessica Wen 2024 (Geology)
Faculty Mentor: Aubreya Adams (Earth and Environmental Geosciences)
Title of Project: *Investigating the Hydration of the Alaskan Subduction Zone with Radial Anisotropy*
Funding Source: Norma Vergo Prize

Research Fellow: Ava Wojtaszek 2024 (Africana and Latin Amer Studies; Educational Studies)
Faculty Mentors: Karen Harpp (Earth and Environmental Geoscience; Peace and Conflict Studies)
Meg Gardner (Educational Studies)
Title of Project: *The Virtual Galápagos: Building an Interactive, Interdisciplinary STEM-Learning Website for Elementary Children*
Funding Source: NASC Division

Research Fellow: Marie York 2026 (Undeclared)
Faculty Mentor: Paul Harnik (Earth and Environmental Geosciences)
Title of Project: *Live-Dead Analysis of Marine Bivalves in the Gulf of Mexico*
Funding Source: NASC Division

Research Fellow: Krelyn Zacarias 2025 (Computer Science)
Faculty Mentors: Karen Harpp (Earth and Environmental Geoscience; Peace and Conflict Studies)
Meg Gardner (Educational Studies)
Title of Project: *The Virtual Galápagos: Building an Interactive, Interdisciplinary STEM-Learning Website for Elementary Children*
Funding Source: NASC Division

Research Fellow: Melly Zhuang 2026 (Undeclared)
Faculty Mentor: Alison Koleszar (Earth and Environmental Geosciences)
Title of Project: *How does microlite number density correlates with explosivity of intermediate arc volcanoes? Evidence from the Holocene record at Augustine Volcano, Alaska*
Funding Source: National Science Foundation

Department of Mathematics

Research Fellow: Dennis Belotserkovskiy 2026 (Undeclared)
Faculty Mentor: Silvia Jimenez Bolanos (Mathematics)
Title of Project: *Nonlinear Neutral Inclusions*
Funding Source: National Science Foundation

Research Fellow: Sophia Child 2025 (Mathematics)
Faculty Mentor: Kelly Isham (Mathematics)
Title of Project: *The Mathematics Behind Designing Large-scale Computer Networks*
Funding Source: Los Alamos National Lab LDRD Reserve Grant

Research Fellow: Nayda Farnsworth 2026 (Computer Science; Mathematics)
Faculty Mentor: Gabe Sosa Castillo (Mathematics)
Title of Project: *Reconstruction of Monomial Orders*
Funding Source: NASC Division

Research Fellow: Brendan Foerster 2024 (Applied Math)
Faculty Mentor: Nick Moore (Mathematics)
Title of Project: *Novel Methods for Rogue Wave Sampling*
Funding Source: NASC Division

Research Fellow: PJ Horoszewski 2025 (Applied Math; Economics)
Faculty Mentor: Gabe Sosa Castillo (Mathematics)
Title of Project: Reconstruction of Monomial Orders
Funding Source: NASC Division

Research Fellow: Chunjiang Li 2024 (International Relations)
Faculty Mentor: Will Cipolli (Mathematics)
Title of Project: *Data Science Collaboratory Project*
Funding Source: NASC Division

Research Fellow: Justin Li 2025 (Applied Math)
Faculty Mentor: Silvia Jimenez Bolanos (Mathematics)
Title of Project: *Neutral Inclusions and Cloaking*
Funding Source: National Science Foundation

Research Fellow: James Njoroge 2025 (Applied Math; Computer Science)
Faculty Mentor: Will Cipolli (Mathematics)
Title of Project: *Data Science Collaboratory Project*
Funding Source: NASC Division

Research Fellow: Aranya Pal 2024 (Mathematics; Economics)
Faculty Mentor: Gabe Sosa Castillo (Mathematics)
Title of Project: *Reconstruction of Monomial Orders*
Funding Source: NASC Division

Research Fellow: Omshi Samal 2024 (Computer Science; Mathematics)
Faculty Mentor: Kelly Isham (Mathematics)
Title of Project: *The Mathematics Behind Designing Large-scale Computer Networks*
Funding Source: Los Alamos National Lab LDRD Reserve Grant

Research Fellow: Marisa Zarcone 2025 (Mathematics)
Faculty Mentor: Gabe Sosa Castillo (Mathematics)
Title of Project: *The Reconstruction of Monomial Orders*
Funding Source: NASC Division

Departent of Psychological and Brain Sciences

Research Fellow: Kyle Born 2026 (Undeclared)
Faculty Mentor: Wan-chun Liu (Psychological and Brain Sciences)
Title of Project: *The Effect of Chronic Artificial Light at Night on Zebra Finch Spatial Learning and Memory*
Funding Source: Mind, Brain and Behavior Scholars Award

Research Fellow: Amira Brown 2026 (Undeclared)
Faculty Mentor: Wan-chun Liu (Psychological and Brain Sciences)
Title of Project: *Familiarity and Unfamiliarity as a Determiner of Social Aggression in Captive Zebra Finches*
Funding Source: NASC Division

Research Fellow: Pariya Chanthasensack 2024 (Chemistry; Physics)
Faculty Mentor: Rachel Dinero (Psychological and Brain Sciences)
Title of Project: *Risk Factors to Caregiver Burden in Parent-Child Dyads for Care Recipients with Serious Mental Illnesses*
Funding Source: NASC Division

Research Fellow: Claudia Coolidge 2025 (Psychological Science)
Faculty Mentors: Jennifer Tomlinson (Psychological and Brain Sciences)
Lauren Philbrook (Psychological and Brain Sciences)
Title of Project: *Couples Who Play Together, Stay Healthy Together: Benefits of Positive Relationship Processes for Sleep in Older Adulthood*
Funding Source: NASC Division

esearch Fellow: Nick Elacqua 2024 (Psychological Science)
Faculty Mentor: Carrie Keating (Psychological and Brain Sciences)
Title of Project: *The 'Eyes' Have it: Using Virtual Reality to Study Leaders' Synchronization of Audience Members' Attention Measured via Eye Movements*
Funding Source: NASC Division

Research Fellow: Leah Greenstein 2025 (Neuroscience)
Faculty Mentor: Wan-chun Liu (Psychological and Brain Sciences)
Title of Project: *The Effect of Artificial Light at Night (ALAN) On Locomotion and Vocalization in Zebra Finch*
Funding Source: NASC Division

Research Fellow: Elizabeth Joffrey 2025 (Neuroscience; German)
Faculty Mentor: Ann Jane Tierney (Psychological and Brain Sciences)
Title of Project: *Effects of essential amino acid and neurotransmitter precursor consumption and deprivation on feeding and mating behavior*
Funding Source: NASC Division

Research Fellow: Kiera Litwin 2026 (Undeclared)
Faculty Mentors: Jennifer Tomlinson (Psychological and Brain Sciences)
Lauren Philbrook (Psychological and Brain Sciences)
Title of Project: *Couples Who Play Together, Stay Healthy Together: Benefits of Positive Relationship Processes for Sleep in Older Adulthood*
Funding Source: NASC Division

Research Fellow: Priya Martin 2024 (Philosophy; Psychological Science)
Faculty Mentors: Jennifer Tomlinson (Psychological and Brain Sciences)
Lauren Philbrook (Psychological and Brain Sciences)
Title of Project: *Couples Who Play Together, Stay Healthy Together: Benefits of Positive Relationship Processes for Sleep in Older Adulthood*
Funding Source: NASC Division

Research Fellow: Marissa Realmuto 2024 (Neuroscience)
Faculty Mentor: Ann Jane Tierney (Psychological and Brain Sciences)
Title of Project: *Effects of essential amino acid and neurotransmitter precursor consumption and deprivation on feeding and mating behavior*
Funding Source: NASC Division

Research Fellow: Nicole Roitman 2024 (Psychological Science)
Faculty Mentor: Rachel Dinero (Psychological and Brain Sciences)
Title of Project: *The Madison Resilience Project: The Post-Pandemic Family Experience*
Funding Source: NASC Division

Research Fellow: Persephone Sween-Argyros 2024 (Economics; Psychological Science)
Faculty Mentors: Jennifer Tomlinson (Psychological and Brain Sciences)
Lauren Philbrook (Psychological and Brain Sciences)
Title of Project: *Couples Who Play Together, Stay Healthy Together: Benefits of Positive Relationship Processes for Sleep in Older Adulthood*
Funding Source: NASC Division

Research Fellow: Dylan Vlasak 2025 (Neuroscience)
Faculty Mentor: Erin Cooley (Psychological and Brain Sciences)
Title of Project: *Measuring Perceptions of Within- and Between-Group Status: A New Measure, Replication, and Extension Exploring the Effects of Subjective Within-Group Status and Health among White Americans*
Funding Source: NASC Division

Department of Physics and Astronomy

Research Fellow: William Aspinwall 2025 (Astrogeophysics)
Faculty Mentor: Jonathan Levine (Physics and Astronomy)
Title of Project: *Photoionization of Strontium Near the 459 nm Two-Photon Resonance*
Funding Source: Volgenau Wiley Endowed Research Fellowhip

Research Fellow: Nikoloz Bujiashvili 2024 (Physics; Computer Science)
Faculty Mentor: Ken Segall (Physics and Astronomy)
Title of Project: *Graph Partitioning Using Spiking Neural Network (SNN)*
Funding Source: Justus ‘43 and Jayne Schlichting Student Research Fund

Research Fellow: Richard Casey 2024 (Astronomy/Physics)
Faculty Mentor: Cosmin Ilie (Physics and Astronomy)
Title of Project: *Dark Matter Production and Gravity Waves From a Dark Big Bang*
Funding Source: Volgenau Wiley Endowed Research Fellowhip

Research Fellow: Lance Chen 2025 (Physics)
Faculty Mentor: Cosmin Ilie (Physics and Astronomy)
Title of Project: *Dark Star Probing*
Funding Source: Justus ‘43 and Jayne Schlichting Student Research Fund

Research Fellow: Jared Diks 2025 (Astronomy/Physics)
Faculty Mentor: Cosmin Ilie (Physics and Astronomy)
Title of Project: *Dark Matter Properties as Determined by Exoplanets*
Funding Source: Justus ‘43 and Jayne Schlichting Student Research Fund

Research Fellow: Gavin Fowler 2024 (Astrogeophysics)
Faculty Mentor: Jonathan Levine (Physics and Astronomy)
Title of Project: *An In-depth Study of How to Collect Data for Rb-Sr Dating Using CODEX*
Funding Source: Justus ‘43 and Jayne Schlichting Student Research Fund

Research Fellow: Leia Francis 2025 (Physics)
Faculty Mentor: Kiko Galvez (Physics and Astronomy)
Title of Project: *Quantum Decoherence of Entangled Photons to Detect Hypoxia*
Funding Source: Justus ‘43 and Jayne Schlichting Student Research Fund

Research Fellow: Noah Hann-Deschaine 2024 (Physics)
Faculty Mentor: Ramesh Adhikari (Physics and Astronomy)
Title of Project: *Biological Materials for Electronic Devices and Functional Surfaces*
Funding Source: Justus ‘43 and Jayne Schlichting Student Research Fund

Research Fellow: Maddie Hulburt 2024 (Astronomy/Physics)
Faculty Mentor: Thomas Balonek (Physics and Astronomy)
Title of Project: *Data Reduction of Asteroid Terrestrial-impact Last Alert System (ATLAS) Variable Stars*
Funding Source: NASC Division

Research Fellow: Ege Kutlubas 2024 (Physics)
Faculty Mentors: Ramesh Adhikari (Physics and Astronomy)
Ken Segall (Physics and Astronomy)
Title of Project: *Optical and Electrical Properties of Methanol Layered Phenylalanine - PEDOT:PSS Thin Films*
Funding Source: Justus ‘43 and Jayne Schlichting Student Research Fund

Research Fellow: Bill Luo 2026 (Undeclared)
Faculty Mentor: Kiko Galvez (Physics and Astronomy)
Title of Project: *Time Delay Quantum Eraser*
Funding Source: Justus ‘43 and Jayne Schlichting Student Research Fund

Research Fellow: Eli Mayes 2026 (Undeclared)
Faculty Mentor: Kiko Galvez (Physics and Astronomy)
Title of Project: *Retrieval of Einstein Beams from Astronomical Images*
Funding Source: Justus ‘43 and Jayne Schlichting Student Research Fund

Research Fellow: Flynn McGrath 2026 (Undeclared)
Faculty Mentor: Jonathan Levine (Physics and Astronomy)
Title of Project: *Photoionization of Strontium Near the 459 nm Two-Photon Resonance*
Funding Source: Volgenau Wiley Endowed Research Fellowhip

Research Fellow: Chris O'Connell 2025 (Astrogeophysics)
Faculty Mentor: Thomas Balonek (Physics and Astronomy)
Title of Project: *Using the Asteroid Terrestrial-impact Last Alert System (ATLAS) Images to Investigate Quasar Variability*
Funding Source: NASC Division / NASA New York Space Grant

Research Fellow: Ryan Ruan 2024 (Physics; Applied Math)
Faculty Mentor: Kiko Galvez (Physics and Astronomy)
Title of Project: *Investigation on Light Beam Size with Table-Top Gravitational Lensing/ Einstein Beam Size Properties Measured Based on Table-Top Measurements*
Funding Source: National Science Foundation

Research Fellow: Will Rye 2026 (Undeclared)
Faculty Mentor: Jeff Bary (Physics and Astronomy)
Title of Project: *Near-Infrared Observations of Accretion Signatures in Low-Mass Accreting Objects*
Funding Source: Justus '43 and Jayne Schlichting Student Research Fund

Research Fellow: Edgar Saavedra 2025 (Computer Science)
Faculty Mentor: Linda Tseng (Environmental Studies; Physics and Astronomy)
Title of Project: *Microplastics/fibers Generation Through Simulated Human Motions*
Funding Source: UNST Division

Research Fellow: Sayed Shafaat Mahmud 2026 (Undeclared)
Faculty Mentor: Cosmin Ilie (Physics and Astronomy)
Title of Project: *Using Neural Networks to Detect Dark Star Candidates in the Early Universe*
Funding Source: Volgenau Wiley Endowed Research Fellowhip

Research Fellow: Harshitha Talasila 2026 (Environmental Studies)
Faculty Mentor: Linda Tseng (Environmental Studies; Physics and Astronomy)
Title of Project: *Water Quality Monitoring in Hamilton*
Funding Source: UNST Division

Research Fellow: Mia Toribio Lantigua 2026 (Undeclared)
Faculty Mentor: Ramesh Adhikari (Physics and Astronomy)
Title of Project: *Leaf-Based Triboelectric Nanogenerators*
Funding Source: National Science Foundation

Research Fellow: Neha Viradia 2025 (Physics)
Faculty Mentor: Ramesh Adhikari (Physics and Astronomy)
Title of Project: *Development of Leaf Based Electric Double Layer Capacitors*
Funding Source: National Science Foundation

Research Fellow: Sam Wilder 2025 (Physics)
Faculty Mentor: Ramesh Adhikari (Physics and Astronomy)
Title of Project: *Bio-based Memristor Creation, Characterization, and Neural Plasticity Mimicking*
Funding Source: Justus '43 and Jayne Schlichting Student Research Fund

DIVISION OF SOCIAL SCIENCES (SOSC)

Department of Economics

Research Fellow: Samay Gupta 2024 (Mathematics; Economics)
Faculty Mentor: Carolina Castilla (Economics)
Title of Project: *Nudge Theory and Extracurricular Participation in High School Students*
Funding Source: SOSC Division

Research Fellow: Vuong Hoang 2024 (Economics)
Faculty Mentor: Carolina Castilla (Economics)
Title of Project: *What's the Plan Now? The Dobbs Decision, The Reversal of Roe v. Wade and The Changed Landscape of Planned Parenthood.*
Funding Source: Walter Broughton '63 Research Fund

Department of Educational Studies

Research Fellow: Jose Arriaza 2025 (Geography)
Faculty Mentors: Karen Harpp (Earth and Environmental Geoscience; Peace and Conflict Studies)
Meg Gardner (Educational Studies)
Title of Project: *The Virtual Galápagos: Building an Interactive, Interdisciplinary STEM-Learning Website for Elementary Children*
Funding Source: NASC Division

Research Fellow: Andrew Lass 2025 (Computer Science)
Faculty Mentors: Karen Harpp (Earth and Environmental Geoscience; Peace and Conflict Studies)
Meg Gardner (Educational Studies)
Title of Project: *The Virtual Galápagos: Building an Interactive, Interdisciplinary STEM-Learning Website for Elementary Children*
Funding Source: NASC Division

Research Fellow: Grace Reilly 2026 (Undeclared)
Faculty Mentors: Karen Harpp (Earth and Environmental Geoscience; Peace and Conflict Studies)
Meg Gardner (Educational Studies)
Title of Project: *The Virtual Galápagos: Building an Interactive, Interdisciplinary STEM-Learning Website for Elementary Children*
Funding Source: NASC Division

Research Fellow: Meghan Subak 2025 (Political Science)
Faculty Mentor: Meg Gardner (Educational Studies)
Title of Project: *Virtual Galapagos Educational Studies Research*
Funding Source: SOSC Division

Research Fellow: Regan Todd 2024 (Environmental Biology)
Faculty Mentors: Karen Harpp (Earth and Environmental Geoscience; Peace and Conflict Studies)
Meg Gardner (Educational Studies)
Title of Project: *The Virtual Galápagos: Building an Interactive, Interdisciplinary STEM-Learning Website for Elementary Children*
Funding Source: NASC Division

Research Fellow: Ava Wojtaszek 2024 (Africana and Latin Amer Studies; Educational Studies)
Faculty Mentors: Karen Harpp (Earth and Environmental Geoscience; Peace and Conflict Studies)
Meg Gardner (Educational Studies)
Title of Project: *The Virtual Galápagos: Building an Interactive, Interdisciplinary STEM-Learning Website for Elementary Children*
Funding Source: NASC Division

Research Fellow: Krelyn Zacarias 2025 (Computer Science)
Faculty Mentors: Karen Harpp (Earth and Environmental Geoscience; Peace and Conflict Studies)
Meg Gardner (Educational Studies)
Title of Project: *The Virtual Galápagos: Building an Interactive, Interdisciplinary STEM-Learning Website for Elementary Children*
Funding Source: NASC Division

Department of Geography

Research Fellow: Jason Qian 2024 (Environmental Geography)
Faculty Mentor: Myongsong Kong (Geography)
Title of Project: *Colgate Campus Sign Database Project*
Funding Source: Communications

Department of History

Research Fellow: Anna Miksis 2025 (History)
Faculty Mentor: Heather Roller (History; Environmental Studies)
Title of Project: *A Social and Environmental History of Agrichemicals: California, New York, and Iowa*
Funding Source: SOSC Division

Research Fellow: Katie Moser 2024 (History)
Faculty Mentor: Heather Roller (History History; Environmental Studies)
Title of Project: *A Social and Environmental History of Agrichemicals: California, New York, and Iowa*
Funding Source: SOSC Division

Research Fellow: Blanca Rivas 2025 (History)
Faculty Mentor: Graham Hodges (History; Africana and Latin American Studies)
Title of Project: *Research Apprenticeship Featuring Archival Work on Henry Highland Garnet*
Funding Source: SOSC Division

Research Fellow: Josh Zou 2025 (History)
Faculty Mentor: Graham Hodges (History; Africana and Latin American Studies))
Title of Project: *Research Apprenticeship Featuring Archival Work on Henry Highland Garnet*
Funding Source: SOSC Division

Department of Political Science

Research Fellow: Vishnu Anandraj 2025 (Economics: Political Science)
Faculty Mentor: Navine Murshid (Political Science)
Title of Project: *The Kathua Case: Understanding Responses and Attitudes to the Ujh Development Project*
Funding Source: Walter Broughton '63 Research Fund

Research Fellow: Andrew Audas 2025 (Political Science)
Faculty Mentor: Ed Fogarty (Political Science)
Title of Project: *Intellectual Property Rights in the Global Economy*
Funding Source: Center for Freedom and Western Civilization, James Madison Fellow

Research Fellow: Peter Biss 2026 (Undeclared)
Faculty Mentor: Sam Rosenfeld (Political Science)
Title of Project: *Coverage of the Presidential Debates in a Changing Media Landscape*
Funding Source: SOSC Division

Research Fellow: Mikayla Cairns 2025 (Peace and Conflict Studies)
Faculty Mentor: Danielle Lupton (Political Science)
Title of Project: *Military Veterans in Congress (1789-Present)*
Funding Source: SOSC Division

Research Fellow: Matt Calenzo 2024 (Political Science; Economics)
Faculty Mentor: Robert Kraynak (Political Science)
Title of Project: *Cicero's Attainable Virtue*
Funding Source: Center for Freedom and Western Civilization, James Madison Fellow

Research Fellow: Michael Hanratty 2024 (Economics; Political Science)
Faculty Mentor: Stan Brubaker (Political Science)
Title of Project: *The Development of the Supreme Court's Powr of Judicial Review*
Funding Source: Center for Freedom and Western Civilization, James Madison Fellow

Research Fellow: Ellie Markwick 2024 (International Relations; Peace and Conflict Studies)
Faculty Mentor: Danielle Lupton (Political Science)
Title of Project: *Military Veterans in Congress (1789-Present)*
Funding Source: SOSC Division

Research Fellow: Fabrizio Montisci 2024 (Peace & Conflict Studies; Political Science)
Faculty Mentor: Dominika Koter (Political Science)
Title of Project: *U.S. Foreign Policy Toward Sub-Saharan Africa: The Challenge of Authoritarian Actors for Democracy*
Funding Source: Center for Freedom and Western Civilization, James Madison Fellow

Research Fellow: Molly Pritchard 2025 (History; Applied Math)
Faculty Mentor: Danielle Lupton (Political Science)
Title of Project: *Military Veterans in Congress (1789-Present)*
Funding Source: Stickles Fund

Research Fellow: Andy Weinstein 2024 (Political Science; Art and Art History)
Faculty Mentor: Masha Hedberg (Political Science)
Title of Project: *From the Printing Press to Twitter Posts: Analyzing the Impact of Technology on the Effectiveness of State Propaganda*
Funding Source: Center for Freedom and Western Civilization, James Madison Fellow

Research Fellow: Margo Williams 2023 (International Relations)
Faculty Mentor: Valerie Morkevičius (Political Science)
Title of Project: *Content Moderation by Big Tech: Internaet Policy Formation in the United States*
Funding Source: Center for Freedom and Western Civilization, James Madison Fellow

Department of Sociology and Anthropology

Research Fellow: Olwethu Ezell 2026 (Undeclared)
Faculty Mentor: Chandra Russo (Sociology and Anthropology)
Title of Project: *Whites Against Supremacy: Cross-racial Alliance in the U.S. Movement for Black Lives*
Funding Source: SOSC Division

Research Fellow: Boyana He 2025 (Environmental Economics)
Faculty Mentors: Chris Henke (Sociology and Anthropology; Environmental Studies)
Andrew Pattison (Environmental Studies)
Title of Project: *New York State's Climate Smart Communities Program: Why and how did local municipalities in New York pursue certification, and what are the policy outcomes?*
Funding Source: SOSC Division

Research Fellow: Robyn Landes 2024 (Peace and Conflict Studies; Chinese)
Faculty Mentors: Chris Henke (Sociology and Anthropology)
Andrew Pattison (Environmental Studies)
Title of Project: *New York State's Climate Smart Communities Program: Why and how did local municipalities in New York pursue certification, and what are the policy outcomes?*
Funding Source: SOSC Division

DIVISION OF UNIVERSITY STUDIES (UNST)

Africana and Latin American Studies Program

Research Fellow: Blanca Rivas 2025 (History)
Faculty Mentor: Graham Hodges (History; Africana and Latin American Studies)
Title of Project: *Research Apprenticeship Featuring Archival Work on Henry Highland Garnet*
Funding Source: SOSC Division

Research Fellow: Josh Zou 2025 (History)
Faculty Mentor: Graham Hodges (History; Africana and Latin American Studies)
Title of Project: *Research Apprenticeship Featuring Archival Work on Henry Highland Garnet*
Funding Source: SOSC Division

Asian Studies Program

Research Fellow: Wendy Wu 2025 (Art and Art History)
Faculty Mentors: Padma Kaimal (Art and Art History)
John Crespi (East Asian Languages and Literatures; Asian Studies)
Title of Project: *Motion in the Art During the Han Dynasty*
Funding Source: AHUM Division

Environmental Studies Program

Research Fellow: Kyleigh Frank 2024 (Biology)
Faculty Mentor: Tim McCay (Biology; Environmental Studies)
Title of Project: *Effects of Slope and Vibration on Jumping Worm Movement and Distribution*
Funding Source: Northeastern States Research Cooperative Grant

Research Fellow: Boyana He 2025 (Environmental Economics)
Faculty Mentors: Chris Henke (Sociology and Anthropology; Environmental Studies)
Andrew Pattison (Environmental Studies)
Title of Project: *New York State's Climate Smart Communities Program: Why and how did local municipalities in New York pursue certification, and what are the policy outcomes?*
Funding Source: SOSC Division

Research Fellow: Robyn Landes 2024 (Peace and Conflict Studies; Chinese)
Faculty Mentors: Chris Henke (Sociology and Anthropology; Environmental Studies)
Andrew Pattison (Environmental Studies)
Title of Project: *New York State's Climate Smart Communities Program: Why and how did local municipalities in New York pursue certification, and what are the policy outcomes?*
Funding Source: SOSC Division

Research Fellow: Adam Limoges 2024 (Environmental Biology)
Faculty Mentor: Tim McCay (Biology; Environmental Studies)
Title of Project: *Impact of Jumping Worms on Leaf Litter Decomposition Rates of Prominent Tree Species in Northern Forests*
Funding Source: NASC Division

Research Fellow: Anna Miksis 2025 (History)
Faculty Mentor: Heather Roller (History; Environmental Studies)
Title of Project: *A Social and Environmental History of Agrichemicals: California, New York, and Iowa*
Funding Source: SOSC Division

Research Fellow: Tilly Morris 2025 (Biology)
Faculty Mentor: Tim McCay (Biology; Environmental Studies)
Title of Project: *The Effect of Invasive Earthworms on Northern Forest Tree Growth: A Mesocosm Study*
Funding Source: NASC Division

Research Fellow: Katie Moser 2024 (History)
Faculty Mentor: Heather Roller (History History; Environmental Studies)
Title of Project: *A Social and Environmental History of Agrichemicals: California, New York, and Iowa*
Funding Source: SOSC Division

Research Fellow: Etiosa Ojefua 2026 (Undeclared)
Faculty Mentor: Frank Frey (Biology; Environmental Studies)
Title of Project: *Antibiotic resistance in Uganda*
Funding Source: Michael J. Wolk ‘60 Heart Foundation

Research Fellow: Edgar Saavedra 2025 (Computer Science)
Faculty Mentor: Linda Tseng (Environmental Studies; Physics and Astronomy)
Title of Project: *Microplastics/fibers Generation Through Simulated Human Motions*
Funding Source: UNST Division

Research Fellow: Harshitha Talasila 2026 (Environmental Studies)
Faculty Mentor: Linda Tseng (Environmental Studies; Physics and Astronomy)
Title of Project: *Water Quality Monitoring in Hamilton*
Funding Source: UNST Division

Research Fellow: Joy Tang 2026 (Undeclared)
Faculty Mentor: Tim McCay (Biology; Environmental Studies)
Title of Project: *Isotopic Niches of Invasive Asian Jumping Worms*
Funding Source: NASC Division

CENTER FOR FREEDOM AND WESTERN CIVILIZATION

Research Fellow: Jamie Anderson 2024 (Russian and Eurasian Studies; Classical Studies)
Faculty Mentor: Daniel Tober (Classics)
Title of Project: *Julius Caesar and the Western Military Tradition*
Funding Source: Center for Freedom and Western Civilization, James Madison Fellow

Research Fellow: Andrew Audas 2025 (Political Science)
Faculty Mentor: Ed Fogarty (Political Science)
Title of Project: *Intellectual Property Rights in the Global Economy*
Funding Source: Center for Freedom and Western Civilization, James Madison Fellow

Research Fellow: Matt Calenzo 2024 (Political Science; Economics)
Faculty Mentor: Robert Kraynak (Political Science)
Title of Project: *Cicero's Attainable Virtue*
Funding Source: Center for Freedom and Western Civilization, James Madison Fellow

Research Fellow: Michael Hanratty 2024 (Economics; Political Science)
Faculty Mentor: Stan Brubaker (Political Science)
Title of Project: *The Development of the Supreme Court's Powr of Judicial Review*
Funding Source: Center for Freedom and Western Civilization, James Madison Fellow

Research Fellow: Mostafa Mohamed 2024 (Philosophy; Economics)
Faculty Mentor: Joseph Stenberg (Philosophy)
Title of Project: *Immanent Realism in the Medieval Era: Islamic and Christian Discussions*
Funding Source: Center for Freedom and Western Civilization, James Madison Fellow

Research Fellow: Fabrizio Montisci 2024 (Peace & Conflict Studies; Political Science)
Faculty Mentor: Dominika Koter (Political Science)
Title of Project: *U.S. Foreign Policy Toward Sub-Saharan Africa: The Challenge of Authoritarian Actors for Democracy*
Funding Source: Center for Freedom and Western Civilization, James Madison Fellow

Research Fellow: Kevin Nguyen 2024 (Philosophy; English)
Faculty Mentor: David Dudrick (Philosophy)
Title of Project: *The Ethics of Human Desire: Levinas in Conversation with Lacan and Girard*
Funding Source: Center for Freedom and Western Civilization, James Madison Fellow

Research Fellow: Claire Prall-Freedman 2023 (History; Peace and Conflict Studies)
Faculty Mentor: Carolyn Guile (Art & Art History)
Title of Project: *The Spatial Imprint of Fascism in Vichy France*
Funding Source: Center for Freedom and Western Civilization, James Madison Fellow

Research Fellow: Louis Rosuck 2024 (Political Science; International Relations)
Faculty Mentor: Benjamin Stahlberg (Religion)
Title of Project: *The Life of Virtue in Maimonides and Aristotle*
Funding Source: Center for Freedom and Western Civilization, James Madison Fellow

Research Fellow: Andy Weinstein 2024 (Political Science; Art and Art History)
Faculty Mentor: Masha Hedberg (Political Science)
Title of Project: *From the Printing Press to Twitter Posts: Analyzing the Impact of Technology on the Effectiveness of State Propaganda*
Funding Source: Center for Freedom and Western Civilization, James Madison Fellow

Research Fellow: Margo Williams 2023 (International Relations)
Faculty Mentor: Valerie Morkevičius (Political Science)
Title of Project: *Content Moderation by Big Tech: Internaet Policy Formation in the United States*
Funding Source: Center for Freedom and Western Civilization, James Madison Fellow

LAMPERT INSTITUTE FOR CIVIC AND GLOBAL AFFAIRS

Research Fellow: Kata Mims 2024 (International Relations)
Faculty Mentor: Bruce Rutherford (Political Science)
Funding Source: Lampert Institute for Civic and Global Affairs

Research Fellow: Connor Rushford 2024 (Middle East & Islamic Studies; International Relations)
Faculty Mentor: Bruce Rutherford (Political Science)
Funding Source: Lampert Institute for Civic and Global Affairs

UPSTATE INSTITUTE

Research Fellow: Molly Abruzzese 2025 (Environmental Studies)
Faculty Mentor: Catherine Cardelús (Upstate Institute)
Title of Project: *The Availability of Local Food through Farmers' Markets*
Funding Source: Upstate Institute

Research Fellow: Juny Ardon 2023 (Educational Studies)
Faculty Mentor: Julie Dudrick (Upstate Institute)
Title of Project: *Fiver Foundation*
Funding Source: Upstate Institute

Research Fellow: Carolina Chavez 2023 (Environmental Geography)
Faculty Mentor: Julie Dudrick (Upstate Institute)
Title of Project: *Sculpture Space*
Funding Source: Upstate Institute

Research Fellow: Cindy Chen 2024 (Art History)
Faculty Mentor: Julie Dudrick (Upstate Institute)
Title of Project: *Exhibiting Newspapers and Community Memory*
Funding Source: Upstate Institute

Research Fellow: Charlie Citron 2024 (Political Science)
Faculty Mentor: Holden Fund (Upstate Institute)
Title of Project: *Madison County Historian and Theodore Burr Covered Bridge Resource Center*
Funding Source: Upstate Institute

Research Fellow: Sophia Diehl 2025 (Neuroscience)
Faculty Mentor: Julie Dudrick (Upstate Institute)
Title of Project: *Madison County Dental Health Summer 2023 Project*
Funding Source: Upstate Institute

Research Fellow: Lucrezia DiVincenzo 2025 (English; International Relations)
Faculty Mentor: Julie Dudrick (Upstate Institute)
Title of Project: *Midtown Utica Community Center*
Funding Source: Upstate Institute

Research Fellow: Tate Fonda 2025 (Neuroscience; English)
Faculty Mentor: Julie Dudrick (Upstate Institute)
Title of Project: *Village of Hamilton, NY*
Funding Source: Upstate Institute

Research Fellow: Rory Gold-Wienk 2024 (History)
Faculty Mentor: Julie Dudrick (Upstate Institute)
Title of Project: National Abolition Hall of Fame and Museum
Funding Source: Upstate Institute

Research Fellow: Kayla Gutheil 2024 (Environmental Studies; English)
Faculty Mentor: Catherine Cardelús (Upstate Institute)
Title of Project: *Enhancing Pollinator Conservation in the Adirondack Park with AdkAction*
Funding Source: Upstate Institute

Research Fellow: Jeisanelly Hernandez 2024 (Astronomy/Physics)
Faculty Mentor: Catherine Cardelús (Upstate Institute)
Title of Project: *Adirondack Diversity Initiative & John Brown Lives!*
Funding Source: Upstate Institute

Research Fellow: Laurajane Kehler 2025 (Molecular Biology)
Faculty Mentor: Julie Dudrick (Upstate Institute)
Title of Project: *Designing A Framework to Optimize Donations at The Center*
Funding Source: Upstate Institute

Research Fellow: Katie Keyes 2025 (Biology)
Faculty Mentor: Julie Dudrick (Upstate Institute)
Title of Project: *A Look at Rural Homelessness within Delaware, Chenango, Madison, and Otsego Counties, New York*
Funding Source: Upstate Institute

Research Fellow: Halle Kuhar-Pitters 2024 (Environmental Studies)
Faculty Mentor: Catherine Cardelús (Upstate Institute)
Title of Project: *The Problem with Coming Home: Addressing the Adirondack Housing Crisis*
Funding Source: Upstate Institute

Research Fellow: Che Ku Kyet 2024 (Molecular Biology)
Faculty Mentor: Julie Dudrick (Upstate Institute)
Title of Project: *CenteringPregnancy within a Refugee Population*
Funding Source: Upstate Institute

Research Fellow: Alexa Lim 2025 (Environmental Studies)
Faculty Mentor: Catherine Cardelús (Upstate Institute)
Title of Project: *Adirondack Center for Loon Conservation*
Funding Source: Upstate Institute

Research Fellow: Sophia Lopez 2025 (History)
Faculty Mentor: Julie Dudrick (Upstate Institute)
Title of Project: *Chenango County Historical Society*
Funding Source: Upstate Institute

Research Fellow: Claire Madsen 2024 (Political Science; Sociology)
Faculty Mentor: Julie Dudrick (Upstate Institute)
Title of Project: *Cornell Cooperative Extension*
Funding Source: Upstate Institute

Research Fellow: Matthew McGeary 2024 (Geography)
Faculty Mentor: Julie Dudrick (Upstate Institute)
Title of Project: *Friends of Rogers Environmental Education Center*
Funding Source: Upstate Institute

Research Fellow: Corey McLaughlin 2024 (Environmental Economics)
Faculty Mentor: Julie Dudrick (Upstate Institute)
Title of Project: *Unjust Costs of Energy Efficiency for Nonprofits*
Funding Source: Upstate Institute

Research Fellow: Folade Olusanya 2024 (Biology)
Faculty Mentor: Julie Dudrick (Upstate Institute)
Title of Project: *Pathfinder*
Funding Source: Upstate Institute

Research Fellow: Jorge Parada-Cisneros 2025 (Psychological Studies; Arts & Humanities)
Faculty Mentor: Julie Dudrick (Upstate Institute)
Title of Project: *Young Scholars Liberty Partnership Program*
Funding Source: Upstate Institute

Research Fellow: Matthew Ravaschiere 2024 (Biology; Environmental Studies)
Faculty Mentor: Catherine Cardelús (Upstate Institute)
Title of Project: *Ausable River Association*
Funding Source: Upstate Institute

Research Fellow: Avalian Rios 2025 (Psychological Science)
Faculty Mentor: Catherine Cardelús (Upstate Institute)
Title of Project: *Saranac Lake Community Schools*
Funding Source: Upstate Institute

Research Fellow: Max Shah 2024 (Undeclared)
Faculty Mentor: Catherine Cardelús (Upstate Institute)
Title of Project: *Exploration of Food Security and Food Access in Hamilton County, NY*
Funding Source: Upstate Institute

Research Fellow: Parna Shakouri 2023 (Anthropology)
Faculty Mentor: Julie Dudrick (Upstate Institute)
Title of Project: *New York State Association for Rural Health*
Funding Source: Upstate Institute

Research Fellow: Kara Shepard 2025 (Anthropology)
Faculty Mentor: Julie Dudrick (Upstate Institute)
Title of Project: *Small Nonprofit Capacity in Southern Madison County, New York*
Funding Source: Upstate Institute

Research Fellow: Sophie Smyth 2025 (Neuroscience; Mathematics)
Faculty Mentor: Julie Dudrick (Upstate Institute)
Title of Project: *Exploring Youth Substance Use and Parental Perception of Risk: Conducting One-on-One Interviews with Parents and Youth in Norwich, NY*
Funding Source: Upstate Institute

Research Fellow: Gabriel Villamil 2025 (International Relations)
Faculty Mentor: Julie Dudrick (Upstate Institute)
Title of Project: *Literacy Providers of Madison County*
Funding Source: Upstate Institute

Research Fellow: Eli Watson 2024 (History)
Faculty Mentor: Julie Dudrick (Upstate Institute)
Title of Project: *Oneida Community Mansion House*
Funding Source: Upstate Institute

Research Fellow: Ray Zhang 2024 (History)
Faculty Mentor: Catherine Cardelús (Upstate Institute)
Title of Project: *ADx Experience: Museum at Blue Mountain Lake*
Funding Source: Upstate Institute

Research Summaries

Research Fellow: Nizak Abdou (2026) **Concentrations: Computer Science; Art and Art History**

Faculty Mentor: Margaretha Haughwout **Department: Art and Art History**

Title of Project: Cosmic Conversations with Flora

Funding Source: AHUM Division

Project Summary:

This summer I explored plant conditions in the Food Forest Studio, a nearby ecosystem dedicated to eco-art at the Paul J Schupf Studio Arts Center in Hamilton. I used various sensors to collect data about the plants' condition such as soil temperature, pH levels, and moisture. Using this live data I created sounds using what John Cage calls 'chance operations' where the sensor inputs make a musical sequence.

I used TeleAgriculture Kits, a collection of sensors and microcontrollers designed by artists in Europe that post their data on a shared network. I collected data on the plants' living conditions in the intricate ecosystem of the Food Forest Studio. I then used the p5js programming language, to translate raw data into visuals and music.

My interface presents the data as if it was being examined by extraterrestrials. I imagine an extraterrestrial explorer interacting with plant communications and trying to understand them. I imagine these ETs are fascinated by them as they attempt to decipher inputs through a control board. Each button has a different effect on how the data is presented, putting plants in different perspectives of magnifying their differences and experiences by illustrating the data in various outputs. Thus allowing the visitor to contemplate their own personal relationship with plants through different lenses.

Visitors to the installation encounter a messy unattended desk of an alien explorer, where you can read the notes they left on sticky notes all over the place, and where you can log in to the alien computer and slowly uncover how they view the plant world. Click on the buttons and see how otherworldly creatures try to make sense of the plant world.

In this project, I unravel the captivating notion that plants, often considered an integral part of our daily lives, could also be perceived through an otherworldly lens. In contemplating plants as otherworldly entities, I provoke contemplation on the boundaries of our understanding of neighboring ecosystems and the intricacies of our connection with the natural world.

Just as distant celestial bodies stir our curiosity and ignite our imagination, plants possess an aura of mystery when viewed from an unaccustomed perspective. This perspective invites us to perceive them not just as static elements of the landscape, but as living beings with their own intricate languages, responses, and interactions. By placing us in the shoes of interstellar voyagers, I sought to elevate them from their familiar role and prompt us to consider the rich tapestry of their existence. What if, in exploring the alien within our midst, we unlock a deeper connection with the world around us?

Research Fellow: **Molly Abruzzese (2025)** **Concentration: Environmental Studies**
Faculty Mentor: **Catherine Cardelús** **Department: Upstate Institute**
Title of Project: **The Availability of Local Food through Farmers' Markets**
Funding Source: **Upstate Institute**
Project Summary:

This summer, I worked with the food systems program of the Adirondack North Country Association (ANCA). ANCA is a 65-year-old economic development organization that focuses on small businesses, food systems, clean energy, and equity and inclusion in the Adirondacks. Access to affordable, healthy, and locally grown food is a pressing issue in the Adirondacks and North Country region. ANCA's food systems program works to drive economic growth, sustain regional farms, and increase access to local food by working directly with farmers.

My research examined summer farmers' markets in the Adirondacks, specifically in Franklin, Clinton, Essex, St. Lawrence, and Warren counties. I traveled to each market and surveyed customers about how they learned about the market, what products they bought, and what other products they would like to see. The goal of this study was to determine customer habits at markets in order to determine future steps to make local food an option for more people. I shared the data I collected with ANCA, who runs two local farmers' markets, as well as other market managers that I met while surveying. The data I collected this summer will provide market managers insight into the customer's perspective on purchasing local food at farmers' markets.

I also was researching the use of SNAP (Supplemental Nutrition Assistance Program) benefits at farmers' markets. A large barrier to purchasing locally sourced food is access and affordability. Healthier foods, like produce, are generally more expensive than purchasing a pre-made meal of processed food. ANCA hopes to overcome this barrier by expanding the use of SNAP benefits at farmers' markets, to make fresh produce an easy alternative to pre-packaged food. My research examined the current use of this program, and I concluded that there had been a slight increase in the use of SNAP benefits from 2022 to 2023. This is an ongoing project, and the continued collection of data on the levels of use of SNAP benefits will further help inform ANCA, market managers, and other organizations in strategies to increase the use of SNAP benefits at markets.

Research Fellows: **Jaanhvi Agarwal (2025)** **Concentration:** **Computer Science**
Amanda Anowi (2024) **Concentration:** **Computer Science**
Faculty Mentor: **Aaron Gember-Jacobson** **Department:** **Computer Science**
Title of Project: **Illuminating the practices of Internet service providers**
Funding Source: **NASC Division; Tom and Liz Brackett Endowed Fund for Diversity, Equity, and Inclusion in Computer Science**

Project Summary:

Networks utilize routers to facilitate the transfer of data packets to and from the network. Due to the growing concern about energy usage in large-scale networks, our goal is to determine if it's feasible to estimate the power consumption of any given internet service provider (ISP). To do this, we narrow our focus on three questions: how many routers are deployed in any given network, how can we extract hardware information from these routers, and how can we compute power consumption given hardware information? The difficulty in this is ISPs do not release topology details and network vendors do not release power consumption information due to privacy reasons. Thus, we explore other means of obtaining this information without relying on ground truth data from ISPs or vendors.

The CAIDA Dataset - It is important to know how many routers are deployed in a network, and their connectivity, as that factors into total power consumption and carbon emissions of a network. The CAIDA (Cooperative Association for Internet Data Analysis) dataset is commonly utilized by researchers for analyzing network topology. In comparison to ground truth data from a large research and education network (Internet2), we find the CAIDA dataset has extra routers and missing links. We construct a visualization of the locations of the extra/missing entities and investigate the tools employed by CAIDA to identify potential factors contributing to these errors.

SNMPv3 - One way to extract hardware information is through leveraging the network monitoring system SNMP (Simple Network Management Protocol). When sent an unauthenticated SNMPv3 request, a router may respond with valuable information including an engine ID which contains a MAC address that uniquely identifies the device. The first half of the MAC address identifies the router vendor. We focus on finding patterns in the last 3 bytes of the mac address to see if a network vendor might allocate specific devices to certain mac addresses. However, not all routers will respond to SNMPv3 requests or utilize SNMPv3.

Power Consumption - Our investigation aimed to analyze the energy measurements of routers and switches used by Internet Service Providers (ISPs) and determine the energy consumption of network layer versus optical layer equipment. We thoroughly examined the publicly available information on each component involved in the network device and attempted to replicate the energy calculations by creating a power calculator that breaks down the power consumption of individual hardware components. The power consumption varies based on load, power supply type, components used, and choice of optics deployed.

Research Fellow: **Hadeel Al Qoronz (2025)** **Concentrations: Biology; Sociology**
Faculty Mentor: **Engda Hagos** **Department: Biology**
Title of Project: **Investigating the Role of KLF4 in DNA Damage and Epigenetic Changes**
Funding Source: **Michael J. Wolk '60 Heart Foundation**
Project Summary:

Cancer is recognized as the second most common cause of death worldwide. Cancer is essentially the abnormal and invasive growth and division of cells, mainly due to the elevated rates of proliferation and increase in the loss of the mechanism of apoptosis among cancerous cells as opposed to normal cells. This hindrance in the cell cycle that promotes cancer is due to both genetic and epigenetic changes. Furthermore, various factors including DNA mutations, oncogenic viruses, and epigenetic changes can have an effect on the function of a gene, a specific DNA sequence that encodes a protein.

Krüppel-like factor 4 (KLF4), for example, is a gene that is known to play a pivotal role in cancerogenesis. KLF4 is a zinc-finger transcription factor that possesses tumor-suppressive properties and maintains genetic stability. Previous findings indicate the progression of cancer and tumor formation in the absence of KLF4. Similarly, aneuploidy, chromosome aberration, and centrosome amplification are induced when the expression of KLF4 is reduced or lost. Although an absence of KLF4 has been shown to give rise to genetic instability, the exact mechanism underlying this is still unknown. As a result, this study aimed to investigate the role of KLF4 in the DNA repair mechanism. In order to determine the role of KLF4 in DNA damage, we compared cells deficient for KLF4 with cells expressing KLF4 in two different cell lines, Mouse Embryonic Fibroblasts (MEFs) and Human Colorectal Cancer Cells (RKOs). In MEF cells null for KLF4, KLF4 was reintroduced by transfection. In RKO cells, DMSO served as solvent control while the drug, Ponasterone-A (PON-A), induced KLF4. I expressly sought to examine the expression of Gamma-H2AX (DNA damage marker) and RAD51 (DNA repair gene) in the two cell lines. We found that RAD51 is higher in cells expressing KLF4 (Fig. 1 A&B).

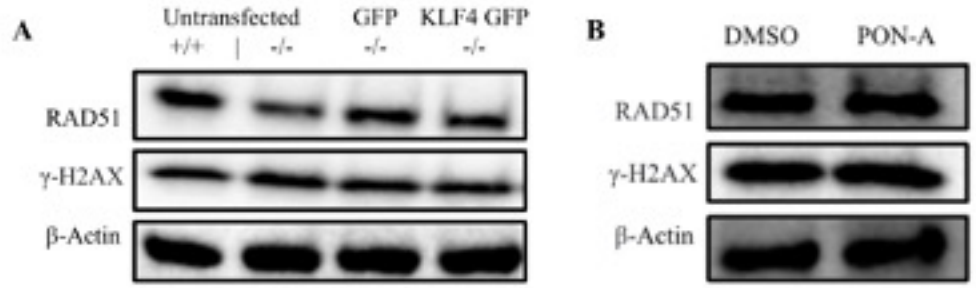


Figure 1. RAD51 is upregulated in the presence of KLF4. (A) Western blots representing RAD51 (37 kDa) antibody, γ-H2AX (15 kDa) antibody, and β-Actin (42 kDa) antibody in untreated MEF cells wild-type for KLF4 and MEFs null for KLF4 untransfected, transfected with GFP, and transfected with KLF4 GFP. (B) Western blots representing RAD51 (37 kDa) antibody, γ-H2AX (15 kDa) antibody, and β-Actin (42 kDa) antibody expression in DMSO and PON-A treated RKO cells.

Research Fellow: Obsidian Ammons (2026) **Concentration:** Undeclared
Faculty Mentor: Anthony Chianese **Department:** Chemistry
Title of Project: Milstein's Catalyst Kinetics
Funding Source: National Science Foundation
Project Summary:

The Chianese Lab is predominantly focused around the study of ruthenium and other metal-based catalysts. One of which is Milstein's Catalyst, a RuPNNimine pincer complex. It was previously theorized that this catalyst is the one that reacts with substrate in certain reactions, and it was later discovered that it has to be activated and converted into a different compound in order to function as a catalyst. My project for the summer was to find the rate of reaction for the conversion of Milstein Catalyst into the active RuPNN-PCy3 Complex, as seen in Figure 1, and the rate of reaction for the hydrogenation of tetradecene oxide into tetradecenoyl in Figure 2. The RuPNN-PCy3 reaction took place in quartz cuvettes, where UV-Vis spectra were taken over time in order to determine the amount of product over time (Figure 1), while the hydrogenation reaction (Figure 2) took place in the Assynt reactor under varying pressures of hydrogen, and aliquots of solution were taken by the GC machine over time. We have a python script to analyze the data we get from these reactions. The project is not complete, however, over the course of the project, valuable data was collected, and the reactions in the Assynt have all been completed (Figure 2).

Figure 1: UV-Vis Reaction

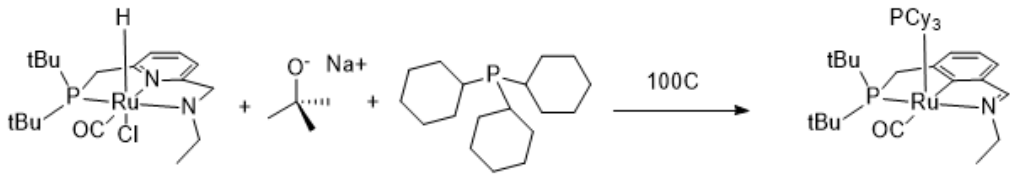
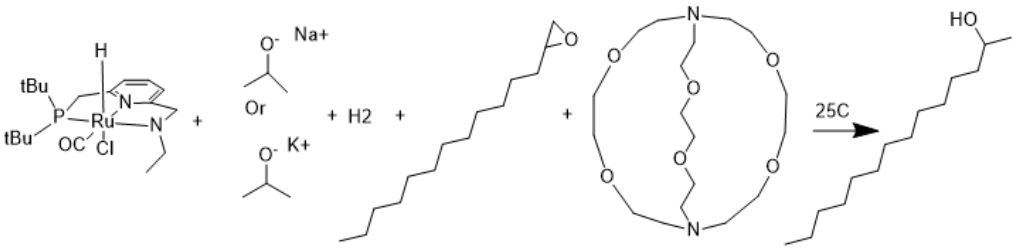


Figure 2: Hydrogenation Reaction



Research Fellow: Vishnu Anandraj (2025) **Concentration:** Economics: Political Science
Faculty Mentor: Navine Murshid **Department:** Political Science
Title of Project: The Kathua Case: Understanding Responses and Attitudes to the Ujh Development Project
Funding Source: Walter Broughton '63 Research Fund
Project Summary:

The paper for this research project analyzes responses to the Ujh multipurpose dam in the Kathua district of Jammu, India. While the dam is projected to improve irrigation and increase access to drinking water and electricity throughout the region, it will also displace 3,700 families from their land, the majority of whom are small-scale farmers. As such, the Ujh project is a potential example of development-induced displacement.

As construction for the project is yet to begin, the research aim was to analyze the varying attitudes towards the project's impending implementation and identify both typical and unique aspects of the Ujh multipurpose project compared to other instances of development-induced displacement in India. These responses were categorized as either government attitudes, which tried to justify the implementation of the project, and local attitudes, which either existed in response to government attitudes or expressed unique concerns and hopes about the Ujh project. The perspectives of the project were analyzed through government reports, public hearings, and newspaper coverage, which were divided into sources that focused on government or local perspectives respectively.

Some of these responses were typical of development projects in India. They focused either on the economic development the dam would spur or the displacement of local families it would cause. Outside this dichotomy; the rights of forest dwelling families, the strategic dimension of the project stemming from India's political motivations in Jammu, and the environmental impact of the dam are factors specific to the Ujh project which have shaped government and local perspectives. The analysis showed that government perspectives emphasized the economic benefits of the project, the importance of its strategic aims, and argued that the detrimental effects of displacement and environmental impacts would be successfully quelled by mitigation measures they proposed. While there were some similarities in the perception of the project's economic benefits, local perspectives were far more concerned that proposed mitigation measures were insufficient to quell the environmental impact and harmful effects of displacement. Fears of displacement were enhanced for forest dwelling communities. Finally, the strategic dimension of the project created fundamentally new conflicts for the displaced locals to consider when shaping their response to the dam. Beyond considering the economic impact of the project, they also had to consider its political impact, creating internal tension between competing interests of locals. The findings suggest that the unique aspects of the project had a significant role in shaping local and government responses to the Ujh multipurpose project and that little alignment existed between the two analyzed perspectives.

Research Fellows: Ian Andrews (2025) **Concentrations:** Astrogeophysics; Geology
Aidan Guller (2025) **Concentration:** Astrogeophysics
Faculty Mentor: Joe Levy **Department:** Earth and Environmental Geosciences
Title of Project: Polar and Planetary Research: Water track sediment chemistry and Mars landform evolution
Funding Source: NASC Division; Norma Vergo Prize

Project Summary:

Water tracks, present in the dry valleys of Antarctica, are trails of wetted soil fed by snowmelt and ground water. They contain high salt concentrations compared to other bodies of water in the warm areas of Antarctica, such as streams and ponds. We analyzed soils from Taylor Valley, Beacon Valley, and the South Fork of upper Wright Valley in order to determine properties of the water tracks in Antarctica. Our goals in this project were understanding water track properties and water distribution, as well as calibrating drone remote sensing data.We hypothesized that the middle of the water tracks is most abundant in water, with the outer edges of the tracks having less. Additionally, we aim to test the accuracy of the Continuum Removed Water Index (CRWI) method of remote sensing to determine soil water content. On-track soils were compared to off-track soils from each region. The two main attributes of the water track soils that we measured were water content (by mass) and salinity (dissolved salt content). In each sample, water content and lab-measured salinity were compared to each other and other factors such as field-measured salinity and grain size.

The most important physical property in understanding water track soil moisture distribution and calibrating drone remote sensing data was gravimetric water content. GWC was measured through a process in which we thawed frozen soil samples at 4 degrees celsius overnight. Thawed samples were weighed using an electronic balance and then placed in an oven at 50 degrees celsius overnight in order to dry them. They were weighed once more after drying and the difference between the dry mass and the wet mass was divided by the dry mass in order to determine the gravimetric water content (GWC). Dried samples were then sieved in order to separate the grains by diameter, with <2 mm being the desired threshold (the sand/gravel breakpoint). We noted the percentage of each sample that was gravel (>2mm grains) by mass.The grains <2 mm in diameter from each sample were loaded into centrifuge tubes in 5 gram increments and 50 mL of Milli-Q water was added to each sample. The tubes were then placed on a shaker table for an hour in order to fully dissolve any salts in the soil. They were then centrifuged for 12 minutes in order to settle all of the grains out. The centrifuged brines were vacuum filtered in order to separate the liquid and solids. We placed an electrical conductivity meter probe in the brine, which measured its conductivity in parts per million. This was important for us to know because water tracks are highly saline compared to other bodies of water, so it is useful to know the relative salinity of water tracks in different areas and with different water contents.

We continued our processing of samples by pouring out the remaining brine from the falcon tubes, leaving the wetted sample at the bottom. We then filled each sample with ~50mL of Milli-Q deionized water and placed them on the shaker table for 30 minutes to dissolve out any remaining salts. Next, we re-centrifuged each sample and poured out all the brine, this time without measuring for an EC value. After that 2nd wash of loaded samples, they were placed at 4 degrees celsius again to preserve any organics within the soils. Our final step was to load the previously collected brines for each sample into new tubes for both cation and anion analysis of the dissolved salts, therefore each sample has two brine loaded tubes to its name.

Moving forward, we plan to use an ion chromatograph to analyze these loaded brine tubes to gain a better understanding of the soil chemistry along these Antarctic water tracks. Combining our collected data for soil moisture and soil chemistry will contribute to the comprehension of the systems that govern the formation of water tracks on Earth, and how these systems might be used as an analogue for similar systems on different planets, like Mars. We hypothesize that conditions in which water tracks can form in Antarctica could be very similar to the conditions required for groundwater to be present on Mars.

Though we have more data to collect with regard to soil chemistry, we were able to plot the properties we measured in the lab against each other. For example, we found a negative correlation between soil moisture and grain size (Figure 1), which gives unique insight into how water tracks affect soils over time. Additionally, we compared the GWC and EC in each sample, which were the two primary properties we measured (Figure 2). In order to test the accuracy of the CRWI calibration, we took the CRWI values of each sample and compared them to the lab-measured GWC values (Figure 3). The stronger the correlation between the two is, the more accurate the calibration was.

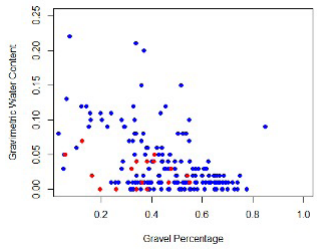


Figure 1: Soil moisture content versus gravel fraction: The blue dots represent on track soil samples, and the red dots represent off track samples. We observed a clear negative trend between GWC and gravel percentage, which we attributed to water's erosion and weathering of larger particles. This shows how the water in water tracks may be able to change soils in the area.

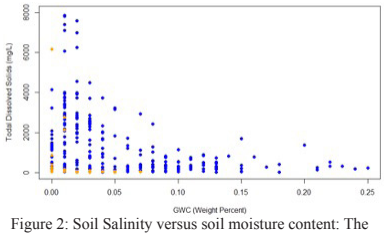


Figure 2: Soil Salinity versus soil moisture content: The blue dots represent on track soil samples, and the orange dots represent off track samples. We observed a clear negative correlation between GWC and EC, which we deduced was a product of wetter soils being more diluted, therefore having fewer ppm of salts present.

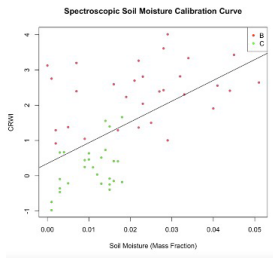


Figure 3: CRWI versus soil moisture: In this figure, the drone measured CRWI was compared to lab measured GWC. Our hypothesis was that CRWI is able to approximate soil moisture in a given area. As this plot shows, there is a positive correlation between CRWI and GWC as we predicted.

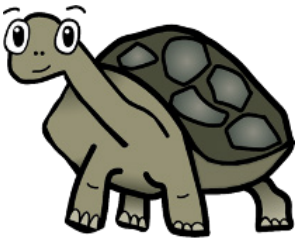
Research Fellows:	**Jose Arriaza (2025)**	**Concentration: Geography**
	Andrew Lass (2025)	**Concentration: Computer Science**
	Grace Reilly (2026)	**Concentration: Undeclared**
	Regan Todd (2024)	**Concentration: Environmental Biology**
	Ava Wojtaszek (2024)	**Concentration: Africana and Latin Amer Studies; Educational Studies**
	Krelyn Zacarias (2025)	**Concentration: Computer Science**
	Leisha Ayala	
	Joyce Gordillo	
	Shannon Jedreicich	
	Sarah Jekel	
	Sabrina Page	
	Ashle Vescio	
Faculty Mentors:	**Karen Harpp**	**Department: Earth and Environmental Geoscience; Peace and Conflict Studies**
	Meg Gardner	**Department: Educational Studies**

Title of Project: **The Virtual Galápagos: Building an Interactive, Interdisciplinary STEM-Learning Website for Elementary Children**

Funding Source: **NASC Division; National Science Foundation**

Project Summary:

A team of 10 pre-service teachers and STEM majors collaborated to construct the Virtual Galápagos, an immersive, web-based curriculum for children in grades 3 through 5. Developed during a ten-week summer program by a highly collaborative team of students from Colgate and Utica Universities, this interactive website provides an online resource for educators interested in ways to teach their students STEM through the lens of the Galápagos Islands. Science topics including conservation, evolutionary biology, and the geosciences are integrated in the learning materials. Children using the site will gain critical knowledge, scientific skills, and creative confidence through discovery-based pedagogical methods.



In the Virtual Galápagos curriculum, students' exploration is motivated by a central scientific mystery. This year's question focuses on the Galápagos giant tortoises. The 12-14 tortoise species in the Galápagos fall into two, broad groups: Tortoises with short limbs and classic, dome-shaped shells, and those with longer limbs and saddleback shells, like the saddle of a horse. This has prompted a still-unresolved scientific question: Why do some tortoises have domed shells, whereas others have saddlebacks? As students explore each module, they gather evidence about the two types of tortoises, their island habitats, ecosystems, and behavior to help them construct an explanation for why and how the different shell shapes exist in this small archipelago (spoiler alert: it's related to natural selection!).

In the construction of the educational platform, we focused on designing student-based learning pedagogy driven by the 5 E's approach: engage, explore, explain, elaborate, and evaluate. In each module, learners collect observations as evidence to construct claims, which they support with reasoning, in an emulation

of the scientific method, and aligned with national science teaching standards. Our emphasis has been to build modules around innovative and interactive exercises that encourage student engagement both with the website and away from their screens, while maximizing accessibility for all learners.

Each of the five modules include lesson plans for teachers, activities for students, learning assets, and a storyline that students follow that guides them to collect scientific evidence to solve the tortoise shell mystery. Learning assets include interactive questions and exercises (drag-and-drop, matching), whiteboard and Canva animations, guided learning exercises, and hands-on activities that encourage students to apply concepts they are learning to their own lives, and offline. In addition, we interviewed scientists currently carrying out research in the Galapagos, whose videos will be integrated into the project to highlight the diversity of scientists and encourage students to see that there is room for them to contribute to scientific advancement.

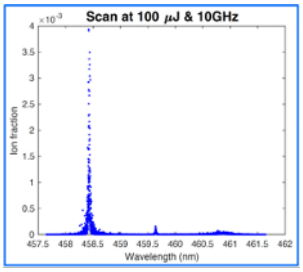
The participants, many of whom are future teachers, learned how to build a thoughtful, innovative STEM curriculum that is engaging for learners, using a wide range of digital tools, while collaborating in a creative group. We became artists, scientists, and educators this summer. Several students from the 2023 team will continue to build and refine the curriculum, which will be tested in local schools prior to being widely distributed. Ultimately, our objective is to make STEM education more accessible and to encourage all students, no matter their background or experience, to become interested and invested in the scientific process.

Research Fellows: **William Aspinwall (2025)** **Concentration: Astrogeophysics**
Flynn McGrath (2026) **Concentration: Undeclared**
Faculty Mentor: **Jonathan Levine** **Department: Physics and Astronomy**
Title of Project: **Photoionization of Strontium Near the 459 nm Two-Photon Resonance**
Funding Source: **Volgenau Wiley Endowed Research Fellowship**
Project Summary:

We work to develop an instrument capable of being sent to the Moon to date rocks there. We have a working prototype with seven lasers; however, lasers are heavy and, if we can get ours working with only three, it will be a lighter and therefore more attractive mission payload. If we can effectively ionize strontium and rubidium atoms by absorption of two photons of the same wavelength, one laser can be used instead of two. We sought to figure out how effectively two photons of one wavelength can doubly excite strontium and rubidium atoms, and which wavelength ionizes the atoms most effectively. Our model predicted that the optimal wavelength for ionizing both strontium and rubidium atoms is the resonant wavelength of the transition between the middle and upper excited states (458.43 nm for strontium and near 776 nm for rubidium). However, physical experiments performed this summer found that wavelengths near the two photon resonance (459.64 nm and near 778 nm for strontium and rubidium, respectively) ionized the elements more efficiently than the wavelengths predicted by our model. Therefore, there must be an issue with the assumptions underlying the model; we suspected that our model's phase diffusion method of modeling laser bandwidth was the issue.

In order to make this determination, we constructed models to analyze the ionization behavior of strontium and rubidium under coherent light using an approach based on the Bloch vector for a two-state quantum system. Using the time dependent Schrodinger equation and the density matrix, we produced an equation of motion for a modified Bloch vector describing a three-level atom – including the coherences between energy states and the population inversions between states. Next, we included spontaneous decay and ionization. We also modeled the bandwidth of the laser with the phase diffusion method, in which the phase of the laser takes a random walk of a given diffusivity. Our model approximated solutions to this system of equations using the fourth order Runge-Kutta method. We could see the theoretical proportion of ions we would get from a laser of a given wavelength by running the model many times with different input wavelengths – a wavelength scan.

Rubidium presented more of a challenge than strontium: at both of the middle and upper excited states, there are two levels of similar energy that we could target. This effectively provided us with a five-level atom, requiring a modified Bloch vector with 25 rows (rather than the 9 rows required for strontium).



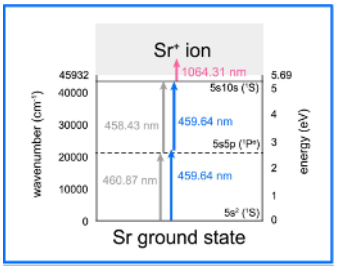


Figure 1 (left): An example of a wavelength scan produced by our strontium model.

Figure 2 (right): A diagram of the double excitation and ionization scheme for strontium; the double excitation and ionization of rubidium follows a similar process.

Research Fellows: **Ekaterina Balsan (2025)** — **Concentration: Chemistry; Classical Studies**
Joe Berberich (2024) — **Concentration: Geography; Chemistry**
Morgan Usselman (2024) — **Concentration: Chemistry**
Faculty Mentor: **Anne Perring** — **Department: Chemistry**
Title of Project: **Ambient Aerosol Measurements at Colgate University**
Funding Source: **Justus '43 and Jayne Schlichting Student Research Fund; NASC Division**

Project Summary:

Atmospheric aerosol particles have incredibly important climate effects. Our group focuses on two specific kinds of aerosol: ice nucleators (IN) and black carbon (BC). IN and their impacts on clouds are among the largest remaining uncertainties in predictions of future climate. BC is a byproduct of incomplete combustion which absorbs sunlight and contributes to positive radiative forcing.

This summer, in our work on IN, we focused on analyzing snow samples and developing a methodology to concentrate the IN in them. Samples are extracted into water and a drop freeze assay is performed with adapted MATLAB code used to detect freezing events. 60-100 2.0 µl drops are deposited with an acid-washed autopipette on a copper disk which is covered with a thin layer of vaseline. (Fig 1) The plate is gradually cooled while images are recorded at defined intervals and we calculate the concentration of IN based on the temperature distribution of freezing events. We find that local samples from spring snowfalls often have significant levels of IN with interesting variability, possibly relating to seasonal cycles or indicating the difference between lake effect and non-lake effect snow. We also established that the filter-based concentration method commonly used in the literature results in poor recovery of IN from the filter, and we are testing alternate concentration strategies.

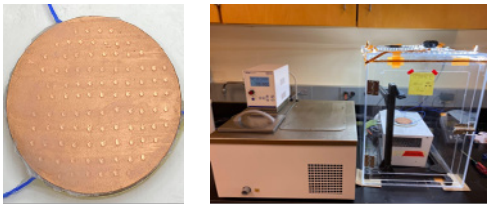


Figure 1: Drops on copper disk (left) and cooling setup (right).

Our work on BC is done in collaboration with NOAA and relies on the use of their Single Particle Soot Photometer (SP2) on airborne platforms during multi-agency studies. (Fig 2) This summer, we continued analysis of data collected during the Asian Summer Monsoon Chemical & Climate Impact Project (ACCLIP, 2022), which focused on convective processing of pollution, and collected new data during the Atmospheric Emissions and Reactions Observed from Megacities to Marine Areas (AEROMMA, 2023) mission, which focuses on urban air quality in North America.

Figure 2: J. Berberich ('24) and E. Balsan ('25) re-install the SP2 after maintenance

The ACCLIP results suggest near complete (>99.8%) BC removal during monsoonal transport, the first observational evidence of its kind. This provides a necessary and strong constraint for atmospheric models, which currently assume relatively efficient convective transport of BC. During the ongoing AEROMMA project we are responsible for SP2 calibration and maintenance and submission of field data. Future analyses will focus on city-to-city variation in BC emissions and to what extent those differences are driven by local- and state-level regulatory policies. This survey of North American air quality will reveal the impacts of past legislation and help us appropriately target future policies.

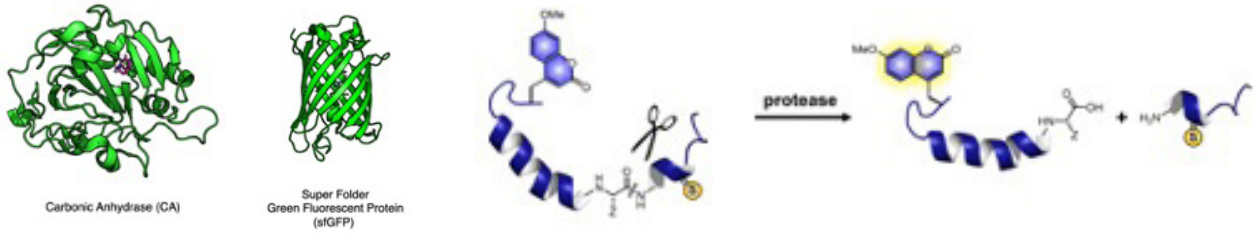
Research Fellows: **Emmerson Bartels (2025)** — **Concentration: Biochemistry**
Giovanni Cavalli (2024) — **Concentration: Molecular Biology**
Harlan Greenberg (2025) — **Concentration: Computer Science**
Zachary Laster (2024) — **Concentration: Molecular Biology**
Sarah Sexton (2026) — **Concentration: Undeclared**
Faculty Mentor: **Jacob Goldberg** — **Department: Chemistry**
Title of Project: **In Vivo Incorporation of 4-Difluoromethylphenylalanine in Proteins**
Funding Source: **Michael J. Wolk '60 Heart Foundation; NASC Division; Picker Interdisciplinary Science Institute; Research Council; Miller-Cochran Fund**

Project Summary:

The goal of our research was to incorporate the unnatural amino acid 4-difluoromethylphenylalanine (dfmF) into proteins. This unnatural amino acid contains fluorine, making it suitable for 19F-NMR, a diagnostic tool that allows for the determination of structural changes in proteins and ligand binding. The incorporation of dfmF into proteins and subsequent 19F-NMR detection has potential applications in medicinal chemistry research, particularly for determining whether or not a drug molecule has bound to a protein.

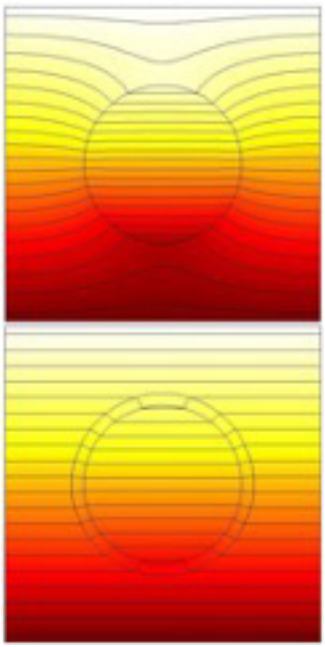
Our lab used genetic code expansion techniques known as orthogonal amber suppression in which an altered tRNA synthetase is able to pair a tRNA molecule with the corresponding fluorinated amino acid for incorporation during protein expression. Using a tRNA synthetase pair from M. janaschii, an archean, and transformed E. coli cells, we successfully incorporated dfmF into two proteins, carbonic anhydrase (CA) and super folder green fluorescent protein (sfGFP) in different positions in each protein. We verified incorporation and protein purity with MALDI-TOF mass spectrometry and gel electrophoresis, respectively. Magnetic resonance studies are underway and provide additional confirmation of amino acid incorporation.

Additionally, our lab chemically synthesized thioamide-containing amino acids, which act as fluorescence quenchers, for monitoring protease activity on substrates containing dfmF in a peptide chain. The quenchers were coupled to a peptide chain containing the fluorophore 7-methoxycoumarin, the fluorescence of which is suppressed by the thioamidous amino acid. The attendant changes in fluorescence allow us to measure the activity of specific proteases, such as chymotrypsin, trypsin, thermolysin, or papain, depending on the specific peptide sequence.

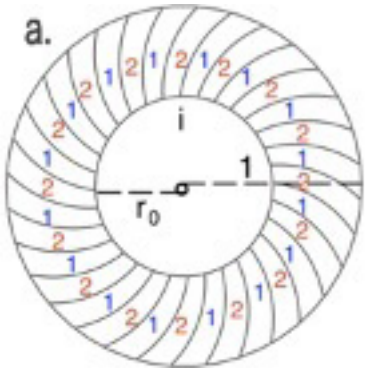


The proteins we chose for incorporation of dfmF (left) and the visual representation of chymotrypsin activity (right).

Research Fellow: Dennis Belotserkovskiy (2026) **Concentration:** Undeclared
Faculty Mentor: Silvia Jimenez Bolanos **Department:** Mathematics
Title of Project: Nonlinear Neutral Inclusions
Funding Source: National Science Foundation
Project Summary:



Cloaking is an emerging area in mathematics with various applications. Take a linear and uniform field, and insert an object into it. Typically, this object perturbs the field based on its physical properties. However, if the field is undisturbed, this object is considered a neutral inclusion. Thus, a field containing neutral inclusions is indistinguishable from an empty field, and the objects can evade detection from an imaging system using the perturbations of the relevant field. This project addresses the problem of determining nonlinear neutral inclusions in electrical and thermal conductivity for specific spherical shapes.



This summer, two central objectives emerged. The first was the verification of mathematician Andrej Cherkaev's work, which studied a circle in an infinite electric field with radius r=1 and a homogeneous circular core of linear material with conductivity σi and radius r0. However, the coating has two alternating linear materials in a logarithmic spiral of angle φ. He defined boundary conditions for the PDE in the continuity of the electric potential and flux along the outer and inner borders. He expressed the conductivity of the annular section as a conductivity tensor that contains eigenvalue conductivities σ1 and σ2 and solved for the effective conductivity of the shape in terms of the unknown constants mentioned above. This explicit formula and the setup to derive it were verified.

The second facet of the project was to expand this formula to a more general case: a nonlinear core. Unlike the linear core satisfying the Laplace equation, this core satisfies the p-Laplace equation with varying p values (the Laplacian is simply when p=2). After following a process similar to Cherkaev's, it was found that an explicit formula could not be found; the effective conductivity could be expressed as a system of one linear and one nonlinear equation. However, the solution to this system could be proven to exist and be bounded. These bounds were found and verified. Also, the behavior of the solution as p and σi varied was analyzed. With increasing p, the effective conductivity converged to a steady-state solution dependent solely on r0. Also, when the extrema of the core conductivity were considered (i.e., superconductivity or perfect insulation), they created bounds for the conductivity matching that of the linear case and, therefore, independent of p.

An ongoing aim of this project is to derive an analogous result in three dimensions. A cylindrical stack of the aforementioned neutral 2D shape is still neutral. However, if the ratio between r and r0 changes, the shape is not neutral. Thermal conductivity is also being explored. The challenge is that heat diffuses and, thus, adds an added variable of time. Even if, in a simple case, the thermal potential is time-harmonic, the PDE is nonhomogenous and much more complex.

Research Fellows: **Rylie Berwanger (2026)** **Concentration: Geology**
Gisele Tjan (2026) **Concentration: Undeclared**
Faculty Mentor: **Amy Leventer** **Department: Earth and Environmental Geosciences**
Title of Project: **Antarctic Paleoclimate Research**
Funding Source: **Hackett-Rathmell 1968 Memorial Fund; Doug Rankin '53 Endowment - Geology Research Fund**

Project Summary:

This summer, our research involved identifying and working with diatoms to learn more about Antarctica's past, current, and future climate. Diatoms are single-celled algae, found in abundance in the Southern Ocean surrounding Antarctica. Diatoms first appeared in the fossil record around 120 million years ago, during the Cretaceous period. Like other organisms, diatoms have been evolving since then, leading to a wide range of species. Different species adapted to live in specific environments and many have since gone extinct, allowing diatoms to provide information about past environments, including age and climate. We focused on the identification of diatoms to learn more about the Antarctic paleoclimate.

Our work was divided into two projects, one focused on ancient diatoms, the other on modern phytoplankton. For the first project, we worked on diatoms from two sediment cores from the Ross Sea, currently the site of a large ice shelf. Today, questions about the rate of ice sheet and ice shelf retreat are important in terms of understanding rates of future sea level rise. Our goal was to prepare slides for quantitative microscopy that would allow for the determination of both changes in diatom abundance, a clue to past primary productivity, and changes in overall assemblage, related to changes in past sea ice and glacial ice cover. As part of our first project, we made quantitative slides from the samples of the cores and analyzed them for diatom abundance and assemblage across different depths and ages of the sediment.

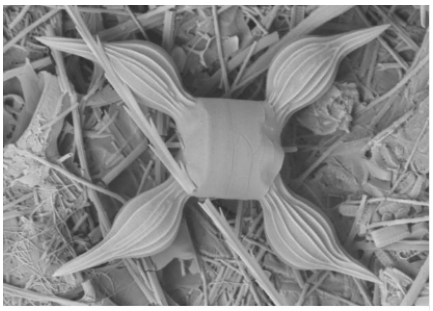


Figure 1. *Chaetoceros bulbosus* imaged on the SEM.

Diatom taxonomy was something we became very familiar with by the end of our research. Having no prior experience with diatoms, we began getting familiar with different species through existing slides and extensive literature. By the end of our summer, we were able to easily identify species of polar marine diatoms via light microscopy and on the Scanning Electron Microscope (SEM).
For the second project, we worked with phytoplankton samples taken along a transect between New Zealand and Antarctica. For each sample location, we documented the phytoplankton assemblage, using SEM imagery. Photos from each site were used to create diatom plates, using Adobe Illustrator. By skillfully manipulating image magnifications, applying precise cropping, and incorporating scale bars alongside individualized keys for identification, comprehensive plates were composed. These diatom plates serve as visual showcases, effectively portraying what was found in each sample. Furthermore, they serve as valuable tools for discerning paleoenvironmental conditions, while also facilitating insightful comparisons across each sample collected.

Finally, to understand the environmental controls on the changing phytoplankton assemblage, we plotted the physical oceanographic properties of the ocean at the time of sample collection, using Ocean Data View (ODV) software. This software converted longitude and latitude data into a map that documented where each sample was taken from. We also used ODV to create color-graded contour maps for other variables, such as sea surface temperature, salinity, fluorescence, transmittance, and the concentration of carbon dioxide, to create a better visual representation of the data.

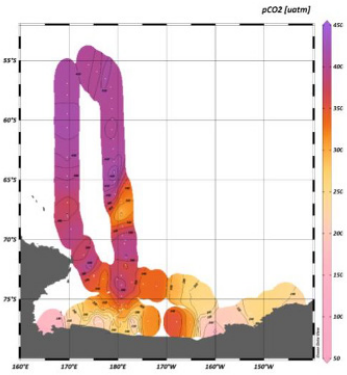


Figure 2. Contour map of carbon dioxide concentration from ODV; low CO^2 values indicate high productivity.

Research Fellow: **Peter Biss (2026)** **Concentration:** **Undeclared**
Faculty Mentor: **Sam Rosenfeld** **Department:** **Political Science**
Title of Project: **Coverage of the Presidential Debates in a Changing Media Landscape**
Funding Source: **SOSC Division**
Project Summary:

In a 96-page report leaked to *Buzzfeed* in 2014, the New York Times painted a bleak future for the world of professional journalism.

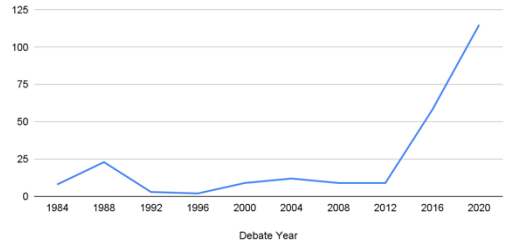
> "Not only is the audience on our website shrinking but our audience on our smartphone app has dipped, an extremely worrying sign on a growing platform," the report reads, "Our core mission remains producing the world's best journalism. But with the endless upheaval in technology, reader habits and the entire business model *The Times* needs to pursue smart new strategies for growing our audience" (Tanzer 2014).

If this statement had been offered by any other newspaper, it would not have come as a surprise since declining revenue is something that has plagued every newsroom around the country (Karter 2022). But coming from The Times, it means something different. If one of the most respected journalistic organs in the country, with more monthly visits to its online platform than all three of its closest competitors (Muck Rack 2023) and more Pulitzer Prizes than any other newspaper (*New York Times* 2023), faces uncertain waters in the 21st century, then what place does professional journalism have in the current media environment?

Offering a case study and text-analysis of *New York Times* coverage of the presidential debates during the last 4 decades, this study posits one possible answer to that question. Namely, that declining viewership and increased competition from other sources of content consumption, both news-based and not, has led to less-balanced, more theatrical, and potentially more partisan journalism. Below, see one of three results which support this conclusion.

The significant increase in the number of "negative" or "strongly negative" sentences used to describe either the Democratic or Republican presidential candidate during the 2016 and 2020 debate years suggests that the language we see in journalism today is different (ie. less neutral) than the language of yesterday.

Figure I: Total # of "negative" or "strongly negative" sentences per presidential debate year



A continuation of this trend may be enough to suggest that the world of serious journalism has adapted itself into becoming more loud, high-stakes, or theatrical in the hope of appealing to a less captive audience.

For more information related to study results and the text-analysis methodology used, access the full report her: https://docs.google.com/document/d/1IcUCHWSYD7X3Qg3Nhi2Ro7mtupKDYLaYw2vC2pSCyr0/edit

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Research Fellows: **Abbey Bonino (2025)** **Concentration: Chemistry**
Diane Kim (2024) **Concentration: Biochemistry**
Faculty Mentor: **Anthony Chianese** **Department: Chemistry**
Title of Project: **Epoxide Hydrogenolysis Catalyzed by a Ruthenium Pincer Complex**
Funding Source: **NASC Division**
Project Summary:

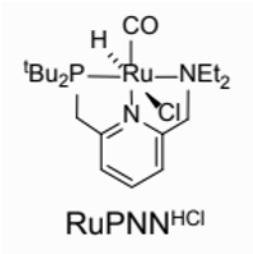
Catalytic hydrogenation is an affordable, atom-economical process that can be performed in large-scale industrial applications. Utilizing this reaction in a variety of different applications is a step toward making chemical synthesis more sustainable, a goal that is on the forefront of chemists' minds in this day and age. One category of organic molecules for which catalytic hydrogenation could be employed is epoxides. Hydrogenating epoxides creates alcohols of both the branched and linear variety depending on the conditions one uses. Furthermore, racemization can be observed due to the chirality exhibited by both the epoxide and its subsequent branched alcohol product. We are able to determine racemization by separating enantiomers through gas chromatography using a chiral column. Our overall goal for this project is to further develop affordable catalytic branched-selective epoxide hydrogenolysis with an emphasis on synthesizing chiral secondary alcohols without racemization. If product racemization could be avoided, epoxide hydrogenolysis could provide access to chiral secondary alcohols with extremely high enantiomeric excess.

This summer, we worked and completed a substrate scope of epoxides that were chosen to investigate the tolerance of certain functional groups expected to be challenging for hydrogenation catalysts; such groups include aromatic rings, ethers, aliphatic chains, an alcohol, and an allyl group, as these are groups that may also undergo hydrogenolysis or other side reactions under our conditions. Our process for each epoxide tested began with a hydrolytic kinetic resolution in order to isolate one enantiomer (if we did not buy the epoxide enantiomerically pure to begin with). The actual hydrogenation reaction took place in a Parr reactor (Figure 1) for 18 hours at 25°C under 30 bar of hydrogen. Each reaction was done at a 0.5 M substrate scale with 2.5% loading of KOtBu base, isopropanol as the solvent, and typically a 1% catalyst loading of the Ruthenium pincer catalyst $RuPNN^{HCl}$ (Figure 2). The exception for the 1% catalyst loading was a 3.3% loading for glycidol. Using the gas chromatogram, we analyzed each reaction to determine the branched to linear ratio, enantiomeric excess, and percent conversion to product. Overall, each epoxide we tested was successfully hydrogenated into a branched, chiral, and enantiomerically pure alcohol, excluding allyl glycidyl ether.

Hydrogenolysis with allyl glycidyl ether had shown inconclusive data due to the terminal double bond; the allyl group could have been hydrogenated. Furthermore, multiple levels of isomerization (double, cis, trans) of both enantiomers may have occurred resulting in a total of 8 different potential products that needed to be differentiated. This substrate could not be fully analyzed without purchasing the many products that may have resulted from the reaction, which is not worth the expense of our limited resources.

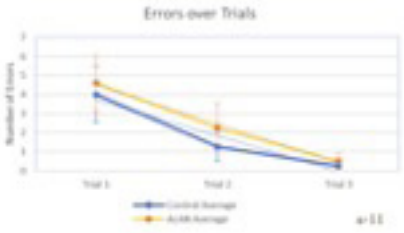
Figure 1 - Parr reactor

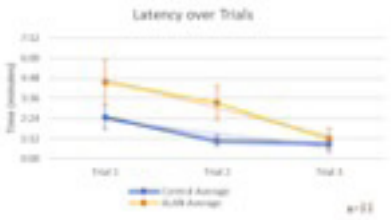
Figure 2 - Ruthenium Catalyst



Research Fellow: Kyle Born (2026) **Concentration:** Undeclared
Faculty Mentor: Wan-chun Liu **Department:** Psychological and Brain Sciences
Title of Project: The Effect of Chronic Artificial Light at Night on Zebra Finch Spatial Learning and Memory
Funding Source: Mind, Brain and Behavior Scholars Award
Project Summary:

As our night environment grows brighter and brighter with new street lights, skyscrapers, and everything in between, so does the need for research on the lasting effects of this chronic artificial light exposure on life. Light pollution tends to affect birds more significantly given their prevalence in cities and other developed areas that larger animals do not cross. My research uses the Zebra Finch animal model to assess potential consequences of long-term artificial light at night (ALAN), specifically the effects on spatial learning and memory. The finches I used were exposed to a constant five lux of light regardless of day or night cycles. Preliminary results suggest ALAN acts as a stressor on the avian brain and body. New research has even found ALAN leads to gene-suppression of hippocampal neurogenesis (Tafique, 2022). Additionally, hippocampal lesions have been found to inhibit spatial memory (Watanabe & Bischoff, 2004). Thus, I hypothesized that the exposure of ALAN will lead to decreased hippocampal plasticity and spatial memory. To properly measure spatial memory, I adapted an experimental protocol where scientists were able to teach Zebra Finches the spatial location of an accessible feeder among inaccessible feeders (Watanabe & Bischoff, 2001). Constraints made it necessary for me to scale my cage down from the study's 6x6 feet to a 3x3 foot model. All the other details remained largely the same. A schedule was created to ensure the birds' comfort in the experimental cage prior to testing; this involved a three day habituation period followed by isolation with all (four) feeders accessible. During testing three feeders were covered, and each subsequent day, the birds' memory of the single accessible feeder was assessed. This was quantified as errors and latency. Errors were added when a bird made a touchdown at an incorrect, covered feeder, meaning it was at the inaccessible feeder for at least one second or pecked at the contents (tape). Latency was the time taken until the bird made a touchdown at the single correct feeder. My results have shown that ALAN birds make more errors and have increased latency times, leading to the speculation that there are indeed neuronal differences within the hippocampus. Further research, involving perfusion, brain sectioning, and immunohistochemistry, will ascertain these ideas.





Research Fellow: Amira Brown (2026) **Concentration:** Undeclared
Faculty Mentor: Wan-chun Liu **Department:** Psychological and Brain Sciences
Title of Project: Familiarity and Unfamiliarity as a Determiner of Social Aggression in Captive Zebra Finches
Funding Source: NASC Division
Project Summary:

This study focused specifically on the aggression patterns of familiar and unfamiliar male zebra finches, with the assumption that familiar males would display more aggressive tactics. This hypothesis ended up being proven true with familiar males exhibiting more aggression overall. The data between the two sets were similar, but this was due to the fact that specific birds within each cohort were outliers. There were two total sets in each group of familiar and unfamiliar; that is, two groups of familiar birds and two groups of unfamiliar birds. Each cohort was tested for one week with the first two weeks of the summer being used on a preliminary trial group of birds. Given that this study only took 8 weeks, I was unable to examine my true interest which was the effect of 24/7 light exposure on fighting habits in zebra finches. This study was meant to focus specifically on 24/7 light pollution exposed birds for the purposes of examining how birds in urban areas might experience decreased quality of life. Previous studies in the Liu Lab have revealed overall negative metabolic effects thus prompting me to explore behavioral effects. I plan to continue this in the fall.

The first week of the study commenced with a preliminary trial consisting of four birds, each unrelated and of the same general age, placed in a cage and consistently monitored for 5 days. The finches were observed manually by me as well as recorded for later footage review. In studying social aggression, it was necessary to define which behaviors could be consistently interpreted as aggressive and which were to be noted off as idle behavior or playfulness. For the preliminary trial pecking (touching another bird with a beak), staring (focusing on another bird for more than one second), chasing (displacing another bird more than twice in a row with no more than five seconds between each displacement), and the raising of the head above another bird were all considered aggressive behaviors. There is some scientific discourse surrounding whether some of these behaviors such as pecking are always aggressive, but for the purposes of this experiment these behaviors were decided to be aggressive as there is some literature hypothesizing that dominant birds typically initiate playing, and dominant birds are typically more aggressive than their peers. Dominance was also a significant part of this study because of the literature surrounding its correlation with aggression. A measure of each bird's perceived dominance, created by combining their noted aggressive behaviors, as well as a few other dominant behaviors such as spending more time in the center of the cage, was analyzed alongside their perceived aggression to situate the birds in a hierarchy and get a sense of general patterns of behavior between birds of different status. This metric also helped reveal behavioral patterns and relationships between birds that had not been analyzed in previous studies.

After analyzing the footage from the preliminary trials certain behaviors were written off as statistically insignificant and removed from the study. Which perch the birds preferred, which was included as a dominance metric at the start, was dropped, as was feeding time after the first official trial. At this point in the study, after the first trial, an examination on spatial learning was added to the behavioral data. We hypothesized that the most dominant birds, which were often the most aggressive, would demonstrate the greatest exploratory tendencies and display robust spatial learning. To test this hypothesis birds were continually exposed and separated from a tray of covered seeds whose position they had to remember.

At the conclusion of the study both hypotheses were proven true.

Research Fellow: **Nikoloz Bujiashvili (2024)** **Concentrations:** **Physics; Computer Science**

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

Title of Project: **Graph Partitioning Using Spiking Neural Network (SNN)**

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

Project Summary:

Traditional computing architectures are rapidly approaching fundamental physical limits on their energy efficiency and processing power. To overcome these limitations, researchers are exploring alternative ways for computation inspired by the human brain's massively parallel, low power architecture. Neuromorphic computing tries to mimic both the structure and the functionality of human brains in order to perform complex mathematical computations and tasks such as pattern recognition more efficiently. Optimization and effective implementation of those novel computing techniques should decrease both computational runtime and energy consumption. In our research, we are using Spiking Neural Networks (SNN) as the basis for neuromorphic computation to solve mathematical problems.

More specifically, our research concentrated on the graph partitioning problem. We used Brian2 python library to simulate the operation of SNN and observe how the system would handle the partitioning. We generated Scale-free and Small-world graphs with a varying number of nodes and randomized edges. While partitioning those graphs, we varied multiple parameters such as simulation time, alpha and beta constants, degree of spontaneous spiking in the system, input and bias currents and tried to identify the conditions necessary for optimizing characteristic quantities of the partitioning such as energy, cut and modularity. As a result of the optimization, we managed to improve graph partitioning quality and identified the parameter combination necessary for this enhancement.

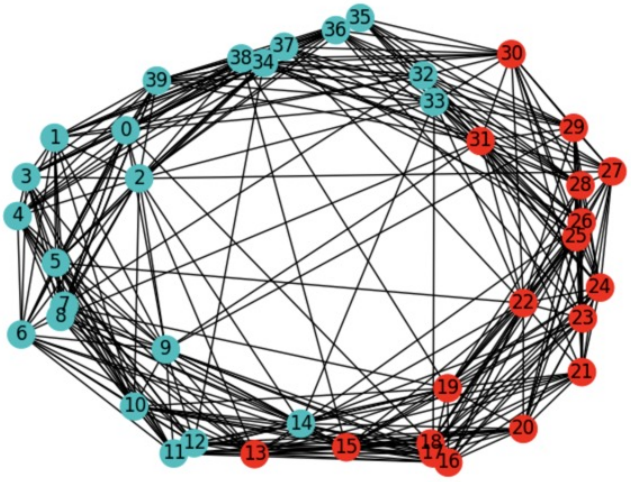


Figure 1: Partition of a randomly generated 40-node Small-world graph performed by the simulation of Spiking Neural Network

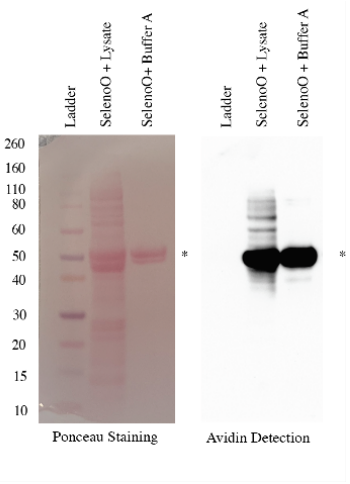
Research Fellows: **Henry Burdorf (2026)** **Concentration: Undeclared**
Abby Getz (2024) **Concentration: Biochemistry**
Ethan Riggs (2025) **Concentration: Biochemistry**
Faculty Mentor: **Jenny Peeler** **Department: Chemistry**
Title of Project: **Investigating AMPylation Activity of SelenoproteinO Homologs**
Funding Source: **Michael J. Wolk '60 Heart Foundation; NASC Division; Justus '43 and Jayne Schlichting Student Research Fund**

Project Summary:

Selenocysteine (Sec) is the 21st naturally occurring amino acid found in all domains of life. Selenoproteins are characterized by the incorporation of Sec into a protein's polypeptide chain. Selenoproteins have been found to be involved with redox homeostasis. A loss of redox homeostasis is associated with various abnormal cellular responses and diseases. Our lab is utilizing chemical biology techniques to study the recently characterized Selenoprotein O (SelenoO).

SelenoO is capable of catalyzing protein AMPylation, the covalent attachment of adenosine monophosphate (AMP) to a target protein. The Sec residue is not in the active site of the protein. However, we hypothesize that the Sec residue plays an allosteric role in the regulation of AMPylation activity. Our goal is to study the functional importance of the Sec residue in SelenoO. To accomplish this, we are working towards cloning a plasmid that encodes for human SelenoO. The plasmid will then be transfected into mammalian cells for further study of the human selenoprotein.

Additionally, we are expressing the Cys-containing SelenoO homolog in Escherichia coli (E. coli). This is followed by protein purification and AMPylation assays. To confirm the AMPylation activity of SelenoO, a biotinylated ATP-based AMPylation assay is performed on purified SelenoO. Furthermore, the mass of the purified SelenoO homologs is then analyzed by Matrix Assisted Laser Desorption/Ionization Time of Flight Mass Spectrometry (MALDI-TOF MS). We aim to use MALDI-TOF MS to detect AMPylation via peptide mass differences as well as utilizing Tandem Mass Spectrometry (MS/MS) analysis to confirm which residues are auto-AMPylated.



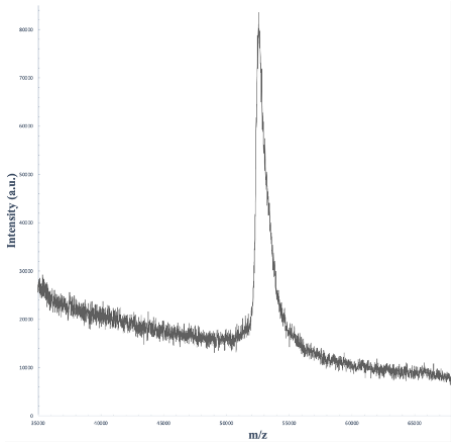


Figure 1: Ponceau Stain confirmed the presence of SelenoO for an AMPylation assay. Avidin detection detected AMPylation activity between SelenoO and lysate substrates as well as auto-AMPylation activity.

Figure 2: MALDI-TOF MS detected SelenoO with a peak at about 54000 m/z signifying a peptide with a mass of 54000 Da.

Research Fellows: **Mikayla Cairns (2025)** — **Concentration: Peace and Conflict Studies**
Ellie Markwick (2024) — **Concentration: International Relations; Peace and Conflict Studies**
Molly Pritchard (2025) — **Concentration: History; Applied Math**
Faculty Mentor: **Danielle Lupton** — **Department: Political Science**
Title of Project: **Military Veterans in Congress (1789-Present)**
Funding Source: **SOSC Division; Stickles Fund**
Project Summary:

This research with Professor Lupton aims to investigate if and how the military backgrounds of Congress members inform their decisions when voting on foreign and defense policies. To explore this question, we have been compiling an expansive dataset that dissects the military backgrounds of every congress member that has served in the armed forces since 1789 to the present day. Utilizing both primary modern and archived sources, we have coded data points that detail the specifics of a member's military record, such as rank, branch of service, and whether that military service was before or after they were elected to Congress. In addition to collecting the data, we have also been reviewing the data sets created by past research assistants and adding any new information we find to ensure that the data is as accurate and up-to-date as possible.

The first part of our summer research was focused on completing data sets on any congressman who had served in the military in any capacity to inform on their military experience. We received spreadsheets with the names of congressmen who had served in the military and the congress they had served in and were then tasked to find the branch(es) they served in, the dates they served for, the length of their service, whether they served on active duty, as a reservist or both, if they were a part of the national guard or state militia, had combat experience, were a prisoner of war, or served in the military after they left congress or while they were in congress. Notes with more specific information on their service such as regiment, wounds incurred, where they served were added as well. We would also make sure to note any discrepancies between sources and highlight unclear information or information that could not be found so that Professor Lupton will know what parts need more attention when she reviews our work to use in her analyses. The spreadsheets would be filled out to the best of our ability using internet resources, making sure to cite the sources we used. Oftentimes looking at obituaries, the national park services database on civil war soldiers, and online biographies would supply the information needed.

Once we completed collecting data on new names in the data set, we moved on to reviewing the work of the previous research assistants as well as each other's work from this summer. This review process consisted of adding three columns to the existing spreadsheets, where we place new sources of information as well as corrections we would make to the previous students' work. In most cases, the collected data was complete and correct, and we were able to find additional sources to verify this information. The hardest part of this stage was finding dates of service that could not be found in the first stage. Many of these dates remain unknown and will have to be researched further by our professor.

Future research for this project will focus on finding military veterans who are currently serving in Congress and contacting them to talk about their military experience. This information will supplement the data we were able to collect this summer and help create a more holistic picture on how military service affects policy.

Research Fellow: **Matt Calenzo (2024)** **Concentration:** **Political Science; Economics**

Faculty Mentor: **Robert Kraynak** **Department:** **Political Science**

Title of Project: **Cicero's Attainable Virtue**

Funding Source: **Center for Freedom and Western Civilization, James Madison Fellow**

Project Summary:

Marcus Tullius Cicero lived the life of a philosopher and statesman in the Roman Republic during his lifetime from 106 BC to 43 BC. Based on his philosophy, Cicero has been characterized by some as an Academic Skeptic. Others think that he simply restates Stoic ideas. But these schools offer a lofty, almost unattainable, characterization of virtue. From the philosopher kings of Plato to the immortality of Aristotle to the strict duty of Zeno, their conception of virtue is bound up with a level of perfection that seems beyond the reach of humans. Cicero, on the other hand, sought to make virtue more attainable and accessible. In doing so, he paid particular attention to the middle class of educated men that would become professionals in the fields of politics, business, law, and philosophy. The attainability of Cicero's virtue is an original contribution to the field of virtue ethics and it should be recognized as such. While it was Socrates that brought philosophy down to Earth, it was Cicero that made virtue more attainable for liberally educated young men by presenting a philosophy that was not one of strict duty or perfection but one that encouraged a practical approach to virtue and its application.

Section I will provide an overview of the ideas about nature, virtue, and the well-ordered soul that form the core of Cicero's philosophy. Section II will discuss the accessibility of Cicero's virtue to the young, liberally educated gentlemen. In section III, I will compare Cicero's virtue and its attainability to that of other schools. Lastly, section IV will explain Cicero's influence on statesmen that came after him.

Research Fellow: **Richard Casey (2024)** **Concentration:** **Astronomy/Physics**

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

Title of Project: **Dark Matter Production and Gravity Waves From a Dark Big Bang**

Funding Source: **Volgenau Wiley Endowed Research Fellowship**

Project Summary:

This project researched the viability of there being a second Big Bang which produced all dark matter. The nature of dark matter is still unknown even though there is an undeniable amount of observational evidence that it exists in large quantities in the cosmos. How dark matter came into existence is still an open question in physics. One possible mechanism for dark matter creation is a similar process to which visible matter was created and is called the Dark Big Bang. Imagine the universe without any visible matter and only dark matter, this universe is known as the dark sector. In reality, the dark and visible sectors are overlaid with each other and interact through gravity. By studying the gravitational interaction between these two sectors, we can test the parameters of a Dark Big Bang such as the strength of the big bang, the time of the big bang, and the properties of the dark matter particles produced. The ranges of these parameters are determined by making sure the universe ends up being the same as we observe it today. While most of this research is theoretical, future gravity wave surveys could detect evidence of the Dark Big Bang. In fact, the NANOGrav 15 Year Survey (NG15) just produced the first evidence in history of a stochastic gravity wave background (GWB) permeating the universe. We now know that spacetime is more like the surface of a choppy lake than that of placid water. Future observations of the GWB could determine the sources of the waves, one of which could be a Dark Big Bang.

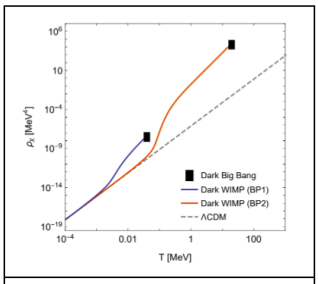
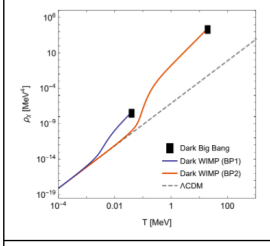


Figure 1. The evolution of Dark WIMP energy density as a function of temperature. As the universe expands and cools, the energy densities of both WIMP scenarios match that of the standard ΛCDM model.

K. Freese and M.W. Winkler, *Dark matter and gravitational waves from a dark big bang*, Phys. Rev. D 107 (2023) 083522 [2302.11579].

My research aimed at understanding the Dark Big Bang and its impact on the evolution of the universe. I followed the paper "Dark Matter and Gravity Waves From a Dark Big Bang" by Katherine Freese and Martin Winkler, self-studying the advanced topics not taught at the undergraduate level and rederiving the equations describing this new history of the universe. Much of my work was in cosmological perturbation theory in which small perturbations are added to the metric tensor and stress-energy tensor of a flat, homogenous, and isotropic background universe to study the evolution of matter overdensities as the universe expands and cools. The goal of this work was to make sure the relic density of dark matter in the Dark Big Bang scenario matches that of the standard ΛCDM model. Because we know so little about dark matter itself, the possible mass of dark matter particles produced from a Dark Big Bang ranges from 10 keV - 1012 GeV. On the light side, the paper considers two dark matter candidate models, Dark Cannibals and Weakly Interacting Massive Particles (WIMPs). Figure 1 shows the evolution of two cases of WIMP production from the Dark Big Bang along with the standard evolution of WIMPs in the ΛCDM model. A first-order phase transition in the dark sector produces ripples in spacetime known as gravity waves. Since the dark sector and visible sector interact through gravity, it is possible for us to detect these waves. Figure 2 shows the gravity wave spectrum of the two WIMP scenarios and the spectrum of heavy Dark-Zilla matter production from the strong Lorentz boost of colliding bubble walls.



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Research Fellow: **Div Chamria (2023)** **Concentration:** **Chemistry; Physics**

Faculty Mentor: **Eric Muller** **Department:** **Chemistry**

Title of Project: **Infrared near-field microscopy at the shot-noise limit**

Funding Source: **NASC Division**

Project Summary:

Nanoscale interactions between molecules define many of the physical properties and chemical reactivities of condensed phase matter. However, established spectroscopic tools are limited by optical diffraction to measure signal that is averaged over a large volume A new spectroscopic imaging method, infrared scattering-type scanning near-field microscopy (sSNOM) offers a new route to nanoscale imaging and spectroscopy, overcoming the diffraction limit through near-field light-matter interactions. Our lab develops new methods and applications of IR sSNOM to measure the optical response of molecular vibrations as a non-invasive yet structurally sensitive probe of chemical identity and intermolecular interactions.

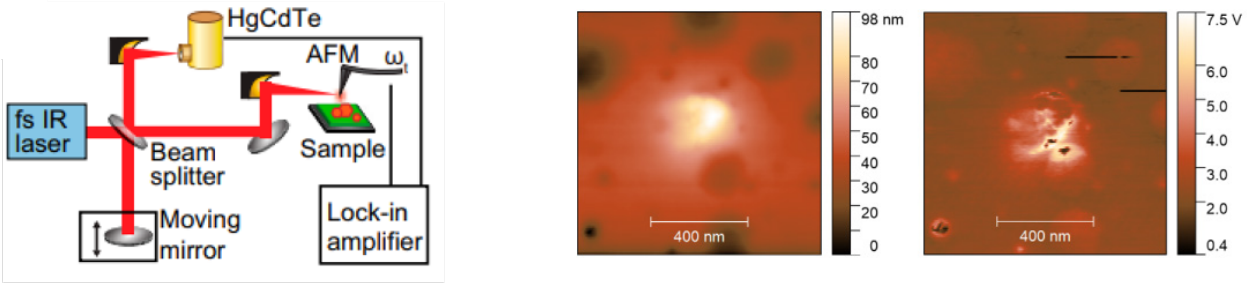


Figure: (Left) schematic of IR s-SNOM. Center, Image of nanoscale topography in a polymer composite, with (Right) and the IRs-SNOM image of material conductivity.

During the summer of 2023, we developed a new detection method for IR sSNOM that brings us closer to the single-molecule limit of detection. Previous IR sSNOM apparatus have utilized detection through an asymmetric Michelson interferometer, which provides highly sensitive detection to as few as 50 molecules through homodyne amplification, yet suffers from sensitivity to noise sources including laser noise and fluctuations in the atomic force microscope. We built a novel detector for IR sSNOM based upon a Mach-Zehnder interferometer, which provides inherent sensitivity to optical quadrature. Furthermore, dual detectors in a balanced detection scheme remove common mode noise from the laser and atomic force microscope. A key parameter, the Intensity Noise Power Spectral Density (INPSD), indicates signal quality. We found that the INSPD of our setup is improved by up to two orders-of-magnitude using this new detector, placing our results at the shot noise limit necessary for detection of single quantum objects.

Next, we applied this new apparatus to measurement of a composite of PEDOT:PSS-L-Phenylalanine. Bright features detected at morphological edges indicate high conductivity, providing valuable insights into material behavior. We aim to use our newly developed IR sSNOM to understand material properties in this polymer sample, and we will generalize our approach to imaging and measurement of a wide range of nanoscale materials.

Research Fellow: **Pariya Chanthasensack (2024)** **Concentration:** **Chemistry; Physics**
Faculty Mentor: **Rachel Dinero** **Department:** **Psychological and Brain Sciences**
Title of Project: **Risk Factors to Caregiver Burden in Parent-Child Dyads for Care Recipients with Serious Mental Illnesses**
Funding Source: **NASC Division**
Project Summary:

Introduction: This meta-analysis explores the factors that contribute to caregiver burden in individuals looking after another with serious mental illnesses (SMIs). Caregiver burden in the context of this review is defined as any persistent difficulties, stress, and psychological hardship experienced by nonprofessional caregivers (also known as informal caregivers) due to looking after another individual with a given disorder. SMIs can be defined as a prevailing mental, behavioral, and emotional disorder that results in an impairment of daily functioning. Within the context of this review, the disorders that will be included are the following: severe anxiety disorders, major depression, bipolar disorder, psychotic disorders, as well as severe eating and personality disorders. This review is exploratory in nature, and analyzes correlational data in peer-reviewed journal articles from select electronic databases that are aligned with the predetermined inclusion criteria.

Aim: The main purpose of this investigation is to explore and identify the factors that contribute the most to the exacerbation of caregiver burden for informal caregivers of individuals with SMIs.

Procedure: Articles were found based on searches of electronic databases including PsychInfo, PubMed, PsychArticles, ScienceDirect, Web of Science, Gale Onefile: Psychology, GoogleScholar, and ProQuest. The initial search yielded 817 articles, with 10 studies meeting the inclusion criteria, and four studies with correlational data that could be used for statistical analysis. Based on the included articles, factors to caregiver burden were identified and data was extracted. Pearson correlation coefficients and corresponding sample sizes were recorded from each respective study. Fisher's Z test and variance was calculated using Wilson (CITE) Practical Meta-Analysis Effect Size Calculator. A three-level meta-analytic model was calculated using R.

Results: A total of six factors were identified across the included articles: care recipient factors, negative perceptions, parent age, parent education, parent health, and social support. The three-level meta-analytic model identified the factors negative perceptions $z = .457$ CI [.387, .527], $se = .031$, ($t(9) = 14.831$, $p < .001$), parent health $z = .314$, CI [.138, .490], $se = .074$, ($t(7) = 4.222$, $p = .004$), and social support $z = -.155$ CI [-.282, -.027], $se = .056$, ($t(9) = -2.750$, $p = .022$), to have significant overall effect sizes. The remaining factors did not yield significant overall effect sizes.

Conclusions: This review reveals that there is still limited research on caregiver burden for caregivers providing support to individuals with SMIs; to the level of specificity that accounts for the different relationships in caregiver-care recipient dyads. However, from the data available, variables that had the largest impact on caregiver burden measures were negative perceptions, parental health, and social support. These aspects may be possible targets for informal caregiver support.

Research Fellow: Cindy Chen (2024) **Concentration: Art History**
Faculty Mentor: Julie Dudrick **Department: Upstate Institute**
Title of Project: Exhibiting Newspapers and Community Memory
Funding Source: Upstate Institute
Project Summary:

The Oneida County History Center is a non-profit historical society located in Utica, NY aiming to protect and showcase the local history of Oneida County to present and future generations. The OCHC has devoted significant efforts to making its rich collections of historical documents, images and artifacts available to the public. The research libraries host researchers daily to facilitate their research on topics and areas of interest. Through free public programs and exhibitions, the OCHC engages a broad audience with the local history of Oneida County.

As an Art History major and Museum Studies minor, I deeply understand the value of preserving historical documents and the importance of community historical museums in educating the public about local history. I have gained valuable insights academically and professionally through working on the newspaper rehousing and exhibition planning project. The newspaper rehousing project continues the reorganizing effort that started during the COVID year. The OCHC houses over 12,000 copies of newspapers that need to be inventoried and archived. My responsibilities have been to inventory them and rearrange the newspaper collection room to a more accessible place for the public and researchers. My second project has been exhibition planning on a Utica paper from the late 19th century to the late 20th century called The Saturday Globe. The Saturday Globe is Utica's first paper to regularly include coloured illustrations on the front page, maintain a national distribution, and use newspaper boys. Its achievements are not widely known so my job was to plan an exhibition to showcase its history and connection to Utica
.
The newspaper rehousing project gave me object-handling skills for original documents and the chance to look into the lives of people who came before us. I have grown to appreciate the backstage conservation efforts by participating in this process. The exhibition planning project contextualized theories I have learned in my Museum Studies classes and provided me with new angles and experiences for my future study. My main focus for this project has been research, label writing and panel design. I adapted to the differences between academic writing and exhibition label writing and improved my writing skills by working with the collaborative and helpful team at OCHC. For my research, as written research about my research topic is scarce, I had the chance to talk to many local historians and journalists. Through this process, I have begun to understand the importance of democratizing knowledge and community memory in a local history center.

Research Fellow: Lance Chen (2025) **Concentration:** Physics

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

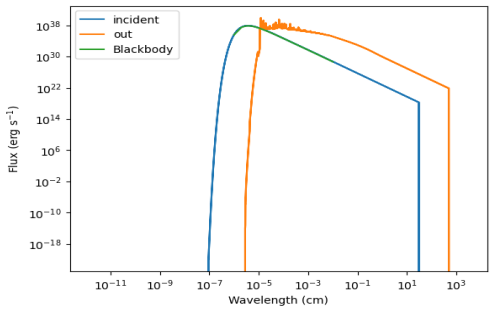
Title of Project: Dark Star Probing

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

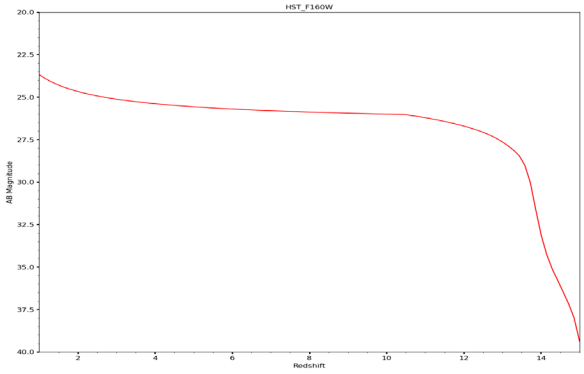
Project Summary:

This summer, I worked with Professor Ilie and four other fellow students on the project investigating potential Dark Star candidates. Dark stars are those theoretical stellar bodies that are powered by dark matter, a hypothetical matter that only interacts with gravity and hence hard to be observed. We were a cool team working on different parts of a big project. My parts involved simulating and analyzing the effects of nebular emission, the area outside of the stars that are filled with ionized gas including hydrogen. Since this project is theory based, I worked both on observant data and codes to help make the data analytical.

In the first two weeks, because I had limited experience and knowledge about Dark Star, I mainly focused on related articles about the star. Professor Ilie helped me find several great articles about Dark Star research. It's good to have a group of people working on the same ground. The topic was quite hard, and a lot of questions hit me, but luckily people in our group helped me out a lot. After had solid understanding on the matter, I dived into a software called Cloudy. Cloudy was used to simulate nebular emission. With input value of luminosity, effective temperature of the star and radius of the cloud, it will output a spectral energy distribution table. I started with a Blackbody example to test on the effects of different inputs. It turned out that the hydrogen density of the cloud didn't matter. Also, the outer radius wouldn't matter to the result in our case. Hence, the only inputs necessary were luminosity, effective temperature of the star and inner radius of the cloud. From those data, I plotted to get the following example plot. During this process, I had one problem that bothered me for a long time and turned out to be the problem of units. Each software or code had their own units system and that caused a lot of pain in activity involved both Cloudy and TLUSTY. In this plot, the green line was the ideal Blackbody energy plot by Astropy, and the other two lines were simulated by Cloudy. As the graph showed, the lines were quite consistent with each other.



Moving on, my final aim was to produce AB magnitude plot to better present the brightness of the possible star after getting through the cloud. With an example code from previous students who worked on a similar matter, I figured out the appropriate codes for this case. The code processed the data got from Cloudy and output as an AB magnitude graph. The example plot of the AB magnitude is showing below.



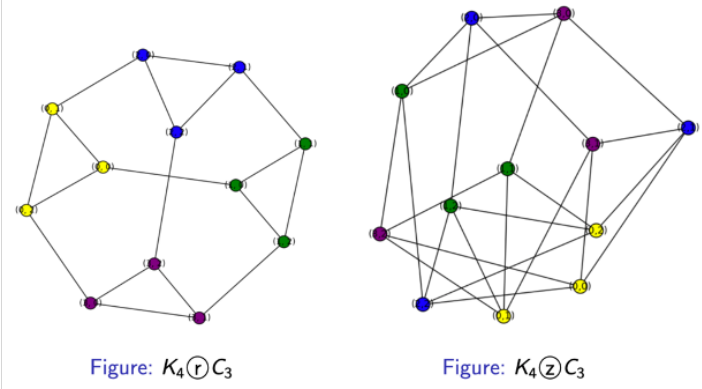
However, the work is not fully done yet. I want to explore more about the nebular emission using the AB magnitude plot.

Note: In this summer, I barely used the cluster because I didn't need to.

Research Fellows: Sophia Child (2025) — **Concentration:** Mathematics
Omshi Samal (2024) — **Concentration:** Computer Science; Mathematics
Faculty Mentor: Kelly Isham — **Department:** Mathematics
Title of Project: The Mathematics Behind Designing Large-scale Computer Networks
Funding Source: Los Alamos National Lab LDRD Reserve Grant
Project Summary:

Large scale computer networks are necessary for simulations, data visualization, and other scientific computations both in industry and in academia. These networks can have tens to hundreds of thousands of processing units – at that scale, it is pertinent that the networks are designed in a way that is efficient and cost-effective. The network can be interpreted as a graph whose vertices represent the compute nodes and edges represent the links between them. Thus it is important to study this problem mathematically.

There are many properties that are desirable in the design of such large-scale networks, such as bundleability (the network consists of isomorphic blocks), flexibility (retaining network properties when changing degree), and scalability (maximizing network size given a degree and diameter).



Examples of graph products

Prior research has utilized graph product constructions to generate large graphs as these products tend to have many of the aforementioned properties. A graph product is simply a way of combining two graphs to give a single larger graph. For two graphs G and H, the vertices of the graph product form the set of ordered pairs (g, h) - where g is a vertex from G and h is a vertex from H. The edges of the graph product are defined according to some set of rules - which is why many different graph products exist. Various products have been created to solve problems in computational complexity, spectral graph theory, and other fields.

This summer, we explored different graph products to examine their viability for network design. This included finding the conditions under which a graph product would be connected or disconnected. It is vital that a network is connected, as this means that there exists a way to travel from any vertex to any other vertex. We also put together a comprehensive table of the degrees and diameters of common graph products. The degree of a graph is the maximum number of edges adjacent to any vertex, and the diameter of a graph is the maximum shortest distance between any pairs of vertices. In this process, we found a new diameter bound for the weak modular product as well as the conditions for when it is disconnected. We also discovered counterexamples to previously published diameter bounds for the zig-zag product, and have come up with new bounds under specific conditions. Additionally, we have stronger conditions for when the zig-zag product is disconnected. We compiled these new results and their proofs into a paper with all the degree and diameter bounds of ten graph products.

Research Fellows: **Aryaman Chobey (2025)** **Concentration: Computer Science**
Oliver Smith (2024) **Concentration: Computer Science**
Anzi Wang (2025) **Concentration: Philosophy; German**
Faculty Mentor: **Grusha Prasad** **Department: Computer Science**

Title of Project: **Can targeted modifications of training data improve neural networks' ability to predict human sentence processing difficulty?**

Funding Source: **NASC Division; Holden Fund**

Project Summary:

People constantly generate predictions about upcoming words. For example, given the sentence "It was raining and I took out my __", most people expect to encounter "umbrella". AI models such as ChatGPT trained to similarly predict upcoming words have met with a lot of success; yet, prior work shows that these models sometimes fail when being used to generate predictions about human behavior. Our hypothesis is that the models fail because they are trained on the wrong kind of data. So we assume that matching the training data with the data humans are exposed to might result in better alignment between models' prediction and human behavior. Aiming to verify the hypothesis, we trained models on developmentally plausible data and evaluated them on two kinds of datasets: datasets measuring models' linguistic abilities and datasets measuring alignment with human behavior.

For developmental plausibility we used the "strict-small" dataset from the BabyLM challenge, a challenge where models are trained exclusively on a 10M token dataset. The datasets are sampled from open-source data representative of linguistic input a child may see between infancy and adolescence, including children stories, daily conversations, and Wikipedia articles etc. In our experiments we trained models by either presenting all of the sentences in the dataset in a random order (RandOPT) or by first training the model on an ordered sequence of the data ("curriculum") and then training it on the sentences in random order (CurrOPT_ft). Our curriculum organized the training data in a sequence and ratio inspired by human cognitive development. Crucially both the models were trained on the same number of sentences.

As shown in the table below, CurrOPT_ft typically achieved higher scores on challenge sets targeted at measuring linguistic abilities (such as tasks like sentiment analysis and causal reasoning), suggesting that presenting sentences in a developmentally plausible order can result in better linguistic competence in many cases.

Model	BLiMP	BLiMP Supp	SuperGLUE	MSGS-C	MSGS-A
RandOPT	65.58	**56.99**	65.7	95.98	66.91
CurrOPT_ft	**67.85**	55.54	**66.8**	**96.13**	**67.33**

However, models trained on the BabyLM dataset, with or without a curriculum, generated predictions that were as misaligned with human behavior as models trained on larger less curated datasets (such as Wikipedia or millions of web pages). This suggests that merely altering the training data to be more developmentally plausible is unlikely to generate language models capable of accurately predicting human language processing. Future research could focus on developing more nuanced training methods, incorporating cognitive and psychological theories of human learning, to further align the model's predictions with human behavior.

Research Fellow: Charlie Citron (2024) **Concentration:** Political Science
Faculty Mentor: Julie Dudrick **Department:** Upstate Institute
Title of Project: Madison County Historian and Theodore Burr Covered Bridge Resource Center
Funding Source: Upstate Institute
Project Summary:

In an age of increasing globalization and digitization, individuals across the world are better able to connect and empathize with one another. However, the dual side of these changes is an increasing loss of community engagement, neighborly kindness, and civic pride. As the world grows closer together we have begun to lose the community bonds that were the foundation of our society for years prior. The Madison County historian's office looks to fix these issues through disseminating historical information in a way that benefits the county educationally and economically. The county historian, Matthew Urtz, is appointed by the county clerk, the latter of which is an elected position currently held by Michael Keville. Through giving presentations, organizing public events, and working with educators in the school district, Matthew fosters a sense of community and civic pride among members of the county.

My project for the county historian was to use local primary documents in order to research individuals and events connected to subjects found within the New York State Social Studies Curriculum. Using these primary sources, I drafted and created United States' history lesson plans for grades 6-12. These lessons were shared with educators across the county, and uploaded to several New York State educational websites, including www.ConsiderTheSourceNY.org. In total I crafted 5 lesson plans, all of which focus on the ways in which U.S. history took place in Madison County. This list included lessons on the 1850 Fugitive Slave Law Convention in Cazenovia, New York, Harriet Powell's 1839 escape on the Underground Railroad, the Japanese-American experience in World War II era Upstate New York, the debate between women's and anti-women's suffrage organizations in Madison County, and a final lesson interacting with immigration records held in the Madison County Archives.

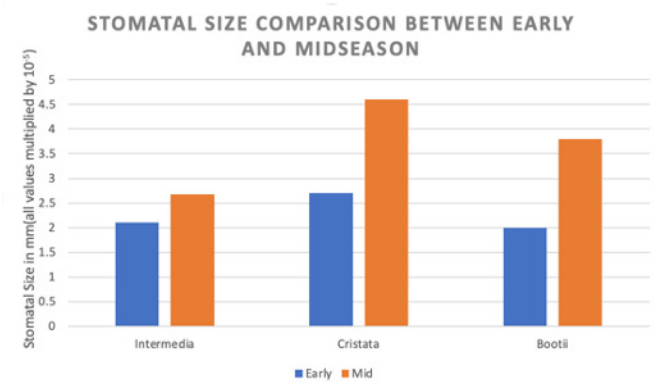
The Theodore Burr Covered Bridge Resource Center is a non-profit organization located in Oxford, New York. Operated through the efforts of Bob and Trish Kane, Noel Rubinton, and the Oxford Memorial Library, the Center's mission is focused on collecting, curating, and presenting covered bridge resources and research materials to those interested in the historic bridges. The Resource Center aims to target this information towards covered bridge enthusiasts, researchers, students, and others looking to learn something new. After opening in 2011, the Center has collected a vast library of these research materials, including over 20,000 historical postcards, hundreds of antique photographs, and over 300 rare books written on the subject of covered bridges. They also cooperate with other covered bridge societies to hold events and generate awareness towards the preservation of historical bridges.

Recently, the Resource Center embarked on a project of digitizing their resources in order to create a website hosting their entire library. Since Oxford is out of the way for many travelers, the Center is focused on putting these research materials out for public consumption, where they may be utilized by all interested. This past summer, I helped the Resource Center develop their website. By providing advice and feedback on design, brainstorming efficient mechanisms to display information, researching covered bridge history, and writing the copy for their webpages, I helped the Center prepare for its website launch. I wrote the textual information on a large portion of the site's web pages, including their mission statement and biographical page. In addition, I helped the Center make crucial design choices on the layout, feel, and style of their website. Once the site is completed, the culmination of mine and other's efforts will be on display at www.tburr.org.

Research Fellows: **Porter Comstock (2026)** **Concentration: Undeclared**
Matt Leopold (2026) **Concentration: Undeclared**
Faculty Mentor: **Eddie Watkins** **Department: Biology**
Title of Project: **Exploring Physiological Variability and Plasticity in Hybrid Wood Ferns**
Funding Source: **National Science Foundation**
Project Summary:

Ferns are known to form complex swarms of hybrids. For example, the wood fern genus *Dryopteris* is composed of only 7 (6 extant) diploid species with more than 25 hybrids ranging from triploid to hexaploid polyploid combinations. In spite of significant research into fern polyploidy, we know very little about the ecophysiology of sterile fern hybrids. Resolving this is important as, far from being rare, some fern populations can be dominated by sterile triploid hybrids. Polyploids can exhibit more vigor, or more advantageous qualities over their diploid counterpart in many species, but this has not been explored widely in ferns. For this study we wanted to know if two commonly occuring triploid hybrids had transgressive physiology compared to their putative parents. To do this, we examined several ecophysiological traits from *Dryopteris xbootii*, a sterile triploid hybrid, and its parents, *Dryopteris cristata* (tetraploid) and *Dryopteris intermedia* (diploid). In the early growing season (May), we measured six D. xbootii, twelve *D. cristata*, and eleven *D. intermedia*, and in the mid (June) and late (September) growing season we measured ten *D. xbootii*, ten *D. cristata*, and ten *D. intermedia* in Cazenovia's Nelson Swamp. Specifically, we measured and compared their photosynthetic rates using a Licor 6400-XT. In addition, we measured and compared stomatal density, tracheid size, and the plant's nutrients by testing for their stable isotopes.

We performed an analysis of variance (ANOVA) followed by a post hoc Tukey test on the light response curves we obtained from both our early and midseason testing. While the early season tests did not indicate a significant difference among the means of the photosynthetic rates, the midseason results do indicate a significant disparity. In the early season, *D. cristata* exhibited comparable rates to *D. intermedia*, but by the midseason, *D. cristata* displayed photosynthetic rates akin to those of *D. xbooti*i. Notably, *D. xbootii* maintains the highest rate of photosynthesis throughout both growing seasons. While *D. intermedia* experienced an uptick in its photosynthetic mean rates, the increase was not as profound as the increase observed in the other two species. Late season data analysis was not complete by time of press.



These findings suggest that polyploid ferns demonstrate greater plasticity than diploid ferns. This inference is further supported by our stomatal size data. As figure one shows, *D. intermedi*a's stomatal size increased by 27%, while *D. cristata* and *D. xbootii*'s increased by 70% and 90%, respectively. Although all three species demonstrated an increase in stomatal size, the polyploid ferns exhibited a higher level of growth, which suggests heightened plasticity among polyploid ferns compared to their diploid counterparts.

These data suggest that the triploid hybrid, *Dryopteris xbootii*, shares more similarities with its tetraploid parent, *Dryopteris cristata*.

Figure 1: Comparing early and midseason stomatal size across three species.

For further research, we propose conducting additional testing during the late season to determine whether the observed trends continue and further reinforce the notion of increased plasticity among polyploid ferns in comparison to diploid ferns. Additional testing of a different triploid hybrid, *Dryopteris xtriploide*a, analysis of the nutrient data from the Cornell Isotope Lab, and recent summer tracheid measurements could provide further useful data.

Research Fellows: **Claudia Coolidge (2025)** — **Concentration: Psychological Science**

Kiera Litwin (2026) — **Concentration: Undeclared**

Priya Martin (2024) — **Concentrations: Philosophy; Psychological Science**

Persephone Sween-Argyros (2024) — **Concentrations: Economics; Psychological Science**

Faculty Mentors: **Jennifer Tomlinson** — **Department: Psychological and Brain Sciences**

Lauren Philbrook — **Department: Psychological and Brain Sciences**

Title of Project: **Couples Who Play Together, Stay Healthy Together: Benefits of Positive Relationship Processes for Sleep in Older Adulthood**

Funding Source: **NASC Division**

Project Summary:

The goal of our research is to use a biopsychosocial approach to investigate the association between positive relationship processes, sleep behaviors, and long-term health and well-being in older adulthood.

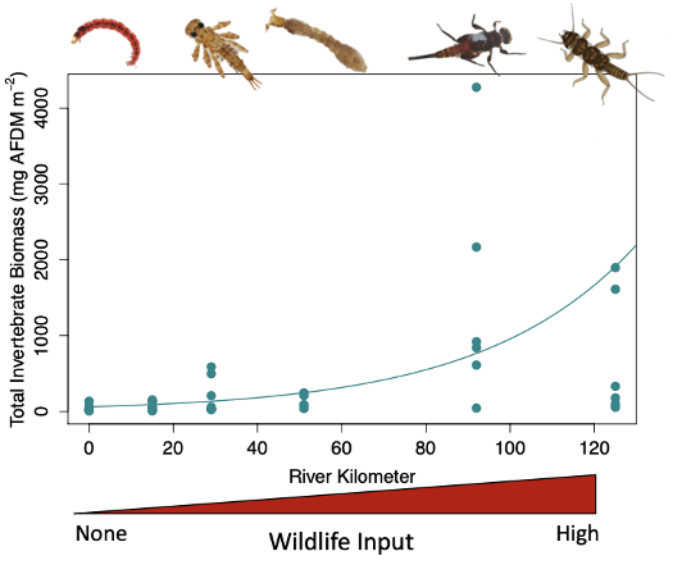
Research finds that couples who do shared leisure activities together experience increased relationship satisfaction, individual growth, and ability to accomplish goals (Aron et al., 2000; Harasymchuk et al., 2020; Muise et al., 2019; Tomlinson et al., in prep). Research has also revealed that sleep is a promising mechanism linking relationships and health (Kielcolt-Glaser & Wilson, 2017). Given that close relationships play an essential role in long-term health and well-being (Pietromonaco & Collins, 2017), especially during older adulthood, we have developed a theory that links exciting shared activities with long-term health and psychological well-being. We hypothesize that daily sleep quality and duration (measured through subjective assessments and objective actigraphy data) and daily subjective well-being (measured through daily reports of positive and negative emotions and satisfaction with life) are mechanisms linking exciting shared activities with health.

To test this, we will recruit 100 cohabitating couples (200 individuals)–where at least one partner is over 65 years old–to participate in a 10-day diary study in which they will report on daily activities, partner responsiveness, subjective well-being (including mood and life satisfaction), health, and sleep quality and duration. Additionally, couples will wear an actigraphy watch which will track their motion, providing behavioral data regarding sleep. This study will also include a two-month and a one-year follow-up regarding participants' mental and physical health. This summer, the research team developed the proposal, protocol, consent form, scripts, debrief, and other documents to submit to the IRB, and also finalized the measures and survey instruments.

Research Fellows: Joseph Coolidge (2024) — **Concentration:** Biology
Benito Vlassis (2025) — **Concentration:** Molecular Biology
Faculty Mentor: Therese Frauendorf — **Department:** Biology
Title of Project: How much hippo dung do invertebrates eat?
Funding Source: NASC Division
Project Summary:

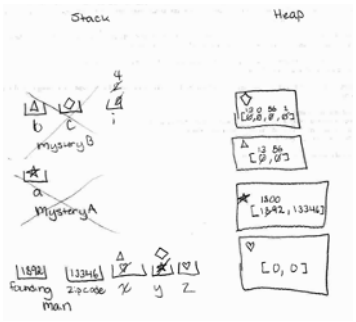
This summer we studied the influence of hippos on freshwater invertebrates in the Mara River located in Kenya. Hippos play an essential role in rivers by creating food sources as well as habitats for other organisms. Hippo populations have been declining all over the African continent in recent years. With little experimental data performed in the Mara River, our research has given us insight into how the changes in hippo numbers affect river organisms. The main way hippos influence river organisms is through the processes of defecation. In this study, we focused on how invertebrates in the Mara River were affected by different levels of hippo dung present. Their dung is packed with nutrients that serve as a major food source for invertebrates. We collected data to see the amount of hippo dung invertebrates consume and to compare the consumption level to other food sources. Aside from types of food sources, we also looked into different food patterns of invertebrates when there are different levels of hippo activity in the river. The availability of these food sources is limited to a variety of factors linked to seasonal changes.

We gathered our data by collecting, measuring, and identifying invertebrates from hippo dung samples, in order to calculate the biomass. In addition, we analyzed microscopic photographs of invertebrate gut samples from different seasons as well as sites along the river, using ImageJ software. This allowed us to compare the different feeding patterns between sites of high and low vertebrate input (hippo dung). Due to little being known about this major water source in Kenya, our research on the invertebrate consumption of hippo dung helps us gain a better understanding of how the food web dynamics in the Mara River function.



Research Fellows: Sarah Cryan (2025) **Concentration:** Computer Science
Greta Hoogstra (2025) **Concentration:** Computer Science
Faculty Mentor: Georgiana Haldman **Department:** Computer Science
Title of Project: Exploring Pedagogical Devices for Difficult Computer Science Concepts
Funding Source: NASC Division
Project Summary:

Introductory computer science (CS) courses ask students to understand both how to make programs work and why they work. There tends to be certain concepts that students struggle with, despite aid from traditional pedagogical tools like analogies or memory diagrams—a hand drawn visualization of what happens in the computer during code execution. To mitigate these challenges, we researched the effectiveness of a new, more hands-on educational tool for visualizing code execution. The device allows students to physically see and experience the computer's behavior by moving different items as dictated by a program. Overall, the device had success with many students as an intermediary step between learning new programming concepts and understanding how they work.



Right: The study's proposed NM for teaching

Left: A modified student MD that uses icons for references

Hand-drawn memory diagrams (MD)s are often used to teach program dynamics and assess students' abilities to trace code. However, many students struggle to correctly trace code using memory diagrams possibly because MDs don't sufficiently emphasize scope and thus fail to challenge misconceptions many novices have. MDs are a type of notional machine (NM), a term encompassing pedagogical devices that help discern the relevant parts of program dynamics when tracing. In CS model-based learning, these machines prove their value by cutting through rich information and highlighting the most pertinent pieces. Therefore, this study aimed to design and examine a new, unplugged NM for the purpose of teaching program dynamics and correcting misconceptions.

To assess the success of the device, we analyzed data from assessments given before and after an in-class intervention wherein the professor gave a demonstration using the device. We then went through these assessments and divided the problems into targeted (primitive vs. reference variables in parameter passing and other contexts) and non-targeted (code syntax and semantics) components, and coded them for students' accuracy in both categories using a themed analysis approach (that is, they were first coded, and then codes were collapsed into a few main themes). Using this data, we tracked students' understanding of course concepts. We also used a set of surveys, alongside the assessments, to test confidence. Students' confidence and test performance increased throughout the assessments, and we found a statistically significant positive relationship between the increase in test performance and confidence before and after the intervention.

Research Fellows: **Ryan D'Errico (2025)** — **Concentration: Geology**
Riley Farbstein (2024) — **Concentrations: Environmental Geology; Art and Art History**
Mary Thomas Powell (2026) — **Concentration: Environmental Studies**
Alexa Russo (2025) — **Concentration: Geology**
Marie York (2026) — **Concentration: Undeclared**
Faculty Mentor: **Paul Harnik** — **Department: Earth and Environmental Geosciences**

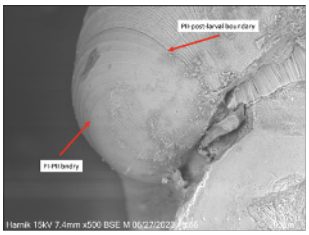
Title of Project: **Live-Dead Analysis of Marine Bivalves in the Gulf of Mexico**

Funding Source: **Doug Rankin '53 Endowment - Geology Research Fund; Bob Linsley/ James McLelland Fund; Norma Vergo Prize; NASC Division**

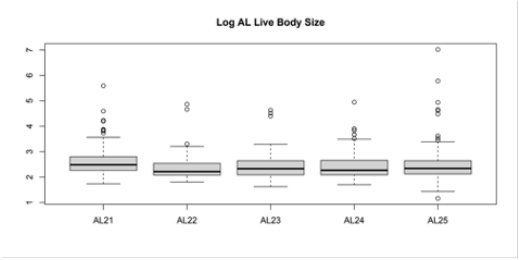
Project Summary:

Conservation paleobiology uses geohistorical records to manage ecosystems and inform restoration efforts. Anthropogenic nutrient inputs have increased primary productivity, and reduced dissolved oxygen levels, contributing to the development of a hypoxic "dead zone" in the Gulf of Mexico. In this project, we compared the historical record of clam larval shell sizes and body sizes in the Northern Gulf of Mexico to those of living clams in order to understand how marine animals have responded to anthropogenic environmental change over past decades to centuries.

Our sampling focused on coastal Louisiana and Alabama due to the proximity of these regions to the Mississippi River and Mobile Bay. At each location, five sites were sampled with a box core at a water depth of 20 meters. Sediment samples were sieved, and all material larger than 2 mm was retained. Articulated live clams were separated and placed in ethanol to ensure their preservation and empty dead shells were put in ziplock bags and frozen for shipment to Colgate.



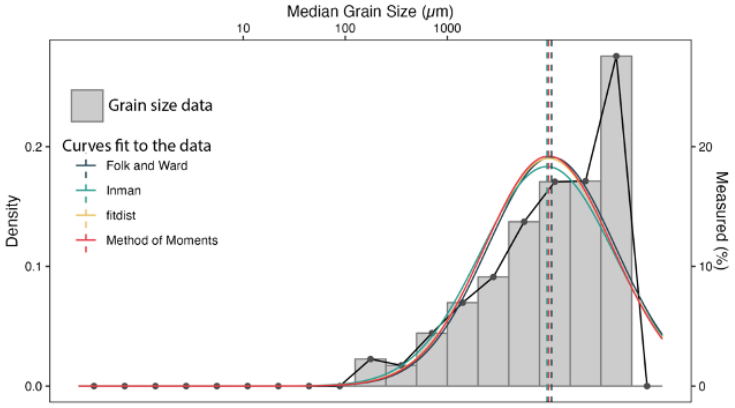
On campus, shells with umbos (the earliest stage of a clam's shell growth) from previously collected samples were picked and potential candidates examined for scanning electron microscopy. Shells in good condition were then imaged with a scanning electron microscope in order to examine their larval shells. These were given a taphonomic grade (how well they were preserved after death) and their larval shells were measured. The first phase of larval shell growth in clams is positively correlated with egg size. The lab has previously studied larval shell variation in *Nuculana acuta, Nucula proxima*, and *Ameritella versicolor*. By imaging a new family, such as the *Lucinidae*, we can determine whether other species exhibit similar responses to human-induced changes in primary productivity. Previous work found that smaller egg size correlated with increased nutrients and resource abundance, whereas larger egg size correlated with more limited resources. The criteria for selecting species for future study include the abundance of live and dead specimens, well preserved dead shells, and presence across different geographic locations.



The body sizes of bivalves may serve as an indicator of nutrient and dissolved oxygen levels, with higher levels of nutrients and/or higher levels of oxygen potentially associated with larger body sizes. Various live and dead bivalve shells in Alabama were measured and their areas calculated and read into R for analysis. The mean body size of live clams in AL is significantly smaller than that of dead individuals. Site AL21 had significantly larger live individuals than dead individuals, while sites AL22, AL23, AL24, and AL25 had significantly smaller live individuals than dead individuals. Live individuals of *Ameritella, Foveamysia, Nuculana*, and *Parvilucina* were significantly smaller than dead individuals of these genera. These changes may be due to a decrease in dissolved oxygen levels. Preservation bias may also contribute to these patterns, as smaller shells are less likely to be preserved than larger individuals.

Research Fellow: **Ryan D'Errico (2025)** **Concentration:** **Geology**
Faculty Mentor: **Alison Koleszar** **Department:** **Earth and Environmental Geosciences**
Title of Project: **The Eruptive Personality of Augustine Volcano**
Funding Source: **National Science Foundation**
Project Summary:

Augustine Volcano is an intermediate arc stratovolcano located in Alaska's Cook Inlet that has been designated as a "very high threat" by the United States Geological Survey (Ewert et al., 2018). It most recently erupted in 2006 and poses hazards to aviation as well as creating a tsunami threat to the area (Waythomas and Waitt, 1998). Due to these dangers, researching Augustine is important for understanding how it may erupt in the future and how the eruption hazards of similar volcanoes can change over time. This summer, I prepared and imaged pumice with Colgate's Scanning Electron Microscope to image microlites (crystals < 50µm) and calculate microlite number density (MND). MND correlates with magma ascent rate, which relates to eruption explosivity (Toramaru et al., 2008; Cassidy et al., 2018). I used Photoshop to process SEM images and identify microlites, vesicles, and phenocrysts, and then I exported these photos to ImageJ to determine MND and vesicularity. Additionally, I conducted a grain size analysis of tephra from multiple eruptions to learn how the explosivity of these eruptions progressed over time (Houghton & Wilson, 2000). I wet sieved tephra from different layers of eruption deposits to separate the tephra clasts by their size, ranging from > 32 mm to < 0.125 mm, then I weighed the different size fractions and constructed grain size distribution curves. I compared these curves in two deposits associated with Augustine's 1100 ybp eruption of Tephra C, and between layers within a single deposit to investigate changes in explosivity during the eruption.



Median Grain Size Distribution for Tephra C at site AMK007

Previous work for Tephra C focused on samples from site KJW001, 5.0 km SE of the summit, the best-characterized site of Holocene eruptive deposits at Augustine. The KJW001 deposit suggests significant changes in eruptive personality through Tephra C, but validating this interpretation requires grain size data from more than one site. I have focused on site AMK007, 5.2 km E of the summit, and determined that the mean grain size for Tephra C is Md = -3.411ϕ (11 mm). This is significantly larger than the mean grain size for Tephra C at site KJW001, 5.0 km SE of the summit (Md = -2.3ϕ or 5 mm; Zehner 2023). At AMK007, Md was smallest at the lower part of the tephra layer (erupted first), largest in the middle, and smaller at the top of the tephra layer (erupted last). This is consistent with observations from site KJW001. My data support the interpretation that the middle layer of Tephra C was accompanied by a second eruptive pulse and an increase in explosivity, validating a model for significant changes in eruptive personality through this eruption.

Research Fellow: Camden Di Carlo (2024) **Concentration:** Biochemistry
Faculty Mentor: Ernie Nolen **Department:** Chemistry
Title of Project: Temporary Silyl Tether and Ring-Closing Metathesis Approach to Tn Antigen Mimics
Funding Source: Justus '43 and Jayne Schlichting Student Research Fund
Project Summary:

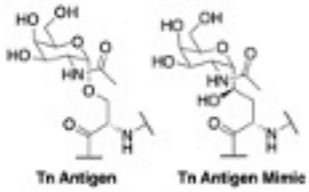


Figure 1. Skeletal structure of Tn antigen and the Nolen lab's desired Tn antigen mimic.

Cells have multitudes of proteins scattered throughout their cell membranes that perform many vital functions. In healthy cells, many of these proteins have chains of sugars (glycans) attached to them, which affect the shape of the proteins and exhibit a role in cellular recognition, adhesion, and various other processes. A common feature of some glycans is that the first sugar in the chain connected to the protein is a galactose derivative, referred to as an N-acetylgalactosamine (GalNAc). However, in many types of cancer cells, the glycosylation process of attaching sugar molecules to proteins is defective, oftentimes leading to only a single GalNAc unit being attached to the protein, which is referred to as Tn antigen (Figure 1). As the name implies, immune systems are able to recognize that the one-sugar version of the protein is unusual, and can create antibodies to recognize the antigen, and therefore cancer cells. It is hoped that this immunorecognition can be leveraged to develop anti-cancer immunotherapies, such as vaccines. Toward that end, many researchers have been working toward constructing Tn antigen mimics that produce stronger immune responses and are more metabolically stable than the original Tn antigen.

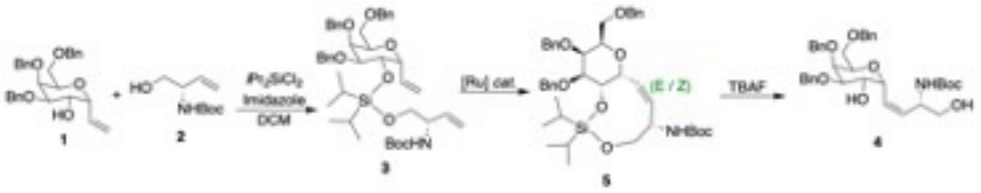


Figure 2. Temporary silyl tether and ring-closing metathesis approach to the *(Z)*-alkene precursor to our Tn antigen mimic.

The Nolen lab has been working toward the synthesis of a Tn antigen mimic with a hydroxymethine in place of the usual anomeric oxygen linkage (Figure 1). We envision that the new linkage would provide greater metabolic stability and influence the conformational preferences of the mimic toward the natural solution conformation of Tn antigen itself. This summer, we attempted to construct a (Z)-alkene precursor (4) to our mimic, which would allow for a stereoselective oxygen transfer via a radical oxime cyclization procedure. To accomplish this, we decided to follow a temporary silyl tether (TST) and subsequent ring-closing metathesis (RCM) approach (Figure 2), which would hopefully produce cyclized alkene 5 preferentially as the Z isomer due to ring strain.

The first step, the formation of the silyl tether between alcohols 1 and 2, proceeded with a moderate yield of 62% of diene 3. However, the ring-closing metathesis to form 5 caused issues, suffering from long reaction times and producing low yields. A screening of various ruthenium-based olefin metathesis catalysts led to the discovery of conditions that produced a 70% yield of material, though the primary product was the undesired E isomer. After other unsuccessful attempts at this TST-RCM strategy, going forward, we have decided to pivot to alternative synthetic routes toward our Tn antigen mimic.

Research Fellow: Sophia Diehl (2025) **Concentration: Neuroscience**
Faculty Mentor: Julie Dudrick **Department: Upstate Institute**
Title of Project: Madison County Dental Health Summer 2023 Project
Funding Source: Upstate Institute
Project Summary:

Madison County Public Health serves their community in a variety of ways. My job was to address the dental health concerns of parents/guardians with young children (0–5 years old). The main goal of this project was to collect basic information from a behavioral standpoint from families in Madison County. As a result of this project, the county hoped to improve at-home dental health practices through the education of community members.

Through our collaboration with our community partners, we compiled current information about practices, education, curriculum, and available resources. I learned the importance of partnerships and how valuable feedback can be. Our community partners were a huge asset to us and played an integral role in our plan to meet and improve our communities' needs. My overall duties this summer were researching current child care center and community partner practices; developing a survey that targets parents with children 0–5 years old; brainstorming research questions for parent focus groups; and educating parents about current recommendations for dental health practices.

A majority of my efforts were targeted toward collecting data for our dental health survey. Our survey was active for about 2 weeks and closed the last week I was working on my project. In the last weeks of my project, I gathered all the materials and resources that I had collected throughout the summer and compiled them into a report. I laid out exactly how we went about this project by including specific details and tidbits that we learned. I documented the times I attended various businesses in Madison County to hand out paper surveys and the flow of traffic I experienced at each location. This kind of information will be very useful for future projects. In my final days in the office, I worked with a colleague analyzing our results on the survey. Our overarching goal was to obtain 100 responses but we unfortunately were just shy of that with 72 respondents in total. Since we included weed-out questions this limited our number of responses. After sorting through weeded out responses, we were able to clearly organize the data into tables and graphs. In these visuals we broke the data down by zip codes and other demographics to see what parts of the county are most in need. This proved to be really eye-opening as our data clearly illustrated the needs.

Although the survey took a majority of my efforts, I also worked on a PowerPoint presentation that included some of the most important data points collected from our survey. The PowerPoint will be shown to community partners as a summary of my project and the work that I helped MCPHD conduct this summer.

Research Fellow: **Jared Diks (2025)** **Concentration:** **Astronomy/Physics**
Faculty Mentor: **Cosmin Ilie** **Department:** **Physics and Astronomy**
Title of Project: **Dark Matter Properties as Determined by Exoplanets**
Funding Source: **Justus '43 and Jayne Schlichting Student Research Fund**
Project Summary:

Dark Matter (DM) is a mysterious form of matter whose existence is required by our current models of the universe. It interacts very rarely if at all with the "baryonic" matter that makes up everything we can see and touch, and determining its properties is one of the foremost goals of astrophysics and particle physics research. Assuming DM can collide with baryonic matter, a phenomenon known as "Dark Matter Capture" will occur, in which DM will collide with the atoms of a celestial body and slow down below the escape velocity of the body, becoming "captured". Over time, this captured DM accumulates. If we now consider that many DM models are "self-annihilating", meaning that the particles can destroy each other in much the same way as matter and antimatter annihilate, the energy released in such reactions will raise the temperature of the celestial body far above the temperature we would expect, which can be detected by telescopes. Comparing the observed temperature of an exoplanet with the temperature we would expect of a planet at a certain distance from a star, we can draw conclusions about the mass and cross section (which governs how often collisions occur with baryons) of the DM particle.

A prime candidate to analyze with this methodology is the gas giant exoplanet HIP 99770 b, with an observed temperature of approximately 1400K, exceeding its expected temperature by nearly 1000K. Because Hip 99770 b orbits its sun-like star at nearly 17au, tidal heating can be safely disregarded, and the heating due to radiation from the star and the planet's internal processes cannot nearly account for the 1000K delta. If we take internal heating and radiation from the star into account and assume that the remaining heat is due exclusively to DM annihilations, then the dependence between the mass and cross section of the DM particle can be calculated.

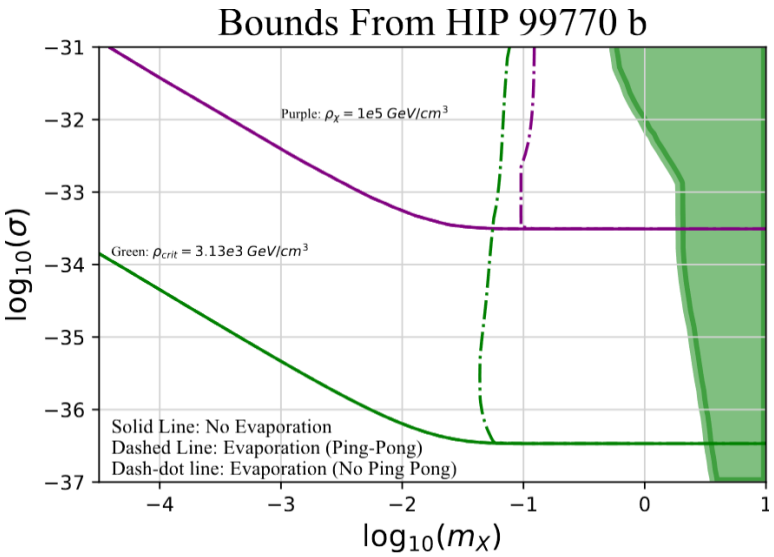


Fig 1: The dependence of the DM particle cross section and mass with two different ambient DM densities (green and purple), where purple represents the highest possible DM density at which the high temperature of the planet could be due to DM annihilations alone. The dotted lines which overlap the solid line are our best guess at the true dependence, while the solid line ignores evaporation, and the dash-dot line ignores evaporation suppression. The solid green area is already excluded by direct detection experiments.

Research Fellows: **Tess Dunkel (2024)** **Concentration: English**
Dulcie Lou Morris (2024) **Concentration: English**
Faculty Mentor: **Jennifer Brice** **Department: English**
Title of Project: **Living Writers Fellows**
Funding Source: **AHUM Division**
Project Summary:

Over the summer, under the guidance of professor Jennifer Brice, I helped coordinate, plan, and organize the Living Writers program at Colgate with the help of my co-researcher Dulcie Lou Morris. This is a program in which we bring talented authors to Colgate to give thirty to forty-five minute lectures that often include readings of their own works. The course is open to all students, and the guest lectures and zoom discussions are open to the public. Dulcie and I read all nine books written by this year's incoming Living Writers authors and we met weekly to discuss literary analysis, the author's intentions, and which facets of each book should be discussed during the fall semester course. Before meetings, we would extensively research the authors, finding biographical information, book reviews, author interviews, and further readings we would recommend to readers. Professor Brice leads a podcast with each author, discussing the intricacies of their works, and Dulcie and I helped formulate ideas into scholarly topics and questions to bring up with each author. As we researched the authors, we began to repopulate the Living Writers website with new information.

The research that we conducted before our meetings accumulated into written biographies of the writers and short summaries of their books, annotated links for reviews and interviews, and suggested articles involving the authors and their respective careers. We worked together to curate which content should be included on each respective books' webpage. Examples of disputed content included specific quotes and reviews of each authors' books.

We pre-planned emails to be sent throughout the semester to all students, alumni, and readers participating in the Living Writers program through Emma, an email marketing service. Throughout the school year, we will continue to aid Professor Brice with advertising and logistics regarding author talks for Living Writers.

Research Fellow: **Nick Elacqua (2024)** **Concentration:** **Psychological Science**
Faculty Mentor: **Carrie Keating** **Department:** **Psychological and Brain Sciences**
Title of Project: **The 'Eyes' Have it: Using Virtual Reality to Study Leaders' Synchronization of Audience Members' Attention Measured via Eye Movements**
Funding Source: **NASC Division**
Project Summary:

Musical conductors and leaders face a common task: They direct the disparate energies of individuals toward a common goal. On stage, conductors use body movement, postures, gestures, and facial expressions to coordinate tempos and direct musicians' dynamics. Charismatic leaders use similar nonverbal tactics to focus the attention and manage the emotions of audience members (Sy et al., 2005; Talley & Temple, 2013). The common denominator is that both charismatic leaders and conductors rely on nonverbal displays to direct, sustain and synchronize individuals' attention in order to create common, psychological experiences. The result may be the formation of a collective identity in which individuals come to share common beliefs, values, and behaviors (Keating et al., 2020; Van Vugt et al., 2008).

This summer, we prepared stimuli to test whether charismatic leaders' nonverbal displays direct and sustain viewers' attention (i.e. synchronize viewers' eye movements), thereby facilitating a collective identity. To test this proposition, 66 30-second thin-slices (short videos) of political leaders' speeches were collected from online sources and edited for viewing in Virtual Reality headsets (see Figure 1). Each video was muted and each background was standardized to highlight the nonverbal behavior of each speaker and to avoid distractions (such as other people in the frame). We also attempted to select leaders who performed in charismatic and noncharismatic ways. To be certain, we compiled our thin slices into a national Qualtrics survey to gather charisma ratings of each leader from a sample of eligible voters. Leaders included males and females varying in race and political party from the House of Representatives and the Senate. Our stimuli were pre-warped for future participants to view them through VR headsets.

For the main study in the fall, participants will watch the thin-slices via VR headsets as physiological measurements – eye movements, pupil sizes, and heart rate – are recorded. Predictions are that charismatic leaders will better synchronize viewers' interpersonal physiological reactions, thus constructing similar psychological experiences among viewers.

Our future goals include the study of brain wave synchronization, as leaders may also synchronize individuals via interbrain processes. We plan to study political leaders and choral conductors, as both use nonverbal displays that could influence cognitive processing. Interpersonal brain wave synchronization is presumed to merge psychological experience as well, suggesting it may also facilitate the formation of a collective identity.

Figure 1: Eye movement tracking in Virtual Reality

Research Fellow: **Olwethu Ezell (2026)** **Concentration:** **Undeclared**

Faculty Mentor: **Chandra Russo** **Department:** **Sociology and Anthropology**

Title of Project: **Whites Against Supremacy: Cross-racial Alliance in the U.S. Movement for Black Lives**

Funding Source: **SOSC Division**

Project Summary:

Whites Against Supremacy actively grapples with the optimistic, yet convoluted, dynamics of contemporary white anti-racist collective action. It specifically assesses white people's organizing in the fight against racism that has been characterized over the last 15 years by the resurgence of white nationalism and a continuation of the historical Black Liberation struggle, as evidenced through the prominence of The Movement 4 Black Lives. This research focuses explicitly on the anti-racist practice of Showing Up for Racial Justice (SURJ), notably as a white-led organization that works in partnership with Black and Brown organizers and organizations. The focus on SURJ works to provide a useful understanding of one racial justice organizing strategy against white supremacist institutions and policies in the United States today. Importantly, *Whites Against Supremacy*'s focus on SURJ seeks to responsibly explore long-held and contested questions of how to ethically call more white people into sustainable and accessible anti-racist action and commitment. While research is ongoing, preliminary findings suggest promising opportunities, however imperfect, in SURJ's efforts in organizing based on a "mutual interest" framework, rather than solely relying on a framework based on white privilege.

As Professor Russo's research assistant on this project, I spent the majority of my time collecting and compiling information for the interview and participant observation parts of her data set. Much of the former included listening to interviews, as well as correcting auto-generated transcripts of conversations held with local SURJ group leaders and national staff along with their Black and Brown organizational partners. As part of this effort, I also annotated forty-plus of the aforementioned interviews for established book themes. Further, my work engaging with the project's participant observation data involved volunteering in Courtwatch sessions two days a week alongside SURJ members. I also participated in numerous SURJ political education meetings and webinars with Professor Russo. This immersion broadened my connection to and understanding of SURJ's anti-capitalist and abolitionist informed organizational culture. This deeper understanding helped to guide my weekly discussions with Professor Russo, where we analyzed the opportunities and complexities of SURJ'S white anti-racist practice and racial and economic justice organizing at large.

Research Fellow: Omar Fargally (2025) **Concentration:** Computer Science

Faculty Mentor: Grusha Prasad **Department:** Computer Science

Title of Project: Investigating The Impact of Online Experimental Platforms on The Magnitude of Psycholinguistic Effects

Funding Source: NASC Division

Project Summary:

In Psychological Science, replication is of utmost importance. This project aimed to replicate the results of two psycholinguistics experiments, originally conducted on Mturk, using Prolific and comparing both the quality and the magnitude of the resultant data. For context, MTurk and Prolific are two of the most widely used online, participant-recruiting platforms. The significance of the project lies in the fact that it sheds light on a very important issue in current research in psycholinguistics - it's anecdotally known that Prolific generates better quality results that tend to have better accuracy and more attentive participants. In this study, our goal was to attempt to verify this widely-known anecdotal observation using a methodologically-grounded approach. Specifically we were interested in whether comprehension accuracy and power (i.e. number of participants required to detect an effect) differed across the platforms. To answer this question, we replicated a self-paced reading paradigm (SPR) where participants read sentences one word at a time. We found that both accuracy and power were numerically higher in the Prolific data compared to the MTurk data, aligning with previous anecdotal observations. To test the robustness of this result, we also collected data for another experimental paradigm, MAZE. Compared to the SPR paradigm where participants passively read sentences, the MAZE requires more active participation: at every given point in the sentence, participants are asked to make a choice between two words. Preliminary analyses indicate that like with the SPR data, accuracy in MAZE data collected on Prolific is higher than that collected on MTurk. We are currently in the process of further analyzing the MAZE data and running statistical analyses on both datasets using mixed effects models to test if the observed difference between the platforms is statistically significant.

Metrics	MTurk SPR	Prolific SPR
Participant Exclusion	%22.4	%4.33
Mean Accuracy	%87.7	%95.6
Power for 400 Participants	0.646	0.748

Research Fellow: Nayda Farnsworth (2026)
Concentrations: Computer Science; Mathematics
Faculty Mentor: Gabe Sosa Castillo
Department: Mathematics

Title of Project: Reconstruction of Monomial Orders

Funding Source: NASC Division

Project Summary:

Ordering systems are invaluable in our day-to-day lives. They are also incredibly important to our understanding of monomial orders (the ranking system for monomials). Given a monomial order one can find matrices to represent it, each one of these matrices possesses an ARRE (Adjusted Row Reduced Echelon form). With this knowledge, we are better able to understand patterns and create generalizations about the MORMOREs (Monomial Orders Represented by Matrices with Only Rational Entries). Due to the fact that all matrices representing the same MORMORE possess the same ARRE form, an important question is whether or not a MORMORE is uniquely determined by its induced orders, i.e. if there is no other MORMORE with the same induced orders. We also question whether given a collection of n monomial orders, each in n-1 variables, they could be the set of induced orders for a MORMORE, and furthermore if this MORMORE is unique. Those that can are called reconstructable MORMOREs. I have spent my summer creating algorithms that characterize which monomial orders are and are not reconstructible.

We spent the first two weeks of this summer learning about Gröbner bases, an important tool in Algebraic Geometry and Commutative Algebra, which first require a monomial order to be computed, and about their applications to real life. We also learned about monomial orders, their properties and induced orders.

The next couple of weeks were used to create an algorithm that would calculate and print all of the GENERIC ARRE forms for the matrices for monomial orders in n variables. This way, we would have the tangible matrices to assess for important patterns that may help us characterize which MORMOREs are reconstructible. I used Python, utilizing methods from the NumPy package.

We next discovered the two characteristics of an ARRE matrix associated with a MORMORE that determine whether or not it is reconstructible. We found that if, after eliminating a column (that is not one of the last two columns) the ARRE form of the new matrix possesses a row, that is not one of the bottom rows, containing only zeros, then the associated MORMORE is reconstructible, and that otherwise it was not.

Hence, I went about creating two algorithms that would use these principles to determine the reconstructibility of any MORMORE, based on its associated matrix. First, I created an algorithm that determines whether a matrix satisfied the criteria described above. This algorithm first verified that the matrix was associated with a MORMORE by checking if its determinant was non-zero and if the first non-zero entry on every column was positive. It would then put the matrix into ARRE form and confirm whether it abides by the priorly stated criteria. In this way, the algorithm would verify the associated MORMORE's reconstructibility.

Then, I created another algorithm that would take a set of n matrices of size n-1, and determine whether those matrices corresponded to the induced orders of a valid matrix associated with a MORMORE. If so, it would then check whether that matrix was reconstructible using the first algorithm and print the result for the user.

These algorithms allow us to now utilize the power of computers to quickly determine the reconstructibility of any MORMORE or if a set of n matrices of size n-1 correspond to the matrices associated to the induced orders of MORMORE.

Research Fellow: Brendan Foerster (2024) **Concentration:** Applied Math
Faculty Mentor: Nick Moore **Department:** Mathematics
Title of Project: Novel Methods for Rogue Wave Sampling
Funding Source: NASC Division
Project Summary:

Rogue waves are a phenomenon that have intrigued and confounded oceanographers for generations. A rogue wave is defined as an ocean wave that is more than four standard deviations higher than the average surface displacement. These waves are difficult to model, however, because they do not follow a normal distribution. Rather, they can be modeled by a high-dimensional distribution called the Gibbs Measure. This distribution is difficult to sample from, so it would be useful to implement a general algorithm that could draw a random sample from this distribution given certain parameters. The process used to achieve this was called rejection sampling. This process allows one to draw a random sample from the normal distribution with certain parameters and accept it if it fits the Gibbs Measure or reject it if not. Repeating this process many times will result in a large sample of the Gibbs Measure with the given parameters.

There were multiple challenges that arose while creating this algorithm. However, to understand these challenges, it is important to first understand more about the algorithm. The first step of the algorithm is to set various parameters that determine which Gibbs Measure to sample from. These parameters include the total energy of the system, the wavenumber, the nonlinearity ratio, and the normalized inverse temperature. After these are set, the algorithm draws a random sample from an anisotropic Gaussian distribution. The covariance matrix of this distribution depends on some of the above parameters and finding the root of a somewhat complicated function. After this covariance matrix is found, the algorithm draws a sample from this normal distribution and passes that as another parameter into the rejection function.

Once all of the parameters are passed into the rejection function, the actual process for generating a random sample from the Gibbs Measure can begin. The idea behind rejection is to have a target distribution and a proposal distribution. The proposal distribution in this case is the normal distribution that the sample came from, and the target distribution is the Gibbs Measure. Then the process looks at each entry from the sample and accepts it with a probability determined by the target distribution divided by the proposal distribution. If it is accepted, it becomes part of the Gibbs Measure sample. If it is rejected, it is thrown away. However, there are multiple challenges that arise in this process.

One of the biggest challenges of this algorithm is determining the rejection constant. Because the value of the target distribution divided by the proposal distribution can be greater than one, there needs to be a constant multiplied by this value to ensure that it is between zero and one. This is called the rejection constant. This rejection constant turns out to be the minimum value of the proposal distribution divided by the target distribution. This is a very difficult value to measure because there is a specific case in which it gets very small. It gets small enough that the probability of acceptance becomes almost zero. This means that the algorithm must find a good estimate of this value for most cases without using the actual value. Multiple numerical methods were tested, but the most successful one was Nelder Mead maximization.

Another challenge faced was calculating the Hamiltonian for the Gibbs Measure. This value must be computed numerically, and it takes a lot of time to find the Hamiltonian for each randomly generated sample. Because of this, more work is needed to overcome this challenge. However, as it is now, the algorithm works to generate a random sample from a given Gibbs Distribution.

Research Fellow: Tate Fonda (2025) **Concentrations:** Neuroscience; English
Faculty Mentor: Julie Dudrick **Department:** Upstate Institute
Title of Project: Village of Hamilton, NY
Funding Source: Upstate Institute
Project Summary:

By working with the village of Hamilton's local government offices as a Summer Field School Fellow with Colgate University's Upstate Institute, I've learned how to write contracts, interpret local laws, and illuminate Hamilton's archives.

This fellowship provided me — as a student of English and neuroscience, entering my third year at Colgate — with the experience I've been seeking in my pre-law education. The opportunity to familiarize myself with the people behind Hamilton, a historic center of both education and community, has made all the difference in my understanding of what it means to operate to manage a well-kept village in partnership with a scenic university. The strong Colgate-to-Hamilton connection is led by Mayor RuthAnn Loveless, who retired from her work in Colgate's alumni office in 2011 after a 19-year career. I attended her weekly mayor's meetings to gauge the leadership style of a seasoned professional.

Meanwhile, Village Municipal Lawyer Jim Stokes and Village Code Enforcement Officer Gerard Snow interpret the nuances of local laws. In my work with Stokes, I created a fact sheet that translates a local renters' law into a one-page summary of regulations and requirements. My objective was to provide an accessible first look at the law to ensure homeowners can understand how often they can rent their property.

The law was put into effect in May of 2023 and allows village residents to use their primary property as a short-term rental for 30 days each year while concentrating short-term rentals in commercial districts of the village — expanding housing is one of the village's leading priorities and will be a focus of grant funding received by the village through the New York Forward program.

On paper, I had the opportunity to revise, update, and consolidate applications for local building permits submitted by residents applying for building projects, such as a new sign, a fence, or a parking lot. Where possible, I considered gender equity in my revisions by changing fields to universalized pronouns (they/he/she instead of he/she).

At its core, my work with the village this summer was all about accessibility. I structured the nuance of contracts and the interpretation of local law in a fashion that bridged the gap between those who are represented on the larger political stage and those who are not. These considerations are central to my moral responsibility as a student pursuing a civil service profession, and I look forward to continuing to work toward greater accessibility in Hamilton for the remainder of my time here at the village government offices and beyond.

Research Fellow: Gavin Fowler (2024) **Concentration:** Astrogeophysics

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

Title of Project: An In-depth Study of How to Collect Data for Rb-Sr Dating Using CODEX

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

Project Summary:

The Chemistry, Organics, and Dating EXperiment (CODEX) is a future lunar lander project comprising a suite of instruments. One of these instruments records Rb-Sr ratios from rock samples to calculate the sample's age. To collect this data, we use lasers to ablate the sample and ionize particles from the ablated gas plume. The ionized particles are then sent into a time-of-flight mass spectrometer, where their abundances can be recorded. We have used a seven-laser approach in past experiments, including our most recent publication (Levine et al., 2023). This setup consisted of one laser to ablate the sample and six lasers to ionize Rb and Sr (three for each element). Our most recent goal has been to reduce the number of lasers used for resonance ionization to two (one for each element). The three-laser approach has led to multiple issues and has required countless hours of testing and research. Besides the typical difficulties that come with developing a new technique, we also dealt with the task of restarting lasers that had been shut down for nearly six months. After multiple weeks of maintenance combined with a couple of malfunctions, we finally collected data ready for analysis.

Our work this summer consisted of two primary goals. First, get the prototype running again. Second, collect data using the three-laser setup. The first goal seemed straightforward but turned out to be way more complex than expected. In our first week, one of the YAG lasers broke due to deterioration in the flash lamp, which caused the cooling water to leak into the rest of the laser. The YAG laser is not necessary for the current setup but did require us to do some maintenance. Later in the summer, we also experienced issues with the femtosecond laser, which is required for our experiments. The pump laser in the system was not properly cooling the Acusto-optic Modulator (AOM). The AOM was clogged with algae and sediment from the water. This meant we had to thoroughly flush the system multiple times and restart the femtosecond laser. On top of this, one of the Swagelok fittings broke, requiring us to wait a few days to get a replacement. This set us back nearly a week. Finally, the sample is put into a chamber and kept under vacuum. After months of the system not being under vacuum meant that the chamber had to be cleaned, and much of the plumbing had to be redone.

The biggest problem in data collection came when the wavemeter broke. For the experiment to work, the resonance ionization lasers must be set to very specific wavelengths. A wavemeter is able to show us the wavelength of each laser. Without the wavemeter, we were unable to make progress with our findings. We used this time to prepare new samples and test other experiments. In the end, we successfully recorded Sr and Rb signals and got ready for data collection.

Research Fellow: Leia Francis (2025) **Concentration:** Physics
Faculty Mentor: Kiko Galvez **Department:** Physics and Astronomy
Title of Project: Quantum Decoherence of Entangled Photons to Detect Hypoxia
Funding Source: Justus '43 and Jayne Schlichting Student Research Fund
Project Summary:

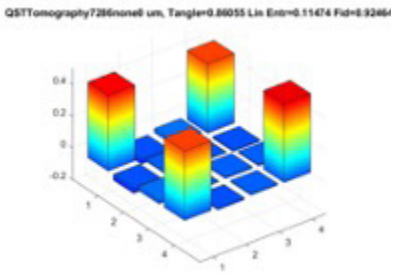
The goal of this research is to demonstrate that entangled photons can be used as a diagnostic tool for Hypoxia, a deficiency of oxygen in the brain. When photons are entangled, their properties are correlated such that we instantaneously know the state of one by measuring the state of the other conjointly. We generated two entangled photons, one which passed through a brain tissue sample before being detected, and one which was immediately detected. This produced a 4x4 matrix called a density matrix, representing the state of the light. From which we found the degree of entanglement of the two photons. We hypothesized that, because interaction with hypoxia samples affects the coherence of the photons differently than in interaction with control samples, we will be able to discriminate between tissue with Hypoxia from normal tissue.

The elements of the density matrix were determined by the polarization of the detected photon pairs, which is a superposition of both photons horizontal (H) and both photons vertical (V). In a perfectly entangled state, the four corner elements of the matrix have an amplitude of 0.5, and every other element is 0. When the photons interact with a tissue sample, the coherence of the state is disturbed, which impacts the state of the light. We describe this phenomena using the qualities tangle and linear entropy. A higher tangle and a lower linear entropy signifies a more perfectly entangled pair of photons. Likewise, a lower tangle and a higher linear entropy signifies a decoherence of the entangled state.

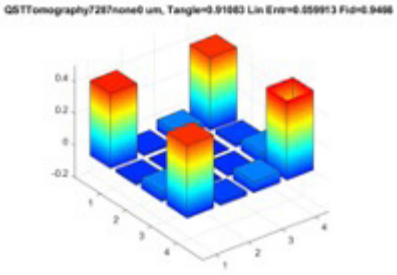
Below are the graphical results of tomographies of two 300μm thick cross-sectional samples of mouse brains. Each was generated using a Matlab-based tomographic measurement set with a 200-second integration time, which improves the precision of the results. The resulting density matrix on the left is of an unhealthy tissue sample, and the tomography on the right is of a control sample. The tangle of the control tissue sample is higher than that of the unhealthy tissue, which might indicate the entanglement of photons is better preserved in interactions with non-infected samples.

To further investigate the effect of interaction with Hypoxia affected tissue on the coherence of entangled photons, we will repeat this procedure using 300μm, 400μm, and 500μm samples. This will help us find a more definitive correlation between sample properties and coherence.

Tomography of Hypoxia Tissue Sample



Tomography of Control Tissue Sample



Research Fellow: **Kyleigh Frank (2024)** **Concentration:** **Biology**
Faculty Mentor: **Tim McCay** **Department:** **Biology; Environmental Studies**
Title of Project: **Effects of Slope and Vibration on Jumping Worm Movement and Distribution**
Funding Source: **Northeastern States Research Cooperative Grant**
Project Summary:

Initially, my summer research focused on worm grunting, the phenomenon where worms seem to flock to the surface of the ground in response to emitted vibrations. While the response is recorded most in Diplocardia mississippiensis, jumping worm species (Amynthas agrestis, Amynthas tokioensis, and Metaphire hilgendorfi) are also shown to exhibit similar behavior. My initial project sought to understand the full effect of grunting on jumping worm behavior with the hope of discovering a frequency emission that would be sufficient to deter the invasive species from surrounding areas. However, the need to first understand the regular distribution and movement of jumping worms in the Northeast became readily apparent. As a result, I shifted my focus from the primary effects of vibration, to the distribution of jumping worms with a secondary interest in how vibrations may affect their movement patterns.

This fall, I will be taking a field-lab tandem approach to investigate the distribution of jumping worms in the fall season. As jumping worms are an annual species, (i.e., are born in the spring and reach maturity by fall), these experiments will focus primarily on the movement of adult jumping worms across a landscape. The field portion will involve several sloped, forested sites around Colgate's campus. Worms will be removed, tagged, and reintroduced to the specific spot from which they were taken. At varying time intervals after reintroduction (e.g., one day, one week, two weeks, etc.), worms will be sampled from areas surrounding the original collection point, and checked for tags. Locating tagged worms in and outside of the reintroduction point will provide insight into the distributive patterns of jumping worms, revealing a potential range of movement over the span of a month. Factors like slope and rainfall may also be considered to better understand how the spread of jumping worms is impacted by the geographic and climatic landscape of the Northeast.

The lab portion of the experiment will use wooden tracks (as pictured) lined with soil to obtain a more concise and controlled understanding of jumping worm movement. Worms will be placed at the base of each track and allowed to move over the course of a couple days. Without manipulation, the locations at which worms are found may provide context for how prone the worms are to movement in limited soil. Additionally, in attaching frequency-emitting speakers to the base of each track, the behavioral response of the jumping worms after exposure to a specific emitted frequency can be quantified. The first part of the experiment will investigate if the vibrations produced by a certain frequency has the potential to "motivate" jumping worms to surface and move across the track within moments. The second, long-term, portion will track how the distribution of the jumping worms may be altered by the constant vibration they are exposed to. This would be able to determine if frequency emission is an effective method of encouraging jumping worms to move, as well as if long term emission may discourage worms from burrowing in proximate areas. To mimic the hilly settings in the field portion of the experiment, the slope of the tracks may also be altered to investigate another variable pertaining to the movement of jumping worms in both controlled and frequency-emitting conditions. Ultimately, the experiments should capture a greater understanding of jumping worm distribution patterns and the implications slope and vibration may have.

Research Fellows: **Ali Ghasemi (2025)** **Concentration: Computer Science**
Ayub Khan (2025) **Concentration: Computer Science**
Mete Minbay (2024) **Concentration: Computer Science**
Faculty Mentor: **Ahmet Ali Ay** **Department: Biology**

Title of Project: **Computational Analysis to detect Circadian related genotypes associated with Depression**

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

Project Summary:

Background: In 2019, one in eight individuals globally had mental disorders (including anxiety and depression), increasing self-harm risk [1]. COVID-19 worsened depression, particularly among adolescents and females [2,3]. In 2020, Major Depressive Disorder cost the US over $325 billion, emphasizing the need for improved diagnosis and treatment [4].

Research indicates strong links between circadian clock genes, governing our biological rhythms, and mental disorders like depression. These genes impact mood through neurotransmitter pathways or diurnal preference [5]. We explore these genetic connections in a UK sample of 99,939 individuals using their genotypic variations and PHQ-9 depression scores.

Methods: The study examined SNPs from 40 circadian genes identified through literature. Data was categorized by sex due to its relevance to depression. Significant SNPs (single nucleotide polymorphisms) were selected (around 100 per category) using Chi-squared, t-test, and LASSO regression. Significant SNP-SNP interactions were determined using linear regression and integrated into the analysis. Multivariate linear and logistic regressions were applied to study the effect of SNP, SNP-SNP pair, and clinical factors, followed by diverse machine-learning analyses. Significant SNPs and SNP-SNP pairs are studied further through mediation, association rule learning, and network analysis.

a) b) c)

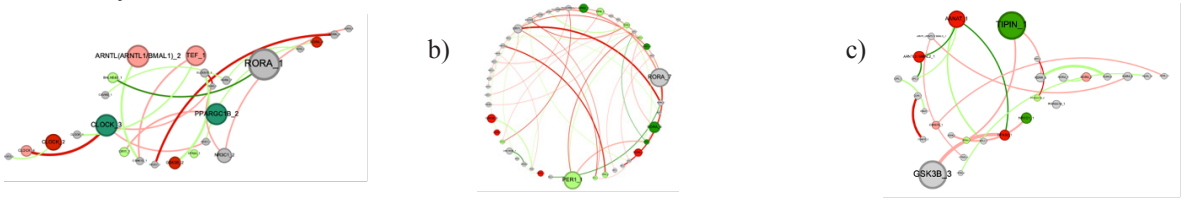


Figure 1: Circadian gene variants can be protective and/or risk factors for depression. Significant epistatic interactions between SNPs were plotted radially for a) overall, b) male, and c) female categories. SNPs are represented by nodes and are grouped by shared genes. Edges represent epistatic interactions between two SNPs. Node and edge colors represent risk (red tones) and protective (green tones), and neutral (gray) factors. Node and edge thicknesses are dictated by Odds Ratio values, where a larger node or thicker edge means more odds of being protective or at risk for depression.

Results/Conclusions:

- Core and peripheral clock gene variants (TEF, GSK3B, AANAT) significantly increased the likelihood of depression, and others (CLOCK, RORA, TIPIN) in protecting from depression.
- Interestingly, some RORA variants in pairs were both risk and protective. A RORA-CRY1 pair was a risk factor, but the same RORA variant with OPN4 was protective. This could be because of the complicated nature of RORA's action pathways. RORA could affect depression directly as it is a nuclear hormone receptor and is heavily linked to melatonin[6]. It is also linked to regulation of clock genes including CRY1, as well as some photoreceptor encoding opsin genes (OPN1SW and OPN1SM) that share pathways with OPN4[7].
- An NPAS2 variant that came up as significantly protective in our logistic regression when in conjunction with a LINC-ROR variant has been associated with risk for MDD [8], and protective from sleep disorders [9].
- We found 12 SNP or epistatic SNP pair interactions to be significantly mediating depression through chronotype. RORA variants comprised the majority of the results, which is consistent with the literature as RORA has been shown to affect mood through chronotype.[10]

Research Fellow: Leah Greenstein (2025) **Concentration:** Neuroscience
Faculty Mentor: Wan-chun Liu **Department:** Psychological and Brain Sciences
Title of Project: The Effect of Artificial Light at Night (ALAN) On Locomotion and Vocalization in Zebra Finch
Funding Source: NASC Division
Project Summary:

Artificial light at night (ALAN), a form of light pollution, alters migratory patterns and circadian rhythm (Fraenkel, 2022). However, the neurobiological effects for birds chronically exposed to ALAN are poorly understood. Locomotion (Liu et al., 2022) and performance on visual, structural, and auditory learning tasks (Lambert et al., 2022) vary individually, and these factors correlate to a bird's cognitive ability and physical fitness. As it is possible to quantify the physical (movement) and cognitive (vocalization quality) abilities in the Zebra Finch (Taenopygia guttata), it serves as an ideal model for understanding the effects of ALAN exposure. It was hypothesized that, compared to control birds, ALAN will experience decreased locomotion, a different daily movement pattern, and reduced song frequency and quality. At a neurobiological level, ALAN provokes a decrease in neuroplasticity by decreasing neurogenesis and a heightened neuroimmune response with increased microglia in the HVC and Area X.

Adult male zebra finches were housed in group cages prior to separation (3 ALAN 2 control). All birds were under a 12:12 hr light-dark cycle with exposure to regular light (200-700 lux) during the day. Control birds had no light (0 lux) at night, while ALAN birds had dim light (3-8 lux) at night. Prior to experimentation, birds were isolated 2-5 days in an isolation cage prior to being moved to a recording cage, and they were marked with orange paint for tracking. All birds were recorded with audio and video for 2 light cycles, and ALAN birds were additionally recorded for 2 night cycles. Ethovision Software was used to analyze the movement data, and SAP 2011 was used to analyze vocal data.

It was found that ALAN birds moved less during the daytime in comparison to control birds. ALAN birds also moved minimally at night and spent an increased amount of time throughout the day under the eating hood. Due to technical complications with the microphone, there was a lack of sufficient data to explore the vocalization aspect of the hypothesis. Additionally, as the camera is unable to detect motion under no-light conditions, it was impossible to record control birds at night to serve as comparison. Future endeavors for this project involve exploring the neurophysiology behind these behavioral differences, increase the sample size, gather sufficient audio vocal recordings, and explore alternative camera options (infrared, heat, etc.) to record control birds at night time.

Research Fellow: Samay Gupta (2024) **Concentrations:** Mathematics; Economics

Faculty Mentor: Carolina Castilla **Department:** Economics

Title of Project: Nudge Theory and Extracurricular Participation in High School Students

Funding Source: SOSC Division

Project Summary:

Nudge theory is a behavioral framework which stresses that subtle and indirect changes in the environment are effective means to change people's behavior and decision-making. Research has shown that this behavioral framework is effective in influencing decision-making in educational settings as well. Researchers have been able to elicit positive educational outcomes, such as reduced absenteeism, using carefully designed nudges. In fact, recent research has shown that nudges are very effective in educational settings and classified nudges based on cognitive load and transparency for varied educational settings

Extracurricular participation has long been considered a vital part of high-school education. Research has found that extracurricular participation is negatively related to negative outcomes such as dropping out of school and drug use and positively related to standardized test scores, grades, and educational aspirations. As a result, promotion of extracurricular participation is significant for the holistic development of students. This is especially true in India where participation in these activities is low. One of the potential reasons for this low participation is teachers and parents perceiving these activities as having little value.

To that end, we designed a study to examine the effectiveness of informational nudges at improving student participation in extracurricular activities and subsequent educational outcomes. To estimate this causal effect, we proposed to conduct a randomized controlled trial (RCT) in a high school in Gurgaon, India. The experiment involved designing an informational monthly newsletter that highlights the work and activities that happen during extracurricular organization meetings. This newsletter would be sent out every month for a year. At baseline (the beginning of the academic year), we would collect current and historical data about club enrolment, student/parent demographic information such as age, household size, education level, and quantitative data (on a scale of 1 to 10) about students' and parents' perceptions about clubs (their inherent value, satisfaction with performance) through a survey. Over the course of the year, the aforementioned survey would be sent out quarterly to track any changes in perceptions. At the beginning of the next academic year, club enrolment/survey data would be compared with historical data to estimate the effect of the newsletter on extracurricular participation and perceptions about extracurricular activities.

Unfortunately, the high school that we were partnering with to perform the experiment withdrew from participating in the study because they were unwilling to share demographic data about students/parents with us, without which our study would not be possible. However, the experiment design is transferable and can be implemented whenever an appropriate and willing high school is found.

Research Fellow: Kayla Gutheil (2024) **Concentrations:** Environmental Studies; English
Faculty Mentor: Cat Cardelús **Department:** Upstate Institute
Title of Project: Enhancing Pollinator Conservation in the Adirondack Park with AdkAction
Funding Source: Upstate Institute
Project Summary:

This summer, I had the privilege of working for the nonprofit organization AdkAction as they began the initial stages of strategic planning for the future of the Adirondack Pollinator Project (APP). Since 2016, the organization has sent 70,000 packets of native northeastern wildflower seeds to Adirondack Park residents upon request. Additionally, the APP has sold over 10,000 native and pollinator-friendly plants since 2018 and has helped install 26 demonstration community gardens across the Adirondacks. The educational component of the project can be seen in the "Library Buzz" children's programming in celebration of Pollinator Week each year in June. My role within the organization was to research large-scale projects that AdkAction expressed interest in while also evaluating how effective the APP has been in its past initiatives. From my research, I determined that the reduction of roadside mowing along state highways is the most feasible and effective way to enhance natural pollinator habitat in the Adirondacks. An additional suggestion was to initiate a community-wide project in which capped landfills are revegetated with pollinator plants and native wildflowers.

In order to determine what would be most effective to enhance pollinator conservation, I spent a significant amount of time researching the greatest threats to pollinators in the northeast. The most pressing threats that pollinator species face are climate change, diseases and parasites, neonicotinoids (a subclass of insecticides), and habitat fragmentation. With these factors in mind, I began looking into projects that would most effectively address these threats while keeping my organization's limited resources in mind. The large-scale projects that I researched included planting pollinator-friendly perennials at capped landfills and on septic drainfields, reducing roadside mowing in right-of-way (ROW) zones, enhancing pollinator habitat in power line ROW areas, and creating pollinator gardens at highway rest areas. Each of these suggestions was researched in detail and the pros and cons were assessed via a review of scholarly articles, case studies, and scientific data. I also turned to community stakeholders and APP partners for their insight on our current programming as a means to assess project effectiveness. My findings were summarized in a final report and presentation for the Adirondack Pollinator Project committee, which yielded questions about potential pilot projects for the following summer.

Research Fellow: **Jadan Hand (2024)** **Concentrations: Spanish; Biology**
Faculty Mentor: **Priscilla Van Wynsberghe** **Department: Biology**
Title of Project: **Identifying genes involved in kin-20 pathway in *C. elegans* through forward genetic screening**
Funding Source: **National Institutes of Health**
Project Summary:

C. elegans, are a microscopic species of nematode, with a completely sequenced genome and a quick life cycle of around 4–5 days. They are also hermaphrodites and thus produce large numbers of genetically identical offspring. Due to this combination of traits, *C. elegans* are considered a model organism as they are convenient to study, and the resulting information may give insight for other organisms. Like humans, *C. elegans* are subject to a circadian clock which affects their biological processes, including development and developmental timing, which are a focus of our research. *C. elegans* have homologs of some but not all genes involved in regulating circadian rhythms. The homolog of the *doubletime* gene (*dbt*) is *kin-20*. *C. elegans* with the *kin-20(ok505)* mutation have decreased fertility, a slow growth rate, an uncoordinated phenotype, and disruption of sinusoidal movement pattern.

The phenotypic disruption caused by mutations to kin-20 suggests that it plays a significant role in organismal development. To better understand this role we have begun forward genetic screening to identify worms with mutations that suppress loss of function in *kin-20* in order to identify genes involved in the *kin-20* pathway as regulators, downstream targets, etc. This was performed by exposing *kin-20* mutants to the chemical Ethyl methanesulfonate (EMS), which mutates DNA in such a way that guanine bases are mismatched to thymine bases, resulting in a transition mutation where an A:T pair "replaces" a G:C pair, at a rate of approximately one mutation per worm. Mutagenized worms were allowed to grow for a generation to become diploid mutants, and then were subject to screening and selected for phenotypic similarities to wild-type N2 worms, i.e. earlier development (gravidness) and movement. Selected candidates were then grown on plates in known quantities, and counted to compare to WT N2 worm plates at the same stages of growth following plating (48 h, 54 h, 72 h), in order to identify most viable candidates.

While there was variation in results across the time points and collections, four mutant candidates in the first round of screening were deemed the most favorable for further screening due to high levels of percent motility. At this point, further replication of counts of these candidates at the set time points is needed before proceeding to sequencing and genotyping. A closer examination of development of gravidness in comparison to N2 worms is also needed, as it was not observed in considerable quantities in the candidates, which is concerning as it was one of the key phenotypes being screened for. Additionally, there is another set of mutant candidates that have not yet been grown and quantitatively screened in comparison to wild-type N2 for phenotypic similarities, which will eventually need to be sequenced and genotyped as well.

Research Fellows: Carlson Hang (2025) — **Concentration:** Biochemistry
Yuhao Wang (2025) — **Concentration:** Biochemistry
Faculty Mentor: Gongfang Hu — **Department:** Chemistry

Title of Project: Developing Metal Complexes Containing Z-type Ligands for Electrocatalytic Reduction of Phosphorus Oxides

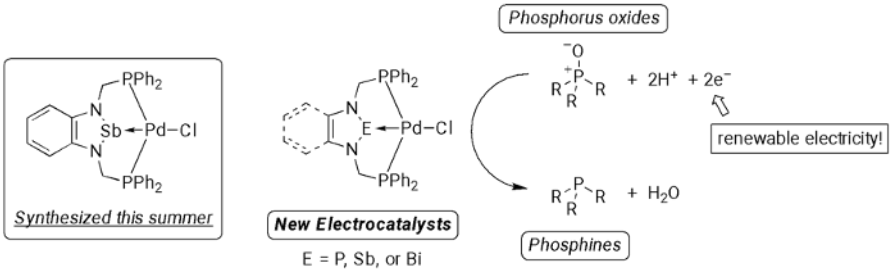
Funding Source: Warren Anderson Fund; NASC Division

Project Summary:

Phosphorus is a valuable chemical element and a widely distributed resource found in the Earth's crust and living organisms. However, the biogeochemical cycle of phosphorus lacks a gaseous state, resulting in limited commercial production methods apart from mining. This has led to concerns regarding the depletion of commercially exploitable and low-cost phosphorus resources within the next 50-100 years, with phosphorus reaching its peak in 2030. Mined phosphorus rock contains phosphorus in the +V oxidation state and is typically reduced to white phosphorus and then subsequently to other intermediates before further modification. The reduction of phosphorus rock demands a considerable amount of energy, making the overall process both energy intensive and inefficient.

The direct, two-electron reduction of phosphorus oxoacids to their synthetically useful counterparts containing phosphorus in the +III oxidation state is of vast interest, as this reaction is governed by a smaller energetic penalty. One fundamental challenge when reducing phosphorus from +V to +III is the selective cleavage of the phosphoryl phosphorus–oxygen bond, which has a high bond-dissociation energy. This chemical reaction also requires exogenous electrons to be added to the phosphorus. Electrocatalytic reduction thus becomes an attractive strategy, in which renewable electricity can be used to drive chemical reactions. Electrocatalysis involves fewer chemicals and, therefore, less chemical waste. Energy from electricity is also more controllable and tunable; one can continuously tune the input electrochemical potential to control the driving force, filling in the energy zones inaccessible by chemical species. One ongoing task is to discover the suitable catalytic species to mediate chemical reactions at high selectivity and efficiency.

In this project, we designed a series of metal complexes featuring Z-type ligands to generate a less nucleophilic metal center upon electrochemical reduction, compared to other types of ligands that have been widely studied. A Z-type ligand refers to a ligand that accepts two electrons from the metal center. They are typically Lewis acids or electron acceptors. In this case, the electron density of the metal center is reduced so that the metal becomes less nucleophilic. Specifically, we proposed using positively charged Group 15 elements, including phosphorus, antimony, and bismuth, as the core atoms for the Z-type ligands as they show strong electron-accepting ability when coordinating with transition metals. This summer, we explored the synthesis of a few ligands and successfully synthesized an antimony-based ligand. Complexation with a palladium(0) reagent via oxidative addition afforded a metal complex, which was studied with 1H and 31P nuclear magnetic resonance spectroscopy. Crystallization of the sample is in progress for X-ray crystallography characterization, which will provide more information about the molecular structure of the bimetallic antimony-palladium complex. Electrochemistry studies will follow to test the activity of the resulting compound for catalytic reduction.



Research Fellow: **Noelle Harrington (2024)** **Concentrations: Philosophy; Biology**
Faculty Mentor: **Krista Ingram** **Department: Biology**
Title of Project: **Non-invasive Conservation: eDNA and Facial Recognition for Harbor Seals in Casco Bay, Maine**
Funding Source: **Oberheim Memorial Fund**
Project Summary:

Harbor seals (*Phoca vitulina*) are a dynamic, coastal species and the most abundant pinniped in the Gulf of Maine. Long life spans, coastal residency, and top predator status make harbor seals an ideal subject for studies of ecosystem health (Bossart et al., 2010). Non-invasive, accurate monitoring of harbor seals poses prominent challenges. Techniques such as tagging, tissue sampling, and catch and release can provide high quality genetic and population data—but these methods are also highly disruptive to wild animals. The goal of this multi-year project is to integrate two non-invasive techniques for harbor seal population studies: drone aerial photography for facial identification and environmental DNA (eDNA) water sampling.

Seals haul out onto rocky outcroppings and beaches during low tide to rest, pup, and thermoregulate. This ritual provides an opportunity to capture images of both large groups and individuals. Utilizing either a boat or an aerial drone equipped with a zoom camera, seals are photographed from a non-disruptive distance. Pictures of seals are processed through SealNet, a facial recognition software developed to identify and chip individual seal faces. Each face is compared to a gallery of known seals to find any matches. This process allows us to identify and name individuals as well as find which seals return year after year and which sites they frequent. We collected ~4000 images from two haul-out sites across 13 days. Images will be processed in SealNet to identify known individuals and add new individuals to SealBase, our Casco Bay seal database.

In addition to facial ID analysis, this summer was spent testing the efficacy of eDNA sampling and processing for population genetic data. DNA that is shed into an environment by organisms and collected from an environmental sample is known as eDNA. For example, as seals swim, eat, defecate, and shuffle in and out of the water, they shed DNA into the surrounding water, and this DNA can be collected by sampling that water (as opposed to taking tissue or blood samples). eDNA sampling is inexpensive, noninvasive, and can capture DNA from multiple individuals within a population at once. We utilized an underwater drone to capture eDNA water samples from harbor seal haul-out sites. In the lab, we filtered samples and successfully extracted DNA. We will analyze the transect samples to determine the optimal eDNA sampling location for future years of data collection. Accurate information on site fidelity, population size, social patterns, and genetic diversity are crucial to informing conservation efforts. By integrating aerial based photography and eDNA water collection, these parameters may be monitored year after year in a completely non-invasive and non-disruptive manner.

Harbor seals on Grassy Ledge, a popular haul-out site with ~ 100 seal visitors at low tide.

Research Fellows: **Boyana He (2025)** **Concentration: Environmental Economics**
Robyn Landes (2024) **Concentrations: Peace and Conflict Studies; Chinese**
Faculty Mentors: **Chris Henke** **Department: Sociology and Anthropology; Environmental Studies**
Andrew Pattison **Department: Environmental Studies**

Title of Project: **New York State's Climate Smart Communities Program: Why and how did local municipalities in New York pursue certification, and what are the policy outcomes?**

Funding Source: **SOSC Division**

Project Summary:

Our research is focused on the New York State (NYS) Climate Smart Communities program (CSC) and the policy capacity of communities to achieve certification. This program is a sustainability framework for cities, counties, villages, and towns to develop and track a range of climate change initiatives. The program is run by the NYS Department of Environmental Conservation (DEC). Building on the work in Pattison, Henke & Pumilio (2021) "Community-based climate action planning as an act of advocacy: a case study of liberal arts education in a rural community," we collected additional data on the NYS communities participating in the state's CSC program. Data was collected from existing datasets of community characteristics, including but not limited to socio-demographic data and readily available government data, e.g., the American Community Survey. We collected additional data through qualitative interviews with key informants in twenty small communities, ten towns and ten villages. We examine the social and political drivers of program participation, the implementation challenges therein, and the outcomes of specific milestones in the program participation process. One of our central questions regards the resources and technical information available to municipalities to complete the climate actions in the program. Our research aims to provide feedback on the CSC program to share with the DEC, communities in NYS, and other researchers.

Among the 20 communities sampled, we divided them based on their median household income into 3 categories: high-income, middle-income, and low-income. In addition to affluence, 50% of our sample used external technical support to get certified, and 50% relied on their internal governmental resources. Since our research focuses on small communities, we limited the population density of every town to < 500 ppl/ sq mile. To date, we have conducted 19 interviews, with 17 CSC certified communities from our sample and also three administrative staff of the CSC program from state and regional levels. We divided our interviews into four sections: 1) *who* were the people involved in the certification process, 2) *why* did they choose to participate in the program (i.e., what were their motivations), 3) *how* did they proceed through the certification process and what resources did they use, and 4) *what* were the policy and other notable outcomes of pursuing CSC certification.

Here are our preliminary results: many of the communities said that doing the right thing motivated them to participate in the CSC program. Communities without any paid staff to do the work often mentioned that time was a significant barrier during the certification process. And for technical capacity, most communities relied on external technical support such as the regional planning boards or higher education. Many of the communities mentioned that the CSC program, especially the checklist of all the action items available for points, provide them with a helpful and instructive guideline for climate actions based on the municipal level. Also, most of the communities we interviewed mentioned that they have not pursued grants from the CSC program after being certified.

These are all preliminary results; we will continue doing interviews and start data analysis in the fall semester, and eventually share the formal results.

Research Fellow: **Vuong Hoang (2024)** **Concentrations: Economics; Film and Media Studies**

Faculty Mentor: **Carolina Castilla** **Department: Economics**

Title of Project: **What's the Plan Now? The Dobbs Decision, The Reversal of Roe v. Wade and The Changed Landscape of Planned Parenthood.**

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

Project Summary:

On June 24th, 2022, the Supreme Court of the United States decided to overturn the constitutional right to abortion established by *Roe v. Wade,* in 1973. To quote the joint dissent authored by Supreme Court Justices Breyer, Sotomayor and Kagan, the decision "eliminates a 50-year-old constitutional right that safeguards women's freedom and equal station [and] places in jeopardy other rights, from contraception to same-sex intimacy and marriage" (*Dobbs v. Jackson Women's Health Organization*, 2022). Our research looks at the impact of this Supreme Court decision on one of the nation's main providers of abortion, Planned Parenthood.

Specifically, we seek to examine the effect of the decision on the number of Planned Parenthood clinics and the number of Planned Parenthood clinics providing abortion (not all of them provide abortions) through a difference-in-difference analysis. Without the constitutional protection upheld by Roe v. Wade, the legislative and legal landscape on abortion has shifted dramatically at the state level. Each state's response to the reversal varies greatly, and this variance in legislative reaction has unforeseen implications for abortion providers. This allows us to look at many possible assignments of treatment and control groups, depending on how we define treatment. For example, if a restrictive policy is proposed and publicized in a state, but not yet passed, counting that state as a treatment state will yield different results and have different implications than had we counted that state as a control state.

Data was collected from all official Planned Parenthood websites. Since only information on currently operating clinics are available, and clinic closures are often inconsistently reported - some fade into non-existence in silence, while some are reported by news outlets, there was a need to acquire data on which clinics were opened and which closed in past years. We supplemented the currently available information with online clinic directories, local news articles, social media and an online tool called Wayback Machine that allows users to view past versions of websites. We use the Wayback Machine to manually compare archived versions of the many regional Planned Parenthood websites with the current listing of clinics to see which clinics were in the archived versions from each year from 2018 to 2023. As a result, we now have a dataset of all the clinics that closed during this time period, as well as an estimate of when these clinics closed. Where possible, we cross-check this data with news reports, Facebook posts, past Yelp reviews and other online sources to confirm and acquire a more accurate time frame. We also used the Wayback Machine to compare archived versions of individual clinics' listing of services provided to see whether or not the services they offered have changed between 2018 and 2023.

The research will hopefully provide some insight into the possible long-term ramifications of the Dobbs Decision on abortion providers and abortion access.

Research Fellow: Carson Hobler (2024) **Concentration: Molecular Biology**
Faculty Mentor: Priscilla Van Wynsberghe **Department: Biology**
Title of Project: Investigating the relationship between *lite-1* and *lin-42* in *C. elegans*
Funding Source: Michael J. Wolk '60 Heart Foundation
Project Summary:

The nematode *C. elegans* is a model organism frequently used in biological research because of its genetic similarities to human biology. Its use is advantageous due to its fully sequenced genome, short life cycle, and large production of genetically identical offspring. Our lab is focused on using these worms to better understand the circadian rhythm cycles that govern countless species, including humans. Circadian rhythms typically follow a 24-hour cycle based on external cues such as light and are vital for the regulation of internal functions and processes. At the molecular level, these rhythms are dictated by circadian clock genes that control protein expression, ensuring specific proteins are present/absent at appropriate times. The protein LIN-42 found in *C. elegans* has been shown to be a homolog of the period protein (an essential circadian clock protein identified in *Drosophila*), but the exact mechanism and pathways of its function remain unclear. My research focuses on investigating the relationship between LIN-42 and LITE-1, an important UV-detecting photoreceptor unique to *C. elegans*, to better understand how this important circadian clock gene is implicated in the photosensation pathway. To do this, I used a phenotypic assay that screened for UV light avoidance and examined mRNA and protein levels of *lin-42* in *lite-1* mutants.

For the UV assay, worms were egg prepped and allowed to grow for 40-44 hours so that they were at a young adult stage. Four strains were used: N2 (wildtype), *lite-1* mutants, *lin-42* mutants, and *lite-1*;*lin-42* double mutants. Worms were placed into the center of petri dishes, half of each petri dish was covered with aluminum foil, and UV light was shone on the side without aluminum foil. After 30 minutes, the number of worms that had moved to the light side (towards the UV light) or the dark side (away from the UV light) were counted and recorded. I then applied a phototaxis index to quantify the data. As expected, N2 worms with functional LITE-1 receptors were more likely to move to the dark side of the plate. *Lite-1* mutant worms demonstrated less avoidance of UV light, with similar numbers of worms being recorded on both the light and dark side. The *lin-42* and *lite-1;lin-42* mutant worms both demonstrated a lower frequency of UV light avoidance, suggesting that LIN-42 plays some role in the photosensation pathway.

To examine mRNA and protein expression, N2 and *lite-1* mutant worms were egg prepped and allowed to grow for 20, 22, 24, 26, or 28 hours (timepoints at which *lin-42* expression is known to peak). After extracting RNA and adding Oligo d(T) and specific primers for *lin-42* and a loading control, conduction of a qPCR analysis revealed slight variations in lin-42 mRNA expression in *lite-1* mutants (higher expression at 24 hours, lower expression at 20, 22, 26, and 28 hours). I plan to conduct further qPCR experiments to confirm this pattern of mRNA expression. Similarly, after extracting protein, running gel electrophoresis, and treating the gel with specific antibodies for LIN-42, western blot analysis revealed varying levels of LIN-42 protein expression in *lite-1* mutants (higher expression at 20 hours, lower expression at 24, 26, and 28 hours). I plan to repeat this experiment to confirm the time periods of protein expression, too.

Research Fellows: **Flannery Hogan (2026)** **Concentration: Astrogeophysics**
Henry Lin (2024) **Concentrations: Astrogeophysics; Economics**
Faculty Mentor: **William Peck** **Department: Earth and Environmental Geosciences**
Title of Project: **Origin of Iron Deposits in the Adirondack Mountains**
Funding Source: **Doug Rankin'53 Endowment - Appalachian Research**
Project Summary:

Magnetite ($Fe^{2+}Fe^{3+}_2O_4$) is a mineral mined frequently throughout the mining districts of the eastern Adirondacks as iron ore. The ratio of ^{56}Fe vs. ^{54}Fe and ^{18}O vs. ^{16}O isotopes in magnetite have been used to determine the formation temperatures and fluid conditions (hydrothermal vs magmatic) of the magnetite. This style of magnetite ore is typically found in Kiruna-type Iron Ore Apatite (IOA) deposits, which are named after the Kiruna-Malmberget mining region in Sweden. The presence of apatite in these ores leads to the occurrence of accessory minerals (such as monazite) and substantial rare earth elements (REEs) within the apatite.

The samples analyzed during the project consists of a mixture of samples we collected in the field (from the Schofield deposit, Hammond Pit, Barton Hill, and Cheever Mine), samples from Colgate (Joker Mine, Vineyard Road, Benson Mine, Lyon Mountain, Jayville, and Arnold Hill), and samples from the US Geological Survey (Chateaugay, Palmer Hill, and Rutgers Mine). Small amounts of magnetite were extracted from each ore and most host granites, with the purest grains hand-picked using non-magnetic tweezers under binocular microscopes and powdered for iron isotope analysis (up to 100mg for ores and at least 20mg for granites). Each sample was then further processed by extracting additional magnetite grains but leaving them unpowdered for oxygen isotope analysis. Quartz was extracted from all samples when more than 10mg were present, also for oxygen isotope analysis. Biotite and amphibole were each extracted when found in ample amounts to provide further iron isotope data, ideally around 20mg. In total, 54 samples were processed, with multiple minerals selected from each. Samples were placed in sample vials and sent to Rutgers University for iron isotope analysis.

Samples were cut into approximately 2.7cm x 4.6cm x 1.5cm billets with a water saw, polished with 220 ad 400 grit polishing compound, 180 and 320 grit sandpaper, and finished with a one micron grit polishing compound, and carbon coated to prepare for analysis using the scanning electron microscope (SEM). Samples that were prone to flaking were coated with epoxy prior to polish, and samples not large enough to be cut into billets or too brittle to be cut were mounted in 1 inch epoxy rounds and polished. Each sample was examined using backscattered electron imaging for the presence and composition of minerals, with a focus on the the textures of apatite and magnetite.

Common magnetite accessory minerals such as clinopyroxene (CPX) and its replacement product chlorite were present in almost every sample, often but not always as fractured CPX being replaced with chlorite. Apatite ($Ca_5(PO_4)_3(F, Cl, OH)$, both REE- bearing and non-REE bearing, were found, with non-REE bearing typically appearing larger and with better crystal form. Monazite $(Ce, La, Th)PO_4$, another REE-bearing phosphate, is commonly found, usually as rims around apatite. A third REE bearing mineral, alanite ($((Ce,Ca,Y,La)_2(Al,Fe^{+3})_3(SiO_4)_3(OH))$, was also observed. Titanium-bearing minerals (titanite, ilmenite, rutile) were found in various samples. Stillwellite, $(Ce,La,Ca)BSiO_5$, was found in one sample. Other notable minerals present include feldspars, zircon, pyrite, chalcopyrite, amphibole, and perovskite, as well as a number of unidentified minerals including a niobium silicate that seems to be common in Hammond Pit samples. Samples were also analyzed with a portable XRF (X-ray fluorescence) spectrometer to survey for bulk composition, though no correlation between elemental abundances and locality was observed.

Research Fellow: PJ Horoszewski (2025) **Concentrations: Applied Math; Economics**
Department: Mathematics

Faculty Mentor: Gabe Sosa Castillo
Title of Project: Reconstruction of Monomial Orders
Funding Source: NASC Division
Project Summary:

A Gröbner basis is a finite generating set of an ideal in a polynomial ring. Gröbner bases are extremely useful for solving complex systems of polynomial equations, which have practical applications in fields such as engineering and economic modeling. *Monomial orders* are necessary tools to find a Gröbner basis for a given ideal over a polynomial ring. For a given ideal, there is a monomial order that is best in order to find the finite Gröbner basis for that ideal, however it is a challenging process to find this ordering. Our research investigates the characteristics and methods involved in reconstructing monomial orders from a set of induced monomial orders.

An induced order is the order that is left when all monomials containing the nth variable are removed from the set of monomials, and the original order is applied. A reconstructable monomial order is one that can be known with absolute certainty given all of its induced orderings. Every monomial order can be represented by a matrix. A given matrix represents a monomial order given that the matrix has the following characteristics:

1. The first non-zero entry in a column is positive
2. Entries are rational numbers

During the course of our research, we characterized the matrices that represent reconstructable orders. Every matrix of rational entries representing a monomial order has the same reconstructability as the upper-triangularized version of the matrix. So, if the upper-triangularized matrix is reconstructable, the original is reconstructable. We found that for a monomial ordering to be reconstructable, the *n by n* matrix of rational entries that represents it must have the following characteristic. One of the first *n-2* rows in the matrix, must have entries from the column with the first non-zero entry *j* to the *nth* column, where each entry is a multiple of the entry in the row above it, and each entry is a multiple of the same factor as the other entries in the row. If this condition holds true, all matrices that have this unique upper-triangular form associated with them are also reconstructable. We created a program in the Julia language to automate this process of checking for reconstructability.

Additionally, we created an algorithm to create an *n by n* matrix representing a monomial order given *n (n-1) by (n-1)* matrices representing the induced orders. This algorithm involves looking at which rows of induced orders have their first non-zero entry in the last two columns, and using this information to deduce the original order. We also created a script in the Julia language that takes inputs of matrices representing induced orders, and outputs a matrix that has matching induced orders, if possible.

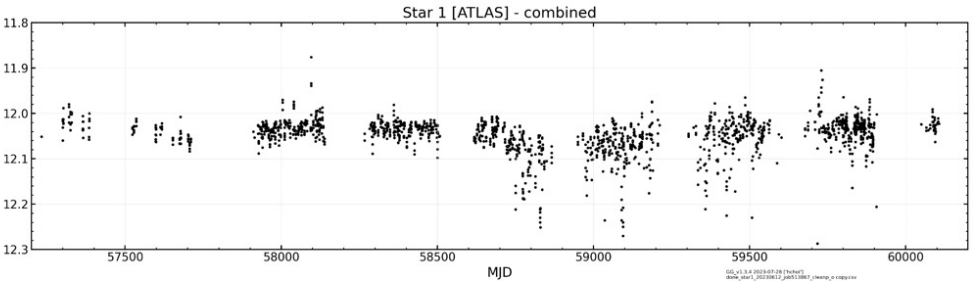
We were successful in answering the questions we set out to answer, but our results open the possibility of new questions, such as: Does every set of induced orders have at least one matrix that has those given induced orders?

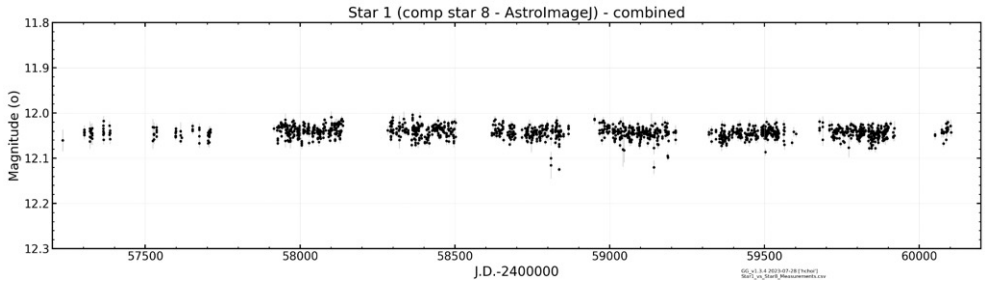
Research Fellow: **Maddie Hulburt (2024)** **Concentration: Astronomy/Physics**
Faculty Mentor: **Thomas Balonek** **Department: Physics and Astronomy**
Title of Project: **Data Reduction of Asteroid Terrestrial-impact Last Alert System (ATLAS) Variable Stars**
Funding Source: **NASC Division**
Project Summary:

The Asteroid Terrestrial-impact Last Alert System (ATLAS) is an all-sky survey that monitors the sky for near-Earth asteroids prior to impact, collecting a massive amount of sky images each night, allowing astronomers to pull data on an object from the ATLAS online database for brightness measurements. We downloaded the forced photometry data of two quasars, BL Lac and 1308+326, and their nearby comparison stars for analysis.

We analyzed the brightness measurements for the comparison stars and quasars using a Jupyter Notebook Python code that excluded bad data based on a set of defined parameters. We defined a signal-to-noise cut-off value of 5, so only clear signal detections would be included in our analysis. Points of low or negative flux values and high flux error were then excluded. We also utilized a zscore calculation of the magnitude to exclude extreme outliers. The pipeline excludes data points with more than 0.03 magnitude (about 3%) error. The pipeline then separated the data by filter. We primarily performed our research using the ATLAS o-band filter.

We conducted our own aperture photometry measurements on the ATLAS fits images within AstroImageJ, which produced more consistent and accurate results than the database's forced photometry. Magnitude measurements are done by comparing target variable stars to a standard, unchanging star. The magnitude of the standard star was calculated as the average magnitude from the forced photometry ATLAS server. Figure 1 graphs ATLAS forced photometry and Figure 2 shows the same fits images but analyzed through AstroImageJ. For more information on our ATLAS analysis, please refer to Chris O'Connell's abstract.





Research Fellows: **Elizabeth Joffrey (2025)** **Concentrations: Neuroscience; German**
Marissa Realmuto (2024) **Concentration: Neuroscience**
Faculty Mentor: **Ann Jane Tierney** **Department: Psychological and Brain Sciences**
Title of Project: **Effects of essential amino acid and neurotransmitter precursor consumption and deprivation on feeding and mating behavior**
Funding Source: **NASC Division**
Project Summary:

Insects exist in environments with varying nutrient availability and must curate their diet to maximize growth and development. Thus, they have evolved abilities to evaluate the nutritional quality of food, including adjusting consumption to maximize a balanced diet, such as compensatory feeding on deficient nutrients, and distinguishing different macro- and micronutrients. Previous research has shown that insects can differentiate between sucrose and protein, as well as between different amino acids. Amino acids are important due to their role in the synthesis of proteins and neurotransmitters (NT). There are 20 naturally occurring amino acids, 10 of which are essential amino acids (EAA) in insects. The EAAs tryptophan (Trp) and phenylalanine (Phe) are of particular interest because they are required to synthesize NT precursors, 5-HTP and L-DOPA for serotonin (5-HT) and dopamine (DA) respectively, and thus may also have behavioral implications. For example, decreased serotonin decreases female receptivity to male courtship. Tierney et al. 2023 previously found that adult crickets can differentiate between sucrose and a mixture of all EAAs and preferred the EAA mixture after EAA deprivation. We investigated if crickets (*Acheta domesticus*) can differentiate between individual EAAs during compensatory feeding and whether preferences differed between developmental stages. Moreover, we were interested in how deprivation of Trp or Phe would affect compensatory feeding of that particular EAA or a related NT precursor. Finally, we wanted to investigate how differences in consumption of NT precursors affect mating behavior, particularly female receptivity to male courtship.

For the first experiment, we hypothesized that after EAA deprivation, crickets would prefer individual EAAs over sucrose due to compensatory feeding. Crickets were first deprived of EAAs with a 3-day sucrose-only diet and then given two separate discs of food, one of sucrose and one of an individual EAA, for 6 hours. Preference was determined by the amount of EAA eaten compared to the total food eaten. Behavior was recorded and the time feeding and the number of visits to the food were subsequently quantified. We found that crickets, regardless of sex or developmental stage, preferred sucrose over all individual EAAs tested thus far, with no differences between EAAs. Possibly crickets prefer foods with a greater variety of nutrients and will not expend energy eating foods with only one nutrient.

In the second experiment, we hypothesized that Trp-deprived crickets would prefer Trp or 5-HTP and Phe-deprived crickets would prefer Phe or L-DOPA. Crickets (unmated adult females) were pre-fed with either sucrose and a mixture of EAA minus Trp or with a mixture of EAA minus Phe for 5 days prior to testing. Crickets were then given either Phe, Trp, L-DOPA, or 5-HTP for 1 hour. The total amount of food eaten was used to determine the preference per condition. Crickets did not eat the test food in any of the conditions. As noted above, crickets may prefer mixtures of nutrients. It was noted that the crickets ate less of the pretreatment food each day, so it is also possible that they developed an aversion for the agar in the foods over the 5-day period.

Finally in the third experiment, we hypothesized that 5-HTP-fed female crickets would be more receptive to male courtship. Crickets were separated by sex prior to molting into adulthood to ensure all subjects were unmated. Female crickets were fed either plain sucrose or sucrose mixed with 5-HTP in the two hours prior to experimentation. All males were fed plain sucrose. One female and one male cricket were placed in otherwise empty tanks and recorded for 2.5 hours. Recordings were analyzed for the number of mounting attempts by the female and the latency of the first and longest mounts, as well as any female rejection behavior such as escaping or kicking. We found that crickets readily consumed the 5-HTP food, suggesting that the pre-feeding manipulation was successful. The experiment is ongoing and additional trials are required to draw definitive conclusions about drug effects on mating behavior.

Research Fellow: Laurajane Kehler (2025) **Concentration: Molecular Biology**
Faculty Mentor: Julie Dudrick **Department: Upstate Institute**
Title of Project: Designing A Framework to Optimize Donations at The Center
Funding Source: Upstate Institute
Project Summary:

Summertime in Hamilton has afforded me the incredible opportunity to explore the non-profit realm in Central New York. Upon my acceptance into a fellowship program through The Upstate Institute, I was placed with a refugee resettlement organization called The Center, a Utica-based non-profit. Since that time, I've had the opportunity to engage in work experience that has been invaluable to the benefit of myself and the community.

The Center's mission, exercised by its dedicated employees, is all about promoting a welcoming environment in Utica and the surrounding Mohawk Valley. The range of job titles at The Center speaks clearly to the complexity that is refugee resettlement, yet everyone plays a vital role in the system. I've gradually acquainted myself with the employees, some of whom work exclusively in Ukrainian resettlement, teaching, administration, and a laundry list of other titles. Everyone who I met went above and beyond their job description. Non-profit work is a sacrifice that many are unwilling to take, but individuals at The Center have demonstrated that this type of work provides a reward of immeasurable value, far beyond a paycheck.

While my role at The Center was limited by a ten-week time constraint, it nonetheless allowed me to practice community service while simultaneously doing meaningful work in the organization's best interest. Prior to my summer experience, I was prepared to develop a database system for effective donation management at The Center. My analytical and data-driven mind felt enthusiastic and comfortable working with numbers to make solutions and implement them into the existing donation process. Upon arrival, I was pleased to work with quantitative data from previous donation drives, but I was arguably more enthusiastic taking on other meaningful tasks. For example, I assisted volunteers with organizing donated clothing and other items into our inventory, attended community education events on a biweekly basis, and painted a space where clients can shop for donated items in the future.

The breadth of my experiences and the value they've served me, The Center, and the community has granted me an enhanced perspective on the reality of non-profit work. While not always glamorous, it provides a vast amount of resources and services for the refugee community in Central New York and beyond. As a Global Public & Environmental Health minor, my work at The Center aligns with my personal values and priorities as it relates to my studies and future career path. The bottom line--- stepping outside of Hamilton and into the larger community has helped me bridge the gap between academia and what it is meant for, that is, to foster a better environment for all.

Being a Field School Fellow has been tremendously important for my growth as a student and a community member. Community-based research programs like The Upstate Institute should be modeled at other upper-level institutions, for they provide learning through service for motivated students with a passion for creating change. Going forward, I am confident that my experiences this summer will remind me of the responsibility that I have as a Colgate Student to do good in the community and beyond, through applying my knowledge and learning to those in-need.

Research Fellow: **Katie Keyes (2025)** **Concentration: Biology**
Faculty Mentor: **Julie Dudrick** **Department: Upstate Institute**
Title of Project: **A Look at Rural Homelessness within Delaware, Chenango, Madison, and Otsego Counties, New York**
Funding Source: **Upstate Institute**
Project Summary:

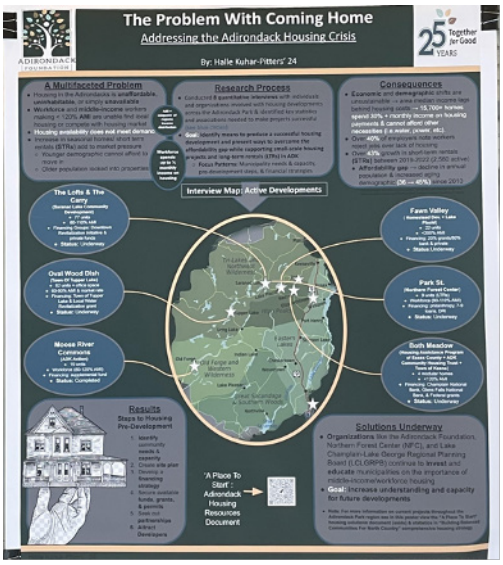
Often, homelessness is viewed solely as an urban issue, eliciting images of people sleeping on park benches or living in encampments. However, rural homelessness is also a growing concern. Rural homelessness faces unique challenges, such as fewer resources, shelters, affordable housing, funding, and services for a larger geographic area. Consequently, people experiencing rural homelessness are more likely to live in abandoned buildings, on state land, with family or friends, or in substandard housing. Addressing rural homelessness requires a tailored approach that looks at the root of this issue.

During the Upstate Institute Summer Field School, I collaborated with the United Way of Mid Rural New York, formed by the merger of the United Ways of Chenango, Delaware and Otsego, and Madison. My goal was to investigate homelessness trends, demographics, root causes, and their impacts on our communities. I interviewed nine nonprofits, faith-based organizations, and local officials across these counties. The interviews I conducted underscored the disproportionate vulnerability of certain groups, such as individuals with substance use disorders, mental illnesses, and a history of involvement with the justice system, who are particularly susceptible to homelessness. These subgroups emphasize the need for tailored interventions and support systems. The primary factors contributing to homelessness in these areas are the lack of affordable and adequate housing and the scarcity of resources and infrastructure. The COVID-19 pandemic exacerbated these issues, increasing homelessness and struggles for low-income households. Rural communities also have limited or no public transportation. This poses an additional challenge, making it more difficult for individuals to access housing, healthcare, and supportive services. Landlords also play a pivotal role in the housing equation. Their willingness to rent to low-income individuals can be influenced by tenant behavior, background checks, and post-COVID caution, adding a layer of complexity. Energy, an often overlooked aspect, plays a significant role in the lives of low-income households. Energy equity issues can impact overall well-being, and transitioning to renewable energy sources introduces new challenges for rural communities. While there is no one-size-fits-all solution, the interviews have shed light on several potential strategies, including transitional housing with comprehensive support services, individualized case management, and the Housing First model. Collaboration between local, state, and federal levels is essential to develop and maintain low-income housing, streamline regulations, and implement policies and programs to reduce homelessness.

In conclusion, rural homelessness is a complex issue that demands a holistic and community-driven approach. By recognizing the diverse challenges, addressing root causes, and fostering collaboration, we can work towards comprehensive solutions that provide stable housing and improve well-being for those experiencing homelessness in these counties. This research is a foundation for future projects and initiatives, offering hope for positive change in the fight against rural homelessness.

Research Fellow: **Halle Kuhar-Pitters (2024)** **Concentration:** **Environmental Studies**
Faculty Mentor: **Catherine Cardelús** **Department:** **Upstate Institute**
Title of Project: **The Problem with Coming Home: Addressing the Adirondack Housing Crisis**
Funding Source: **Upstate Institute**
Project Summary:

Over the last two decades the Adirondack region, like most of the nation, has and continues to experience rising housing unaffordability. Local residents, especially those in the median-income or workforce socioeconomic category cannot afford housing where they are employed and unable to access services such as New York State housing aid or loans. Over the summer I tackled this multifaceted issue by researching housing solutions currently being implemented in the park. I was looking at how these projects came to fruition so that other communities and individual stakeholders knew what steps to take to develop housing solutions in their communities. I did this by identifying housing developments that focused on the workforce sector, specifically projects that targeted those who made between 80 and 120% area median income which do not qualify for New York State Section 8 housing assistance, however they are also unable to compete on the regular housing market which had increased by more than 10%. The last decade has seen a heavy influx of people into the region from urban centers, a movement only enhanced by the 2020 Coronavirus pandemic. Through a series of 8 qualitative interviews and associated literary research I compiled a list of suggestions for potential housing projects with the best chance for success in the adirondack region.



The results of this inquiry (see photo a) was summarized into 3 main categories: physical pre-development needs, financial pre-development, and social pre-development needs of a housing project.

that communities and stakeholders should first identify the needs of a community for a housing development, the capacity they have not only for the physical project but also financial support prior to developer intervention. This should be followed by the development of a financial strategy or at the very least consultation to ensure that costs match the physical development planning. Throughout these initial interviews, I learned that ensuring public approval and interest was crucial to the successful completion of the project. ;only after all these considerations have been made should project leaders reach out to a developer.

My findings support that housing is needed throughout the park and the current housing stock does not meet the needs of residents. The increase of short-term rentals, longer more costly commutes, and out-migration are forcing residents to choose between housing and basic utilities such as food, water, and childcare. Moreover, I found that local residents wanted to pursue housing solutions but were stuck in terms of access to resources to move toward development. Altogether, this case study contributes to work begun with the Adirondack Foundation and their 'A Place To Start' housing solutions document made in partnership with the nonprofit, the Northern Forest Center, on improving housing, especially workforce housing offering solutions to help close the Adirondack affordability gap.

Research Fellow: **Ege Kutlubas (2024)** **Concentration: Physics**
Faculty Mentors: **Ramesh Adhikari** **Department: Physics and Astronomy**
Ken Segall **Department: Physics and Astronomy**
Title of Project: **Optical and Electrical Properties of Methanol Layered Phenylalanine - PEDOT:PSS Thin Films**
Funding Source: **Justus '43 and Jayne Schlichting Student Research Fund**
Project Summary:

Poly(3,4-ethylenedioxythiophene) polystyrene sulfonate (PEDOT:PSS) is a polymer that becomes electrically more conductive with the addition of certain organic materials into it with different methods. One example is the aromatic amino acid called L-Phenylalanine (L-Phe). Past research suggests the improvement of electrically conductivity of PEDOT:PSS thin films (<600 nm) when mixed with L-Phenylalanine. Combined with the application of methanol, PEDOT:PSS & L-Phe thin films become more transparent, and electrically more conductive, making them a potential biodegradable alternative to indium tin oxide in photovoltaic cells.

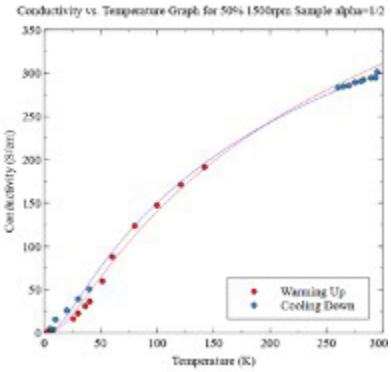


Figure 1: Temperature Dependence of Conductivity

The dark blue color of PEDOT:PSS becomes less dominant when mixed with L-Phenylalanine solutions, and the application of methanol on thin films allows excess PSS to be removed from the film through evaporation, increasing the transparency of the film. The enhancement of the charge transport via removing the excess PSS and linearizing the PSS chains can be seen with the evident 1D variable range hopping charge mechanism seen in the temperature dependence measurements in Figure 1. The L-Phe mixed thin films with methanol application closely follow Mott's Law with an alpha value of ½.

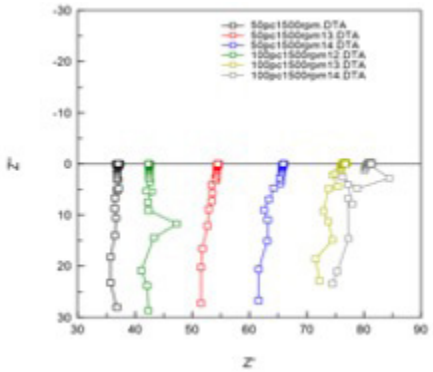


Figure 2: EIS Graph of 50% L-Phe - 100% PEDOT:PSS Thin Films

Electrochemical Impedance Spectroscopy (EIS) gives insight into the enhanced charge transport with the addition of methanol and L-Phe. Base solution thin films of PEDOT:PSS exhibit capacitive behavior, which is eliminated from the methanol-applied samples in Figure 2, shown with the lack of semicircular graphs.

In light of these findings, the potential applications of PEDOT:PSS & L-Phe thin films as biodegradable transparent electrodes, combined with the enhancement with methanol can be investigated further with the now evident charge transport mechanisms.

Research Fellow: Che Ku Kyet (2024) **Concentration:** Molecular Biology

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

Title of Project: Centering Pregnancy within a Refugee Population

Funding Source: Upstate Institute

Project Summary:

My time at The Center was spent researching the Centering Pregnancy model. Centering Pregnancy is a prenatal care model that is focused on group prenatal care rather than the traditional individualized care that is most common in western medicine. Centering Pregnancy has been successfully implemented within the Mohawk Valley Health System. Now the Mohawk Valley Health System is hoping to expand this model of care to the regional refugee population. This summer, I was tasked with researching traditional models of prenatal care that is practiced within the Karen, Afghan and Congolese populations. Furthermore, I looked into how their status as refugees could impact their overall health and their response to the US medical system as a whole. The result of my project was a report that listed traditional prenatal care practices and the struggles pregnant refugee women face. Within that report, I also included suggestions to help health care providers bring more cultural consciousness to their services by acknowledging and including the cultures of the populations listed above. For example, some of the suggestions that I provided were; when talking about nutrition and good eating habits, it is helpful to speak on the matter using examples from culturally familiar food because that is mainly what they will be consuming in their homes. With the research that I did for The Center, they will be able to work with MVHS to provide culturally appropriate care that listens and acknowledges the experiences of refugee populations.

Research Fellow: Pierce Leclerc (2025) **Concentration:** Geology

Faculty Mentor: Aubreya Adams **Department:** Earth and Environmental Geosciences

Title of Project: Deep Earth Imaging of the Alaskan Subduction Zone

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

Project Summary:

The southern margin of Alaska is the home of one of the largest subduction zones in the world, containing the Pacific Plate and the North American Plate, with the former continually subducting beneath the latter. This convergent boundary causes an enormous amount of volcanic and seismic activity – but this activity is not entirely consistent across the boundary. Some areas endure high-magnitude earthquakes, while other areas are much more mellow. The primary objective of the study is to determine what factors beneath the surface, such as fluid and gas flow, could be causing this variability in seismic behavior. Another objective is to create models which visualize collected data to pinpoint the potential locations of these structures. Data was collected from 105 deployed seismic stations along the southern margin during an experiment from 2018-2019 and was subsequently sorted into data files. A previous model displaying variations in shear wave velocity was updated, and a second model was created which allows visualization of different types of data along any input line, from the perspective of any input axis. Both models were created using Unix scripts and Generic Mapping Tools (GMT).

The first model, a 2-D surface plot mapping [longitude] x [latitude] x [shear wave velocity or radial anisotropy], is an updated version of a previous model that required two files to be precompiled prior to execution. The new model does not require precompilation via Fortran and requests a single file pertaining to an input depth, which contains a column of data for each dimension. The second model contains two plots – a 2-D plot of Alaska mapping [longitude] x [latitude] as well as an input line, and a 2-D surface plot mapping [longitude or latitude] x [depth] x [shear wave velocity or radial anisotropy], depending on the desired axis view and data file. Given a starting point and end point for the line, the model takes a data file with format [longitude] [latitude] [depth] [shear wave velocity or radial anisotropy] and uses nearest neighbor interpolation to create a 2-D surface plot from the interpolated data along the input line. The model was designed to be highly flexible; it can utilize any type of fourth-column data, plot from the view of any cardinal direction, and has a precision of up to 0.1 degrees latitude or longitude. This can allow for the creation of videos demonstrating the change in fourth-column data over specific distances, with a frame rate corresponding to the desired level of precision.

Research Fellows: Chunjiang Li (2024)
James Njoroge (2025)

Concentration: International Relations
Concentrations: Applied Math; Computer Science

Faculty Mentor: Will Cipolli
Department: Mathematics

Title of Project: Data Science Collaboratory Project

Funding Source: NASC Division

Project Summary:

Addressing the complexities inherent in traditional statistical platforms, our team engaged in the development of user-friendly web applications for statistical analysis, leveraging the R Shiny framework. This initiative equips individuals, irrespective of their programming background, with intuitive and robust tools for constructing, visualizing, and interpreting advanced statistical models.

Our focus was on enhancing existing functionalities and optimizing the user experience through the addition of pivotal features. We ensured that each application delivered accurate and comprehensive data output. Rigorous code maintenance, unit testing, and uniformity checks across all applications were also conducted to adhere to contemporary coding standards.

Expanding beyond our primary objectives, we developed comprehensive applications to perform One-Sample, Two-Sample, and K-Sample Population Variance tests. These applications seamlessly manage the entire analytical workflow, from data summarization and preprocessing to the deployment of sophisticated techniques such as bootstrapping and permutation tests. A conscious emphasis on user-friendliness ensures these applications are accessible to a broad audience, ranging from experts to novices in the field.

This multifaceted experience has enriched our capabilities in programming, statistical analysis, and user experience design.

Research Fellow: Justin Li (2025) **Concentration: Applied Math**
Faculty Mentor: Silvia Jimenez Bolanos **Department: Mathematics**
Title of Project: Neutral Inclusions and Cloaking
Funding Source: National Science Foundation
Project Summary:

In this project, the problem of determining nonlinear neutral inclusions in (electrical or thermal) conductivity is considered. Neutral inclusions, inserted in a matrix containing a uniform applied electric field, do not disturb the field outside the inclusions. The well known Hashin coated sphere construction is an example of a neutral inclusion. The project deals with constructing neutral inclusions from nonlinear materials . In particular, assemblages of circular inclusions with spiraling laminate structure inside them with a nonlinear core are studied and their effective (electrical or thermal) conductivity is found.

Introduction: Neutral inclusions is simply being “invisible”. This could be researched by some particular laminate structure assemblages which allows: when electric fields penetrate the structure, it bends/reflects and eventually when it leaves the structure, the electric field points to the same direction just as when it did not enter the sturcture. Under such circumstances, if one is detecting on the side that accepts the electric field, the laminate structure would not be noticed since the pattern is the same as if it wasn’t there: Invisibility is successfully reached.

One of the basic structures that could achieve “invisibility” is the Hashin coated sphere construction. The structure is simply 2 concentric circles; the inner circle, which is known as the “core” has conductivity $\sigma 1$ and the area between the outer circle and the inner. Known as the “coating” has conductivity $\sigma 2$. Through calculations using Differential Equation, a ratio of $\sigma 1$ and $\sigma 2$ is calculated such that the electric field bends/reflects till the pattern stays the same before and after it enters the structure; the effective conductivity is found. Furthermore, when the core material is non-linear, invisibility still holds.

The summer project then explored the feasibility for a more complicated structure with a nonlinear core and a linear spiraling laminate structure on the coating. After tremendous reasoning and calculation, the effective conductivity is found and this assumption is eventually verified.

Research Fellow: **Alexa Lim (2025)** **Concentration:** **Environmental Studies**
Faculty Mentor: **Catherine Cardelús** **Department:** **Upstate Institute**
Title of Project: **Adirondack Center for Loon Conservation**
Funding Source: **Upstate Institute**
Project Summary:

The Adirondack Center for Loon Conservation is a research facility working to protect and research Loons. Loons are a diving bird that are considered a symbol of the Adirondacks. Loons are an indicator species as their status reflects that of the entire ecosystem. Even though the Loon population has been steadily increasing after the mitigation of harmful pollutants like mercury, they continue to be negatively impacted by human encroachment on their habitat and climate change. Fluctuations in water levels threaten nesting sites, as Loons nest along the shoreline, as does human development along the humans shoreline, These continued threats highlight the need for our conservation efforts to ensure their populations can thrive.

The Loon Center fills a critical gap in the region by monitoring Loon populations as well as educating the community on their role in the ecosystem. The Center for Loon Conservation has monitored the status of Loon populations in the region since 1998 and has conducted research studies, such as monitoring their migration patterns and mating habits. It is also committed to engaging with the community to teach the public about Loon behavior and habits. Community engagement is vital for conservation efforts.

This summer, I observed Loon behavior and leg bands by kayaking on lakes and ponds. Leg bands are metal bands wrapped around Loons legs right above the foot; each Loon has a unique color combination and number on the leg which identifies the individual Loon. This banding information informs behavior, such as preferred lake, mating patterns, and migration patterns. I also monitored the nesting patterns and survivorship of chicks. Unfortunately, of the four nests I monitored, I observed only one successful nest with one chick hatched, but this chick was soon predated. These data contribute to the research efforts conducted at the center to continue conservation efforts and learn more about Loon behavior.

For one week in July, the Loon conservation team goes out onto various lakes throughout the Adirondacks to band loons. Loon capture and banding efforts occur from sunset to sunrise. When a Loon is captured we collect blood and feather samples and take general body measurements. These data give us information about their health, such as pollutant and parasite load.

When I was not out on a lake, I also worked to engage with the visitors in the Loon Center located in Saranac Lake. There, I created and distributed a survey about Loon courtship and nesting to gauge visitor knowledge. The results were used to curate the up-and-coming exhibits: Year in the Life of a Loon. The exhibit details a Loon’s life, including a section dedicated to their courtship and nesting behavior. The center is a key part of our project, as it works to educate anyone who comes through Saranac, ranging from tourists who have never seen Loons to people who help us monitor the Loons.

Research Fellow: Adam Limoges (2024) **Concentration:** Environmental Biology
Faculty Mentor: Tim McCay **Department:** Biology; Environmental Studies
Title of Project: Impact of Jumping Worms on Leaf Litter Decomposition Rates of Prominent Tree Species in Northern Forests
Funding Source: NASC Division
Project Summary:

Jumping worms (Amynthas agrestis, Amynthas tokioensis, Metaphire hilgendorfi) are invasive species of earthworm to the Northeastern United States and the Northern Forest. My aim is to contribute to the growing knowledge of how these worms are impacting the newly invaded forests they inhabit. Hendricksen (1990) showed how detritivore earthworms prefer certain litter types and have impacts on the composition of the leaf litter layer of the forest floor. This study focuses on determining if jumping worms are increasing the rate of beech, maple, and oak leaf litter decomposition on the forest floor in the Northern Forest (NY and VT). The experiment is designed so that differences in leaf species can also be analyzed to see if there is a preference for or against certain species and what that may mean for nutrient cycling in these forest ecosystems. This experiment is currently ongoing and should conclude at the end of Spring 2024.

For this experiment leaves were collected from the Adirondack Park within the Northern Forest and sorted by species (beech, oak, and maple). The rate of leaf litter decay was estimated using the litter bag method (Falconer et al. 1933). For each species, 4.0 g were placed in an even layer in 12”x12”x1/4” mesh bags, woven shut, and labeled. These were placed in the Northern forest at Camel’s Hump State Park, Green Mountains Audubon, Shelburne Farms, Gull Bay Preserve, and Roger’s Rock Campground Area. Each location had a set of paired sites, one invaded with jumping worms and the other with no jumping worms. At each site litter bags were arrayed in three 3x7 rectangular grids, with each being 2.5 m from a central tree and equally spaced radially (Figure 1). Existing leaf litter was brushed away and then replaced on top of the bags after placement. Bags were staked down using a single ground staple through the corner of each bag. At every site, three litter bags of each leaf species, one from each rectangular array, were collected initially to control for handling and then each subsequent month for handling. There was also a collection in the Spring. The collected samples were placed in Berlese Funnels for four days and any invertebrates were collected and preserved in ethanol. Samples were then transferred to drying ovens kept at 60-65 degrees Celsius for two days, or until a constant mass was achieved. Samples were then weighed to obtain the final mass. The difference in the initial leaf litter mass to the final leaf litter mass was calculated and a one-way ANOVA blocked by site was used to determine if there were significant differences between invaded and non-invaded sites. Climate also has impacts on decomposition rates so climate data will be collected and invaded sites and worm free sites being paired controls for variability due to climate and local weather.

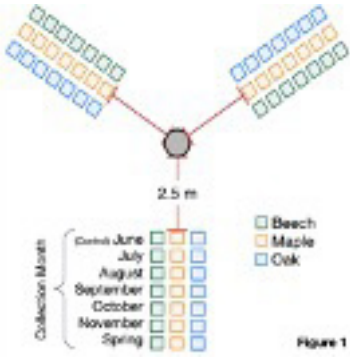


Figure 1

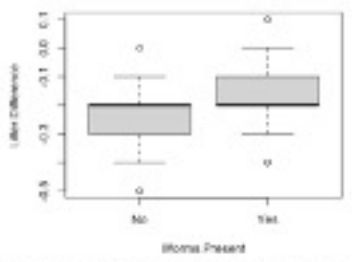


Figure 2: Mass of leaf litter lost across treatment groups within the control group for handling. The group means of -0.25 g for no worms present and -0.18 g for invaded sites differ (p = 0.0028).

The average amount of litter lost in the control for handling was 0.21 g. However, the amount of litter lost in the groups placed at sites with jumping worms was lower than that of the bags placed at sites without worms, yielding losses of 0.18 g and 0.25 g, respectively (Figure 2). There is a 0.28% chance we would observe this by chance alone. Since the loss in the non-invaded sites is higher than that of the invaded sites and we predict that the opposite effect will occur with the treatment of jumping worms, any significant results going forward where more mass is lost in bags collected from invaded sites will still hold true, since the adjustment from the control will slightly decrease the chance of a significant result.

Research Fellow: **Faye Liu (2026)** **Concentration:** **Undeclared**

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

Title of Project: **Enhanced Catalyst Development for Non-Racemizing Epoxide Hydrogenolys**

Funding Source: **National Science Foundation**

Project Summary:

The Chianese lab focuses on the development of improved catalysts for non-racemizing epoxide hydrogenolysis. The current catalyst, Milstein's catalyst, exhibits practical limitations, necessitating the search for the next generation of catalysts. Our primary objective is to improve catalyst efficiency and cost-effectiveness, while maintaining a high branched selectivity and preventing racemization. We have synthesized and evaluated three potential catalysts, as depicted in Figure 1.

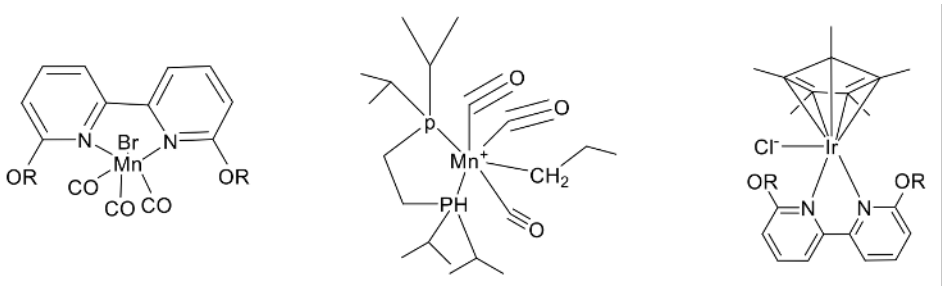


Figure 1. Metal complexes to synthesize for epoxide hydrogenolysis. R = H or Me

Our methodology involves testing the branched-selective efficiency of catalysts. To achieve this, we first synthesize the catalyst and then prepare reaction solutions containing the catalyst, substrate, and a base. These solutions undergo an 18-hour reaction under 30 bar hydrogen pressure within a Parr reactor. Subsequently, gas chromatography (GC) is conducted for the reacted solutions. These chromatograms reveal distinct components in the solution, including the solvent, branched and linear products, and residual starting reactant. By integrating corresponding peaks, we are able to determine the ratio of branched to linear products and calculate hydrogenation yields.

For instance, according to the hydrogenation outcomes of the IrCp*-bpy-Cl catalyst, calculations indicate that the catalyst with the O-H ligand exhibits higher percent yields in comparison to the variant with the OMe ligand. In addition, both catalysts are able to work without the base but the yields are all lower than 15%. Furthermore, increasing the catalyst quantity can increase the yields, but it also results in more solvolysis byproducts.

Overall, the interplay of factors during hydrogenation such as temperature, substrates, bases, and solvents can exert influence on hydrogenation outcomes. Our forthcoming steps involve expanded experiments to find out the relationships between these variables and the catalyst's hydrogenation yield and the branched-to-linear product ratio.

Research Fellow: Bill Luo (2026) **Concentration:** Undeclared

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

Title of Project: Time Delay Quantum Eraser

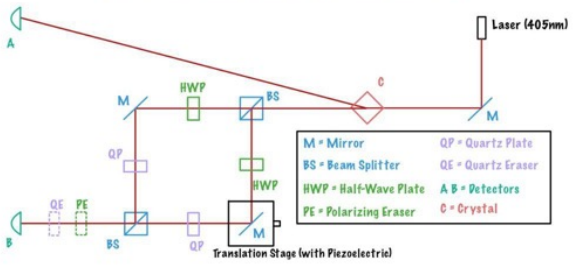
Funding Source: Justus '43 and Jayne Schlichting Student Research Fund

Project Summary:

Introduction: In the lab, light is typically distinguishable through its polarization. That is, light that oscillates horizontally will be distinct from light that is vertically oscillating. This summer, I tested a new method of distinguishing light using time delays. The results will prove useful for future experiments involving the quantum properties of light, specifically how light waves interact in a quantum sense when they meet.

Theory: Light travels at almost maximum speed through free space (in air). But we can slow down light by passing it through a medium depending on the medium's index of refraction. Moreover, white light—light that comes from common everyday objects—is unpolarized, but we can polarize it by propagating it through a filter, or polarizer, which absorbs the light depending on its orientation. Birefringence combines these two ideas. Light that passes through birefringent material will be refracted by different amounts depending on their polarization, thus creating a delay between light between the vertically polarized and horizontally polarized components. In our apparatus, we used birefringent quartz to incorporate this concept.

Apparatus: We sent a beam of down-converted photons through a Mach-Zehnder Interferometer setup. The 50-50 beam splitters allow equal amounts of light to pass through each arm, and there are half-wave plates (HWP) and quartz plates (QP) placed symmetrically along each arm. To the left of the apparatus are detectors that count photons over time. If photons are detected by Detectors A and B within a small time window, they will be correlated photon pairs. Using this data, we can rotate the HWP and QP of the top arm to make the light distinguishable or indistinguishable by either polarization or arrival time, or both. The bottom right mirror of the setup is mounted on a translation stage which is moved via a piezoelectric, changing the arm length; this will make the light waves be at different phases when they meet, and the photon count will show interference patterns if the waves are indistinguishable. Lastly, there is a polarizing eraser (PE) and a quartz eraser (QE) that are switched on or off in front of Detector B, which reverse the distinguishability of the light caused by rotating the HWP and QP.



Experiment: We collected data with our apparatus on 5 different settings to test if the delay made the photons distinguishable. First, with both arms identical and all erasers out, the photon count showed an inference pattern. Second, we turned one HWP to 45o, which rotates the propagated light to vertical, so that one arm is orthogonal and delayed from the other, leaving no interference pattern. Next, we switched on the PE, polarizing all light to be diagonal, but leaving the delay, making the light distinguishable. In the last two tests, we erased the delay by either turning the QP 90o so the vertical light was no longer delayed, or switching on the QE so that the delay was reversed before the light arrived at Detector B. The experiment demonstrated a type of "quantum eraser" not considered previously.

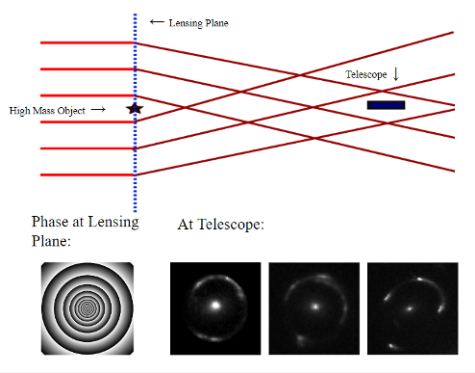
Research Fellow: Eli Mayes (2026) **Concentration:** Undeclared

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

Title of Project: Retrieval of Einstein Beams from Astronomical Images

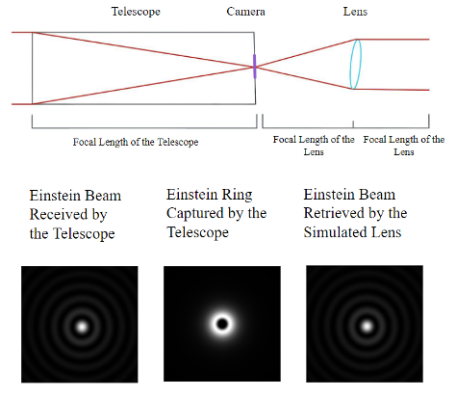
Funding Source: Justus '43 and Jayne Schlichting Student Research Fund

Project Summary:



As light passes by a high-mass object, such as a black hole or star cluster, the light bends around the object causing a lensing effect known as gravitational lensing. This phenomenon is seen in space through our observation of Einstein rings and crosses in deep-field astronomical images. In previous investigations, we have replicated this lensing effect in the lab using a laser, a Spatial Light Modulator, and optics. We have also created a mathematical model that depicts how the beam looks after the lensing plane. We call this beam an Einstein beam. In this investigation, we are using astronomical images to test whether the relationship found in the lab accurately depicts gravitational lensing as observed in space.

To begin our investigation, we searched for images of Einstein Rings taken by the Hubble Space telescope. Once several images were located, we isolated the Einstein Ring in the image and created a filter to remove extraneous stars. In order to retrieve the Einstein beam from the observed ring, we took the astronomical image and passed it through a simulated lens in Matlab which has the effect of taking the Fourier transform (a mathematical operation that decomposes an image/wave into its sine and cosine components). This allows us to retrieve the intensity profile of the Einstein beam observed by the telescope.



Using the mathematical model discovered in the lab, we were able to obtain a predicted intensity profile from each of the images of the Einstein rings observed in space. We compared the predicted intensity profiles with the intensity profiles observed by the telescope. In so doing, we found that two of the observed Einstein rings very closely matched their predicted intensity profile. Because this study has produced results consistent with the mathematical model discovered in the lab, it is important to continue searching for additional images in order to strengthen our findings.

Research Fellow: **Matthew McGeary (2024)** **Concentration:** **Geography**
Faculty Mentor: **Julie Dudrick** **Department:** **Upstate Institute**
Title of Project: **Friends of Rogers Environmental Education Center**
Funding Source: **Upstate Institute**
Project Summary:

I undertook a new endeavor this summer as a Field School Fellow started by Ellen Rathbone at Rogers Center, in Sherburne NY. The project aimed to inventory the ever-so-important bumblebees present at Rogers Center and CNY, and the initiative is fittingly called The "B-Team." The goal of the project was to utilize community science based software, iNaturalist, to create an inventory of the native species of bumblebees in the area. The B-Team project was conceived because there is a serious decline of native bees in the United States, and New York State as a whole. These insects are imperative for the local agricultural economies, as well as the local ecosystems.

Northern Amber Bumblebee (Bombus borealis), Photo taken 07/06/2023 by Matthew McGeary

I was tasked with the startup and initial research for the B-Team. I organized the project, set data guidelines, started the promotion of the project, and laid the foundation for a hopefully long-term project at Rogers Center. We aimed to inventory the bumblebee species in Central NY, and the focus of my work specifically is inventorying the species present at Rogers Center, as well as helping to organize the data being gathered through the B-Team's wider project on iNaturalist, that targets all of Central New York. To address the decline in the bee population, we must first inventory and conceptualize exactly what is happening. I walked miles a day collecting important data, and found a population of Northern Amber Bumblebees (Bombus borealis), which is considered a critically imperiled species in NYS. This is a big find for the B-Team, and could lead to future grants. Recently we've been awarded a grant for Pollinator Habitat Restoration, in which we plan to re-seed the Adam's Farm parcel of Rogers Center with native wildflowers (bumblebees and other native pollinators food of choice), replacing the invasive species of honeysuckle, Dame's Rocket, and garlic mustard. Invasive species of plant life taking root where they shouldn't, is yet another problem the environment faces in tandem with climate change. My final deliverable for Rogers Center was a story map that I created using ESRI's ArcPro GIS software. This story map has been published, and will soon live on the Rogers Center website. This story map introduces the B-Team to the world, illustrates the importance of the project, emphasizes community participation, and shares the initial findings of the B-Team. At the conclusion of my research, I left Rogers Center with all of my materials, methods, and data, in hopes that the Upstate Institute continues its work with Rogers Center as a community partner, and my hope is that someone can pick up where I left off, and continue the B-Team work.

Research Fellow: Corey McLaughlin (2024) **Concentration:** Environmental Economics
Faculty Mentor: Julie Dudrick **Department:** Upstate Institute
Title of Project: Unjust Costs of Energy Efficiency for Nonprofits
Funding Source: Upstate Institute
Project Summary:

The Bell Tree, Inc. is a nonprofit that functions as a community center for Earlville and surrounding towns, providing a safe space for families with young children. It offers different kinds of programs and activities for both children and adults, especially around the holidays. After opening in 2019, the COVID-19 pandemic set back the organization's ability to provide programming and community support. The Bell Tree serves local residents well, but its budget is limited while its mission is crucial for children's development and community strengthening. In addition, the organization is run by a volunteer board and has no current staff; these dedicated volunteers are unable to constantly provide the capabilities needed for improving the organization.

Not-for-profit organizations in Upstate New York like The Bell Tree struggle to fund projects on their own. Especially in areas with little business and a smaller population size, nonprofits mostly rely on the community around them and funding opportunities offered by the state of New York or local foundations. Both federal and state policies are shifting towards limiting oil and gas usage to reduce carbon emissions, but it can be difficult and costly to make these changes.. Incentives, such as tax credits and grants, are often aimed towards households and businesses, leaving few opportunities for nonprofits.

While working for The Bell Tree, I assessed an audit already done by NYSERDA (New York State Energy Research and Development Authority). After looking at the organization's current energy costs and potential costs for installations, I looked into grant opportunities for The Bell Tree to utilize in the near future. I worked closely with Professor Globus-Harris to analyze the costs of several energy-efficient options, including solar power, HVAC systems, and LED lighting. Professor Globus-Harris teaches Environmental Economics at Colgate, and she assisted me in my research while providing advice for The Bell Tree. After understanding the expensive costs, we turned to Bruce Moseley, who worked in Colgate's grants office for 15 years. He introduced me to the National Register of Historic Places that identifies Earlville as a Historic District. He also pointed me towards the New York State Preservation League and Community Foundation, which are two potential funding sources. The resources Bruce Moseley shared with me will contribute to the journey of sustainability and greater energy efficiency for The Bell Tree. However, this will be a difficult path due to the obstacles small nonprofits face when attempting to improve their infrastructure.

The upfront costs required for installing environmentally-friendly equipment are usually very high, but they are worth the long-term benefits, such as lower future expenses and reduced carbon emissions. Potential upfront costs can be covered by loans and grants. However, most local foundations require the grant recipient to pay the costs upfront and get reimbursed by the foundation after the installation or renovation is complete. In order to successfully obtain grants that may fund the project from the start, nonprofit organizations often must submit lengthy applications and meet onerous qualifications, such as a minimum energy usage for lighting, heating, cooling, etc. Incentives for US citizens to use more energy-efficient technologies involve tax credits and rebates offered by the federal and state governments. Tax credits are not an option because nonprofits are tax-exempt, and rebates are more frequently targeted towards households or businesses. Rebates for nonprofits are rare and have strict requirements. The Bell Tree does not plan on abandoning their goal, but the process requires a lot of time and money. Policy change and new incentives may be the solution for nonprofits like The Bell Tree as they work to achieve greater energy efficiency, but such technologies need to be more affordable and accessible to everyone.

Research Fellows: **Stella Miao (2025)** **Concentration: Geology**
Tom Richards (2024) **Concentration: Biochemistry**
Faculty Mentor: **Karen Harpp** **Department: Earth and Environmental Geoscience; Peace and Conflict Studies**

Title of Project: **A Geochemical Investigation of the Galapagos Mantle Plume**

Funding Source: **National Science Foundation; Justus '43 and Jayne Schlichting Student Research Fund**

Project Summary:

There are two complementary projects in our study, "A Geochemical Investigation of the Galápagos Mantle Plume," both focused on the eastern Galápagos. The Galápagos Archipelago consists of a chain of volcanic islands in the eastern Pacific that forms as the Nazca plate travels east over a mantle plume. This region is populated by a few islands, some drowned islands, and many seamounts (submarine volcanoes). Research questions focus on understanding the structure of the Galápagos plume and how the plume contributes to the growth of a variety of different volcanic edifices in the eastern part of the archipelago.

The first project uses the 5-10 Ma Eastern Galápagos Platform Carnegie Ridge (EGPCR) rock samples to investigate plume structure and dynamics as the Nazca plate moves eastward, away from the plume center (near Fernandina Island). Our work focuses on two primary research questions: a) Do volcanoes on the northern and southern margins of the EGPCR represent secondary magmatism, occurring after the plate has moved away from the plume's influence; and b) How is the surficial expression of a compositionally zoned mantle plume affected when located beneath a mid-ocean ridge and what does this tell us about plume structure? Specific methods to address these questions include the use of high-resolution ^{40}Ar-^{39}Ar radiometric dating, major and trace element content determination, and Sr-Nd-Pb-Hf isotopic ratio analysis. If age data indicate that the seamounts are 5-10 Ma, they may have been formed by the plume; if they are considerably younger, secondary magmatism may be responsible for their formation. Work on this project will continue over the next year.

The second project is a comparison of the two oldest Galápagos islands, Española and San Cristóbal, to understand the role of the nearby mid-ocean ridge in eastern island construction. Española is ~45 km south of San Cristóbal, with lava flows erupted only between 2.63 and 3.17 Ma. San Cristóbal emerged ~2.3 Ma, but has been intermittently active as recently as 5 ka. Geochemical analyses of lavas from both islands indicate that Española's magmas exhibit less compositional variation and were generated at greater depths by more melting than those from San Cristóbal. This observation suggests that the magmatic plumbing system supplying Española may be hotter, with a higher magma supply than at San Cristóbal. We propose that because of its position on the southern edge of the archipelago, Española was exposed to less influence from the ridge than San Cristóbal during its construction. Data being used to test this hypothesis include radiogenic isotopic ratios, major and trace element analyses, and radiometric age determinations. Work on this project continues throughout this year.

Research Fellows: **Anna Miksis (2025)** **Concentration: History**

Katie Moser (2024) **Concentration: History**

Faculty Mentor: **Heather Roller** **Department: History; Environmental Studies**

Title of Project: **A Social and Environmental History of Agrichemicals: California, New York, and Iowa**

Funding Source: **SOSC Division**

Project Summary:

This summer, we assisted Professor Roller in conducting and collecting research for her upcoming book on the experience of rural peoples in dealing with the chemicals associated with agriculture (specifically herbicides, insecticides, and fungicides). She asks the question: how, over the past fifty years, have these farmers and growers made the decisions to use such substances on the land, and how has it affected their relationships with their families and neighbors? To answer such a question, we looked at online oral history collections held by UC Santa Cruz, University of Kentucky, and SUNY Oneonta; we traveled to Iowa and looked at physical documents in both the Iowa State University and Iowa University archives; we searched online newspaper collections; and we conducted nine in-person interviews with conventional and organic farmers.

The online oral history collections we worked with varied from commercially successful artichoke growers in California to struggling tobacco farmers in Appalachia. As we read and listened to stories of chemical use across generations, memories of exposure, and farmers' opinions of agrichemical use, we took careful notes, pulling out themes and patterns we noticed in these interviews across the diverse range of farmers whose stories we consumed. The other digital component of our research included combing through digitized newspapers from New York, Iowa, and California to find articles, farmer profiles, and Letters-to-the-Editor that centered farmer voices and opinions on agrichemicals. We compiled our notes in the database program called Zotero.

In looking at physical documents, our first step was to travel to Cornell's Rare and Manuscript collections in order to look at numerous boxes of oral histories collected by the university's study into Farm Decision making. Not long after, we flew to Iowa, where we stayed for two weeks working in an archive each in Iowa City, courtesy of the University of Iowa Special Collections, and one in Ames, at Iowa State. In both we spent time looking at documents from the Voices of the Land collection, which focused on farm women's recollections of the farm crisis in the 1980s, as well as the correspondence, assorted papers, and pamphlets of university employees. Once we had worked our way through the boxes of documents we took to the stacks, flipping through bound collections of the farming publications *Wallaces Farmer* and *Successful Farming*, looking for pesticide ad campaigns and changing attitudes on the use of chemicals between the 1970s and today. In addition to looking at oral history interviews, we also conducted our own, learning how to successfully interview people—and how satisfying it is to be able to ask our own questions. Ranging from conventional to organic, corn and beans to grapes, our interviews spanned the Iowan corn belt and the New York Finger Lakes. We climbed in tractors, trucks, and atvs as we toured corn farm after vegetable farm, talking to farmers about the chemicals they use or don't use—and just how those decisions were made. Some were pragmatic, some morally complex. For every interview, we took extensive notes, and grew more enamored with the organization known as the Practical Farmers of Iowa. Once, we were even interviewed ourselves! Host of Buggyland, Mary Swander, got us both on her podcast and in the newspaper.

As we researched in each collection, we discovered patterns and themes, learned new vocabulary and heard new ideas, and expanded upon a research project that has taken us across time, across the country, and through the minds and decision making processes of over a hundred people as they chose to use dangerous agrichemicals.

Research Fellow: **Mostafa Mohamed (2024)** **Concentrations:** **Philosophy; Economics**
Faculty Mentor: **Joseph Stenberg** **Department:** **Philosophy**
Title of Project: **Immanent Realism in the Medieval Era: Islamic and Christian Discussions**
Funding Source: **Center for Freedom and Western Civilization, James Madison Fellow**
Project Summary:

It would seem true that Socrates is a human being and Al-Ghazali is a human being. But what explains why the term 'human being' applies to both and what exactly do they share which makes that true? In virtue of what are they both human beings? Giving an adequate account to this question of predication and others is, at best, a difficult journey. This set of questions came to be known as the problem of universals, in part because the Latin term, '*universalis*,' can mean *having general application* and many of the terms we use and the properties they pick out apply to many things. As a result, when a medieval thinker took a view on the nature of universals, they were taking a view on what explains the general applicability of terms such as 'human being,' 'black,' or 'round' to a range of things and what makes claims about such things true or false.

The attempted solutions to this problem range from transcendent realism, which holds that these universals are real, mind-independent entities that exist within an eternal and immaterial world. This was made famous by Plato, who posited that there existed a transcendent realm, a world of forms, where these universals exist; for example, as Plato would have it, there is a single form of 'humanness' in which both Socrates and Al-Ghazali participate. Through this participation in an external and immaterial form, both men are of the same kind of thing, 'human.' This is contrasted with the nominalist position, stemming from the Latin '*nomen*,' name. This position holds that universals as mind-independent entities do not exist. Rather, universals are merely names we impose on things, names that can be truly predicated of many things. In this view, there is each particular thing, say, Socrates and Al-Ghazali, and, due to similarities, we impose a word to capture the fact that they have certain similarities - in this case, the word 'human.' There exists, however, no underlying essences or forms that bind these particulars together.

Both these answers to the question face their challenges. Partially for that reason, a third attempted solution held sway among many medieval thinkers, immanent realism. This position, like transcendent realism, holds that universals do exist independently, however, they do not exist within some world of forms. Instead, universals are wholly present within the particular things which instantiate them. The property of humanness is therefore present in Socrates and Al-Ghazali, and every other human. This explains our shared species, while not creating an abstract realm to do so. Drawing upon three of the most influential contributors from the Christian and Islamic worlds, Boethius, Avicenna, and Aquinas, this paper will first explain their positions, display the arguments they provide in support of their immanent realism, and finally highlight the philosophical and theological advantages of this position.

Research Fellow: **Tilly Morris (2025)** **Concentration:** **Biology**

Faculty Mentor: **Tim McCay** **Department:** **Biology; Environmental Studies**

Title of Project: **The Effect of Invasive Earthworms on Northern Forest Tree Growth: A Mesocosm Study**

Funding Source: **NASC Division**

Project Summary:

This greenhouse experiment examines the effect of jumping worms, European worms, and the combination of the two on the growth of four tree species native to the Northern Forests of the Northeastern United States. Because of their ability to impact both above and below ground environmental elements, invasive earthworms are capable of significant ecosystem disruption. Areas that originally did not have any earthworms, like some of the Northern forests in the Eastern United States, are especially vulnerable to negative impacts from Earthworm invasion. Invasive European earthworms, like *L.terrestris*, first invaded North America following European colonization and have since been linked to ecological disruptions. Three other species of earthworms that originated in Asia, *Amynthas tokioensis*, *Amynthas agrestis*, and *Metaphire hilgendorfi*, commonly referred to as jumping worms, have since become increasingly present across North America, as well. These three species tend to invade together, and have been found to significantly alter soil in invaded areas. Physiological differences between European and jumping worms imply that they may have different ecological impacts, implying that jumping worms may be affecting plant growth in different ways. We have an ongoing project looking at these effects in the field, but a mesocosm study allows us to look at them in a controlled setting with all external environmental factors eliminated. By helping us understand the effect of European and jumping worms on tree growth, this study will tell us more about the effect of jumping worm invasion on Northern Forests. It will help us make predictions about how these forests will be maintained in the future as invasive earthworm populations and geographic ranges increase.

The study consists of four earthworm treatments and five seedling treatments fully crossed for a total of 172 replicates. The earthworm treatments are jumping worms (*Metaphire hilgendorfi*), european worms (*L. terrestris*), both worms (using both *M. hilgendorfi* and *L.terrestris*), and no worms. The seedling treatments are white spruce, red oak, sugar maple, black cherry, and a no seedling control.

Potting conditions are meant to resemble field conditions as closely as possible. The soil is local topsoil that was solarized in early June to kill any possible worms or worm eggs. It is topped with 27 g of Adirondack leaf litter per pot to resemble field conditions. Mesh bags (50cmx160cm) were made and placed in each pot to keep worms from exiting their respective pot. The trees are currently kept in the Colgate University Greenhouse. They are placed randomly and rotated throughout the greenhouse during each measuring period.

The trees are measured once every four weeks. The diameter and height of each tree is measured, allowing us to calculate the biomass of each seedling. A leaf count is also taken to track general plant health. As the jumping worms were not mature until late this summer, this study is still in its early stages and will be continued at least through spring 2024.

Research Fellow: Kevin Nguyen (2024) **Concentration: Philosophy; English**
Faculty Mentor: David Dudrick **Department: Philosophy**
Title of Project: The Ethics of Human Desire: Levinas in Conversation with Lacan and Girard
Funding Source: Center for Freedom and Western Civilization, James Madison Fellow
Project Summary:

Human desire has always occupied a central role in the history of Western philosophy, from Plato's Eros toward the Good to Augustine's longing for God. My research project aims to explicate and clarify the concept of "metaphysical desire" from Levinas's seminal treatise on ethics, *Totality and Infinity*, by comparing and contrasting Levinas's notion of desire to that of Girard's and Lacan's, the other two contemporaneous accounts of desire.

Levinas, Girard, and Lacan all agree that the human being is fundamentally the desiring subject. Furthermore, all three thinkers also agree that desire is not the result of human instincts or free will but is always already governed by some external 'Other.' However, they diverge upon the nature of this Other. Girard argues that the other person is the origin of desire, as human desire must be formed by imitating another person's desire, a process he names "primary mimeticism." Thus, for Girard, an individual's desire is born from an interpersonal "mimetic rivalry" with another person.

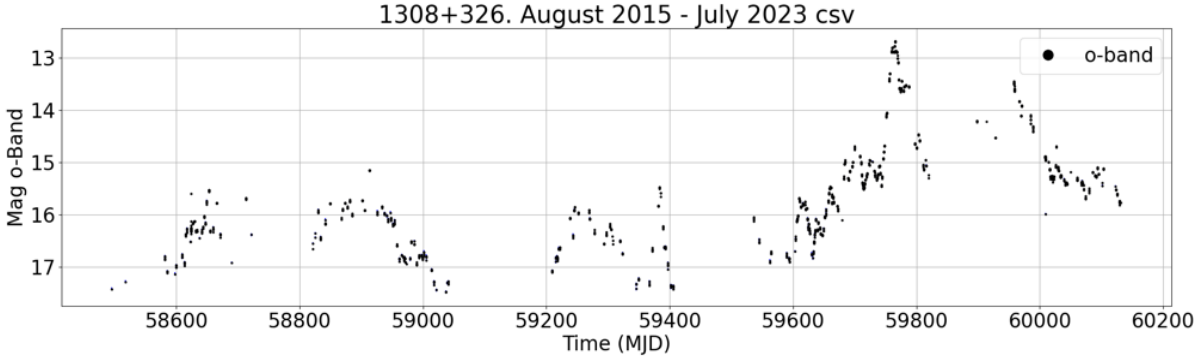
Lacan agrees with Girard that human desire has its origin in interpersonal mimesis. However, for Lacan, what ultimately sustains desire are various sociocultural laws, norms, conventions, and discourses external and preceding the individual, what he calls 'the big Other.' As a Freudian, Lacan holds that human desire is the result of the unconscious; however, for Lacan, the "unconscious is neither primordial nor the instinctual" but "the [big] Other's discourse.". In other words, in Lacan's view, desire and the unconscious are not what one must repress in socialization but precisely what emerges from socialization.

Levinas's view on desire is perhaps the most unique because Levinasian desire is an extimate drive toward no object. For Levinas, human's primordial relation to the world is of affective "enjoyment," as human lives off the world (Levinas 110); at the same time, the excess of this enjoyment also leads to a doubling of desire, driving humans toward "*something else entirely,* toward the *absolute other*" (34). However, the Other person, Levinas argues, cannot be reduced to an object or an entity as the Other's presence "at each moment destroys and overflows the plastic image" it presents (51). Therefore, even though Levinasian desire orientates toward and anticipates the Other, it "cannot be satisfied" by the Other (34).

Research Fellow: **Chris O'Connell (2025)** **Concentration:** **Astrogeophysics**
Faculty Mentor: **Thomas Balonek** **Department:** **Physics and Astronomy**
Title of Project: **Using the Asteroid Terrestrial-impact Last Alert System (ATLAS) Images to Investigate Quasar Variability**
Funding Source: **NASC Division / NASA New York Space Grant**
Project Summary:

uasars, a subclass of active galactic nuclei (AGN), are astronomical objects interesting for study due to their great distances, high luminosity and unpredictable variability in brightness. These objects can give astronomers a look into galaxy formation and the early universe. The Asteroid Terrestrial-impact Last Alert System (ATLAS) is an all-sky survey that monitors the sky for near-Earth asteroids prior to impact. This survey collects hundreds of sky images each night. Astronomers can extract brightness measurements for any star-like object using the ATLAS online database. This summer, we looked into the potential of using the ATLAS database to study long-term quasar and stellar variability. We downloaded and analyzed the forced photometry data of two quasars, BL Lac and 1308+326, and their nearby comparison stars.

After the first three years of data, we noticed that the ATLAS forced photometry data had unexplainable dips and inconsistencies in brightness for many star-field objects approaching 12th magnitude. This was even clearer in stars known to be non-variable. When conducting our own photometry in AstroImageJ on the same images, we produced more convincing and consistent results. Our results through AstroImageJ implied that the photometry conducted within the ATLAS server had inconsistencies that gave inaccurate data. Some of our hypotheses included different telescopes that had slightly different photometry values or the photometry server utilized a gaussian fit rather than an aperture analysis used in AstroImageJ. For more information on our data reduction pipeline for ATLAS data, please refer to Madeline Hulburt's abstract.



Research Fellow: **Etiosa Ojefua (2026)** **Concentration:** **Undeclared**

Faculty Mentor: **Frank Frey** **Department:** **Biology; Environmental Studies**

Title of Project: **Antibiotic resistance in Uganda**

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

Project Summary:

The evolution of antimicrobial resistance (AMR) is a growing threat to health worldwide, and recent reports show that inadequate surveillance capacity, especially in East Africa, is compromising both direct patient care in terms of antibiotic choice, and also contributing to the rise of AMR [1,2]. Additionally, there is evidence that the indiscriminate use of antibiotics and rise of accessing antibiotics privately through drug shops without a prescription is fueling the evolution and spread of strains resistant to multiple antibiotics [3,4]. Upper-respiratory infections are the second leading cause of death in children under 5 in Uganda [5] and account for 40% of all under-5 outpatient attendance at clinics and hospitals nationwide in Uganda [6,7]. The primary pneumonia-causing bacteria is Streptococcus pneumoniae [8], and one study of AMR in nasopharyngeal bacteria in eastern Uganda found that one-third of children were given a self-prescribed antibiotic within the past two weeks for fever, running nose, or cough, that 60% carried Streptococcus pneumoniae, and that a high proportion (80-99%) of cultures were resistant to cotrimoxazole, penicillin and oxacillin [9].

Professors Frey and Scull have a collaboration with Bwindi Community Hospital to identify factors associated with patterns of AMR in S. pneumoniae in children under 5. The study area includes 101 villages belonging to 14 different parishes across 3 sub-counties, with households randomly selected for inclusion in the study based on the proportionate representation of children under 5 across parishes in the sub-counties. Briefly, following informed caretaker consent, a trained staff administers a caretaker survey to understand illness and treatments sought, a nasopharyngeal swab is collected and cultured in the lab to identify the absence or presence of S. pneumoniae, and antibiotic susceptibility testing (AST) is performed to determine whether the culture is susceptible or resistant to 12 different antibiotics available in the region. Nearly 400 samples have been collected to date, and this summer I worked to cross-check the survey data entry, quantify AST data by processing approximately 1,000 images, and perform some preliminary analyses. Currently, the prevalence of S. pneumoniae is about 40%, with high levels of resistance to beta-lactam penicillins, moderate levels of resistance to erythromycin, trimethoprim/sulfamethoxazole, and gentamicin, and low levels of resistance to ciprofloxacin. Geographic variation appears to link patterns of prevalence, antibiotic resistance, and treatments administered.

[1] Ampaire L et al. 2016. African Journal of Laboratory Medicine 5: a432. [2] Omulo S et al. 2015. Antimicrobial Resistance and Infection Control 4:1. [3] Ocan M et al. 2015. BMC Pharmacology and Toxicology 16:26. [4] Nyeko R et al. 2022. BMC Pediatrics 22:322. [5] Ministry of Health. 2016. The Republic of Uganda: Kampala Uganda. [6] Dan K, Rachel KH. 2015. African Journal of Pharmacy and Pharmacology 9:730-737. [7] Kallender K et al. 2008. Bulletin of the World Health Organization 86: 332-338. [8] Simoes EAF et al. 2006. Pages 483-497 in: Disease control priorities in developing countries. Second edition. Washington (DC): The International Bank for Reconstruction and Development / The World Bank. [9] Rutebemberwa E et al. 2015. Upsala Journal of Medical Sciences 120: 249-256.

Research Fellow: **Aranya Pal (2024)** **Concentrations:** **Mathematics; Economics**
Faculty Mentor: **Gabe Sosa Castillo** **Department:** **Mathematics**
Title of Project: **Reconstruction of Monomial Orders**
Funding Source: **NASC Division**
Project Summary:

In everyday life, we are constantly ranking, ordering various objects based on certain criteria. A monomial order, as the name suggests, is an ordering system for monomials. A monomial m in n variables is an expression, $m = x_1^{a1} x_2^{a2} ... x_n^{an}$, where each exponent is non-negative. Now, the natural question that arises is why are we so interested in ordering these abstract entities? A very straightforward application of monomial orders would be to rank people or objects around us with multiple statistics, making it hard to measure them by a single score or number. In situations like that, we can convert those statistics to monomials, which are then more easily ranked based on whatever criteria we might want. A second, more important implication of monomial orders is the role they play in the computation of *Gröbner Basis*, an important tool in the fields of Algebraic Geometry and Commutative Algebra that aids us in solving large systems of equations, leading to applications in engineering, graphics design, economics and many other areas. It is known that to compute Gröbner Bases, we have to first define a monomial order, as different monomial orders may lead to distinct Gröbner Basis. This summer, our project was to find a way to categorize a certain class of monomial orders, called reconstructible monomial orders, which can be computationally cheaper to find and therefore can aid in making the process of finding the right Gröbner Basis more efficient.

Given a monomial order, we can define its induced i^{th} ordering as the monomial order on the n-1 variables that are obtained when the i^{th} variable is not considered. Then, if all of the induced orders for a particular monomial order are unique, the order is reconstructible. To tackle the question of categorizing all reconstructible orders, we had to first be able to quantify a monomial order. According to Robbiano's Theorem, all monomial orders can be represented by matrices, therefore, our primary theoretical work is classifying what the entries of a matrix that represents a reconstructible order looks like. As we want our work to be computationally viable, we restrict ourselves to Monomial Orders Represented by Matrices with Only Rational Entries (MORMOREs). The next challenge lies in the fact that even though we have a way to represent monomial orders, the representation was not unique. Therefore we define a unique matrix representation for any monomial order, the ZARRE (Integer Adjusted Reduced Row Echelon) form, and for any n variables, the number of distinct ZARRE forms for MORMORES are $(n!)^2$ in number. However, as reconstructability is a property that is unchanged by column permutations, it is enough to analyze all ZARRE forms that are upper-triangular. Therefore, after analyzing all the upper-triangular ZARRE forms for 3, 4, and 5 variables, we are able to give the following general classification for reconstructible MORMOREs: *Given a MORMORE, τ, in n variables, where $n \geq 3$, and let M be the ZARRE form of a matrix representing it. Now, let N be the matrix obtained by rearranging the columns of M to obtain an upper triangular matrix. Then, τ is reconstructible if and only if there is* $1 \leq j \leq n-2$ *and a rational number c, such that either* $N_{j,i} = 0$ for all $1 \leq i \leq n$, $i \neq j$ or $N_{j+s,i} = cN_{j,i}$ for all $1 \leq i \leq n$, $i \neq j$.

Research Fellow: **Bryan Palaguachi (2024)** **Concentration:** **Physics; Chemistry**
Faculty Mentor: **EricMuller** **Department:** **Chemistry**
Title of Project: **Infrared nano-spectroscopy of aqueous mixtures**
Funding Source: **Justus '43 and Jayne Schlichting Student Research Fund**
Project Summary:

All known life depends upon water as the medium that gives rise to complex chemical and biological interactions. The unique properties of water as a solvent can be traced to its hydrogen bonding structure. Optical spectroscopies have arisen as a tool to understand the chemical nature of water, particularly using the vibrational OH stretching and bending modes as a local probe of its hydrogen bonding structure. Our group has recently developed a new nanoscale imaging and spectroscopy of *in liquid* IR sSNOM to measure solid surfaces in a liquid environment, which now extend to investigate the liquid water itself. My goal is to analyze preliminary IR sSNOM measurements of water.

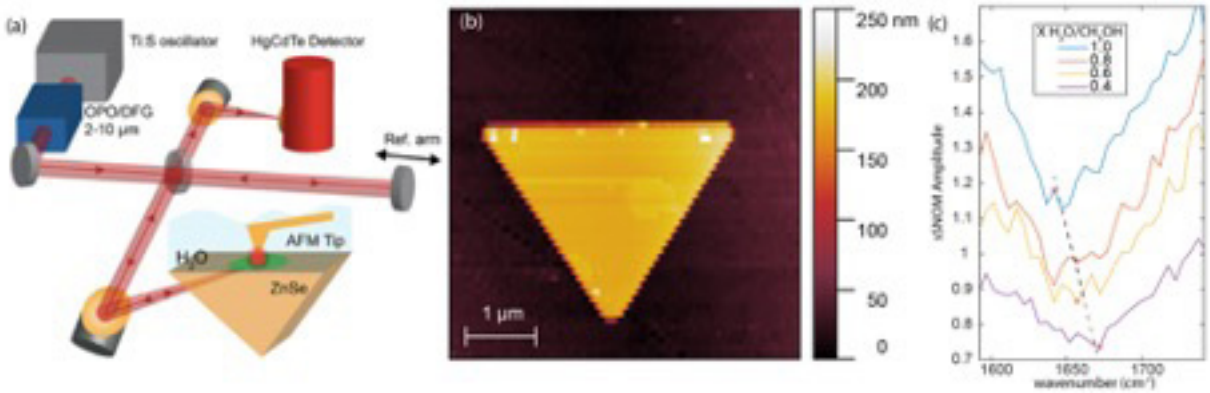


Figure: (a) schematic of in liquid IR s-SNOM setup. An infrared laser illuminates water in the region between the tip of an atomic force microscope (AFM) and gold nanotriangles on the ZnSe support substrate. (b) AFM height image of a single Au nanotriangle. (c) The water bending mode appears as a dip in the spectrum at 1650 cm-1, which decreases in intensity with decreasing water content in a methanol mixture. Changes in the hydrogen bonding structure of water cause the dip to shift to higher wavenumbers.

During summer 2023, my research has focused on analyzing preliminary spectra from in-liquid IR s-SNOM (Infrared Scattering Scanning Near-field Optical Microscopy) of water mixtures. I analyzed the spectra using coding in Matlab using methods including Fourier transform to produce spectra from the raw interferograms. In my data analysis, I found that in liquid IR s-SNOM has the necessary sensitivity to detect the bending vibrational mode of the HOH bond in water, which appears as a broad dip in the spectral amplitude at 1650 cm^{-1}. Furthermore, I found that the signal and overall sensitivity to vibrational modes of water were significantly enhanced in the nanoscale region above metallic nanoprisms. In mixtures of water and heavy water (D_2O), I found that the overall peak strength is dependent upon the fraction of hydrogen atoms in the water. Finally, I'm working to analyze the data to measure potential spectral shifts in the HOH bending mode that are predicted with changing hydrogen bond strength in water-alcohol mixtures, although our preliminary spectra are quite noisy. Our results demonstrate sufficient sensitivity for measurements of the hydrogen bond network in water, and we aim to use this method to understand changes in the hydrogen bond network of water mixtures at nanoscale active sites and interfaces.

Research Fellow: **Ryan Park (2024)** **Concentration: Biochemistry**

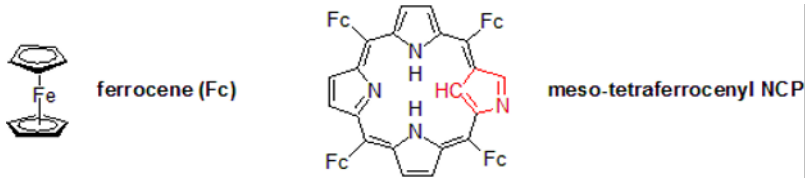
Faculty Mentor: **Rick Geier** **Department: Chemistry**

Title of Project: **Synthesis of an N-Confused Dipyrromethane for the Preparation of an N-Confused Porphyrin Bearing Ferrocene Substituents**

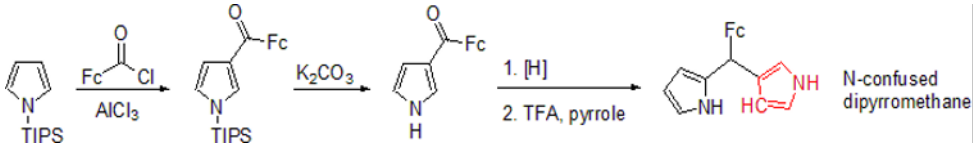
Funding Source: **Warren Anderson Fund**

Project Summary:

Porphyrins are a family of compounds of biological, fundamental, and commercial significance. N-Confused porphyrin (NCP) is an isomer of porphyrin with an inverted pyrrole ring. Ferrocene is a redox-active organometallic compound. Porphyrins bearing ferrocene substituents have been previously found to display multiple redox potentials indicating electronic communication across the porphyrin ring. The lower symmetry NCP bearing ferrocene substituents has not been synthesized. The overall goal of this project is to synthesize and study meso-tetraferrocenyl-N-confused porphyrin.



Our research group previously attempted a one-flask synthesis of the targeted NCP without success. As a result, our focus shifted towards a multi-step synthesis so that each step could be confirmed and reaction mixtures would be less complex. One of two key building block molecules is an N-confused dipyrromethane (NC-DPM). A prior student began preliminary studies of the NC-DPM synthesis. Work remained to improve yields, increase scale, and fully characterize the synthetic intermediates and the NC-DPM.



The goal for this summer was to expand upon our previous work by more thoroughly examining each step leading to the NC-DPM and refining reaction conditions. The first step of the synthesis is the acylation of TIPS-pyrrole at a β position with 1-chlorocarbonylferrocene. Our results compared well with prior work, and we examined a broader range of reaction conditions. The desilylation of the TIPS group was successfully done multiple times in a quantitative yield. Our studies of the reduction of the β-acyl pyrrole followed by acid-catalyzed reaction with pyrrole revealed the presence of unreacted starting material, over reduced starting material, and the targeted NC-DPM. We found that yield of the NC-DPM was improved by using sodium borohydride as a reducing agent rather than DIBAL-H which afforded high levels of overreduction. With our studies of the NC-DPM largely complete, we will turn our attention to the synthesis of the second building block molecule.

Research Fellow: Zack Pelland (2024) **Concentration:** Neuroscience

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

Title of Project: Subconcussive head impacts sustained in American football alter gut microbiome diversity and composition

Funding Source: NASC Division

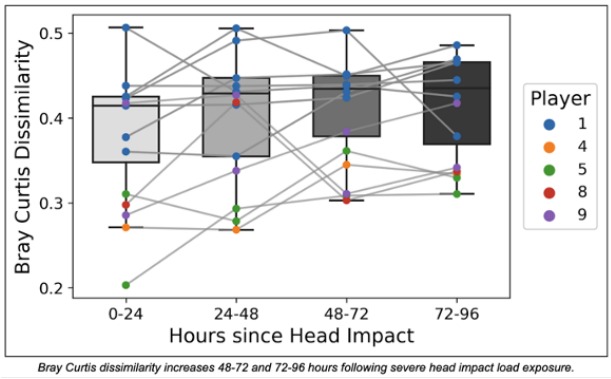
Project Summary:

Mild traumatic brain injuries (TBIs) are injuries to the brain caused by forces applied to the head, commonly resulting in a number of neurological symptoms. Isolated mTBIs can lead to prolonged disability known as persistent post-concussion syndrome (PCS), and repeated exposure to mTBIs—common among military personnel and athletes—is linked to an increased risk of developing neurodegenerative diseases. Repetitive subconcussive head impacts (RSHIs) are a subset of mTBIs that result from cranial impacts, but they do not generate symptoms or a clinical diagnosis. RSHIs tend to be difficult to study; however, exposure to RSHIs, similar to mTBIs, has been linked to short-term changes in neurological function and an increased risk of neurodegenerative diseases.

Both the short-term changes in neurological functioning and the increased risk of developing neurodegenerative diseases associated with mTBIs and RSHIs have been linked to chronic neuroinflammation. The gut microbiome, which is the community of trillions of microorganisms that line the intestinal tract, is implicated in the regulation of neuroinflammation. Because of the links between neurodegenerative diseases, neuroinflammation, and the gut microbiome, we suspected that the gut microbiome might change in response to exposure to RSHIs. A demonstrated link between the gut microbiome and RSHIs represents a potential avenue to diagnose, treat, and prevent severe or long-term neurological damage from mTBIs. American football players represent an avenue to explore the relationship between RSHIs and the gut microbiome as they experience between 100 and 1,000 RSHIs per season.

To determine if there is a link between RSHIs and the gut microbiome, fecal samples were collected, head impacts were monitored, and clinical factors were surveyed amongst a subset of players from the football team during the 2022 season. The final analysis included 226 fecal samples from six players. The analysis revealed that beta diversity (a measure of the dissimilarity between two gut microbiome samples) increased three days following exposure to head impacts, with 15 clinical factors accounted for. We hypothesize that these acute changes in beta diversity may account for the longitudinal changes in the gut microbiome that we witness across the season, which potentially suggests that the accumulation of RSHIs leads to gut dysbiosis that could be related to chronic neuroinflammation.

The results of this study encouraged further exploration, and a modified study is now underway amongst a new subset of football players. This study implements a thorough control group, salivary inflammatory markers, cognitive assessments, head impact monitor verification, and larger sample sizes. The modified design could potentially determine if there is a relationship between RSHIs, the gut microbiome, cognition, and inflammation.



Bray Curtis dissimilarity increases 48-72 and 72-96 hours following severe head impact load exposure.

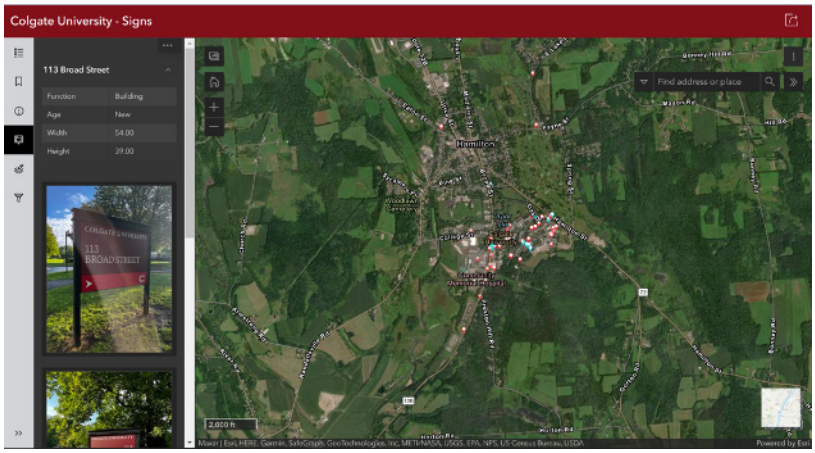
Research Fellow: Jason Qian (2024) **Concentration:** Environmental Geography
Faculty Mentor: Myongsong Kong **Department:** Geography
Title of Project: Colgate Campus Sign Database Project
Funding Source: Communications
Project Summary:

Colgate University is looking to and is currently in the process of replacing signs for buildings and directions on campus since many signs are outdated and navigation is not easy on campus. The Office of Communications recognizes a lack of an organizing system that contains all the signs on campus, so my job over the summer was to create a geodatabase of all the signs on campus. By utilizing the field app of Survey123 and connecting it to ArcGIS Online, I created two databases – one for all the permanent signs on campus and the other for temporary signs that are put up for events – as well as a StoryMap and two instant apps to allow easy access to the data, with the ability to sort, filter, search, etc. for the corresponding signs that Communications requested.

The project consists of several steps: database building, data collection, app development and documentation.

In order to effectively categorize and filter signs of different kinds, I created fields to record the function, age, number of supporting legs, whether it is a standardized size, etc. I also created date fields to capture the dates that signs are first logged, edited, and installed (the date when a new sign is installed). I added various domains to each of the fields in order to better categorize them into distinct categories. To collect the signs on campus and in the surrounding areas, I used ArcGIS Online, Survey123, and QuickCapture. With the help of my supervisor Myongsun Kong, I established the fields necessary and started to work on the field portion of the project. There were two options in terms of software I could use: QuickCapture and Survey123. In the end, I chose Survey123 due to the scope of data it captures compared to QuickCapture. I was able to collect data and photos of all signs on campus, in the Village of Hamilton, as well as around Lake Moraine (Glendening Boathouse.) These data can be and will be updated as the Office of Communications updates the signs.

After database building and data collection, the end result is a StoryMap as well as two apps that allow easier access and modification to the database than using ArcGIS Online directly. I also documented this process with a user friendly guide as well as a technical document detailing the geodatabase. This is my first attempt at building instant apps, and I really appreciate this opportunity to learn new skills and practice and enhance my existing skills in GIS acquired in class.



Research Fellow: **Bronwen Rees-Wiedemann (2024)** **Concentration: Molecular Biology**
Faculty Mentor: **Priscilla Van Wynsberghe** **Department: Biology**
Title of Project: **Investigating how let-7 microRNA levels are impacted by *lite-1* and *lin-42* in *C.elegans***
Funding Source: **Michael J. Wolk '60 Heart Foundation**
Project Summary:

C.elegans are transparent nematodes that are often used as model organisms for genetic research due to their ease of manipulation, quick life cycle, large number of offspring, and sequenced genome. *C.elegans* are typically hermaphroditic, though males exist. *C.elegans* reproduce approximately 3 days after birth and undergo four larval stages broken up by four molt stages before reaching adulthood. Professor Van Wynesberghe's lab uses *C.elegans* to better understand how a variety of proteins and genes impact development, specifically in relation to the circadian rhythm. Circadian rhythms act as internal clocks which typically follow a 24-hour cycle that work to regulate bodily functions. The circadian clock is affected by light cues and regulated by an assortment of genes which oscillate on a schedule and with this specific timing, they control the developmental timing of *C.elegans*. This summer my research focused on the circadian clock gene lin-42, a critical component of the circadian rhythm that acts as a transcriptional repressor of let-7 microRNA.

Let-7 is a tumor suppressor microRNA, which are small segments of RNA that post-transcriptionally regulate gene expression by preventing the production of particular proteins. Let-7 is a 22-nucleotide long RNA molecule that plays an important role in cell fate. Let-7 comes on between the L3 and L4 stage of development, a stage which typically occurs around 26-28 hours post birth in wildtype *C.elegans*. lite-1 mutant and lin-42 mutant worms were used to analyze let-7 levels. Lin-42 represses let-7, so we were investigating if lite-1 also represses let-7 expression, and if so, does lite-1 inhibit let-7 through lin-42? My research this summer focused on identifying how let-7 microRNA levels are impacted by the genes lite-1 and lin-42 in *C.elegans*.

I analyzed let-7 levels by conducting RNA extractions and using qPCR. I used samples of N2 (wild-type), lite-1, lin-42, and lite-1;lin-42 *C.elegans*. I extracted the RNA from each of the samples and treated them with DNase before extracting and resuspending the RNA for the second time. I calculated the concentration of the RNA product using a nanodrop before using a thermocycler to create cDNA out of the samples. I used a complementary looped primer to create the cDNA followed and due to the small size of the microRNA, Taqman miRNA was used to amplify let-7 through the addition of a forward primer, reverse primer, and a probe. From here, I used qPCR to quantify the amount of let-7 in the different worm strains. Data was collected from 24, 26, 28, and 30 hours so measurements could be compared between and within worm strains.

I noticed that let-7 levels were significantly lower in N2 worms than in other variants, which was to be expected due to the strain having functional lite-1 and lin-42 genes. Let-7 levels were highest after 28 hours in lite-1, lin-42, and lite-1; lin-42 strains. Additionally, worms with both lite-1 and lin-42 mutated showed a lower level of let-7 than worms with only lite-1 or lin-42 mutated. No definite conclusions can be drawn currently, and more data will be collected.

Research Fellows: Blanca Rivas (2025) **Concentration: Anthropology**
Josh Zou (2025) **Concentration: History**
Faculty Mentor: Graham Hodges **Department: History; Africana and Latin American Studies**

Title of Project: Research Apprenticeship Featuring Archival Work on Henry Highland Garnet

Funding Source: SOSC Division

Project Summary:

Our work over summer consists primarily of searching various online databases and paper collections for documents related to the person of Henry Highland Garnet, a prominent Black abolitionist and minister known for his oratorical gift and impressive physique. New York was the primary stage for Garnet's abolitionist activity, nonetheless he traveled across the Atlantic for various diplomatic missions and to plead the anti-slavery case. Garnet was very active in Northern abolitionist circles and often came into contact with other giants of the cause such as Douglass and Garrison. Over the duration of our apprenticeship program we searched through America's Historical Archives, Accessible Archives, Library of Congress Newspapers, the Frederick Douglass Papers and the Black Abolitionist Papers (from 1830-1865) for traces of Garnet and collected a sizable sum of relevant material.

We discovered that Garnet received amputation for a deteriorating leg injury and acquired a prosthetic limb in his youth- this process was reported in several issues of The Colored American in 1840 and 41. This information becomes intriguing when juxtaposed with accounts of Garnet's impressive stature and manly demeanor widely admired in abolitionist circles. What was Garnet's experience as an underprivileged disabled person in 19th century America? How did he receive his treatment and maneuver with a prosthetic limb? How specifically did Garnet's disability affect his image as an abolitionist? Such are questions that we seek to answer through further research and contemplation.

Something else of interest we encountered in our course of research is Garnet's fairly consistent endorsement of Colonization, which refers to the re-colonization of Africa (or sometimes the resettlement to unestablished lands or African enclaves in the Americas) by American descendants of enslaved Africans. Such a position resulted in disputes between Garnet and his fellow abolitionists (most notably, Frederick Douglass) at various points in their political careers. Disputes of this nature in fact reflect the intellectual vigor and diversity of abolitionist circles. In this summary we shall recount briefly Garnet's specific views on the issues of Colonization, namely its historical baggage and present purposes, through a helpful document that can be found simultaneously in several databases we covered. We are well aware of the problematic implications of Colonization, yet given the brevity this summary demands we shall not engage in its controversies at length but simply report Garnet's positions on the movement in question.

The Colonization project up until Garnet's generation managed to resettle some free blacks to the West African coast and create the Republic of Liberia. It began under the sponsorship of the American Colonization Society (ACS), whose members, being primarily white segregationists and slaveholders, opposed the integration of blacks into American society. Therefore the free African American community was at large adverse to the colonization project, which was a de facto obstacle to their direct enfranchisement in the United States.. Garnet, however, unequivocally rejected the ACS's vision of colonization: as he explains in a response to Samuel R. Ward, a fellow abolitionist, republished in Frederick Douglass's Paper on March 2nd, 1849, "...my opinion of the Hon. Henry Clay, and other Colonizationists of the same stamp, has undergone no change. I have no reason to believe that he is now different from what he has been during his whole public life-that is, a hardened sinner-a cruel and murderous persecutor of my people, and of late a baptized and confirmed hypocrite." Clay was a prominent politician, a slaveholder, and indeed a co-founder of the ACS. Garnet developed his own interpretation of the Colonizationist mission.

In the same response Garnet reaffirmed his commitment to "enfranchisement in this land of our birth" by means of "patient labor, frugality, education and pure religion." Garnet seemed to believe that Africa would benefit from the project of Colonization, as, according to him, a successful Republic of Liberia "[would] be highly beneficial to Africa in a commercial and political point" (though he did not further specify in the published response), crush slave trade in the African coast with power, and "create respect for our race throughout the civilized world" through building diplomatic relationships with European nations. Apparently Garnet conceived Colonization as a means to raise Africa from a perceived inferior status and improve the conditions of blacks around the world.

Towards the end of his response Garnet beckoned "every colored man who sincerely believes that he can never grow to the stature of a man in this country" to immigrate to Liberia and exercise full citizenship and "do some good there". Yet Garnet firmly asserted that he was not one such man himself, as "there is work enough for me here," once again declaring his commitment to equality and integration of free Africans within American society.

Research Fellow: **Jorge Rochet (2025)** **Concentration:** **Theater; Environmental Studies**
Faculty Mentor: **April Sweeney** **Department:** **Theater**
Title of Project: **'Ni Una Bomba Más': Accounts of the US Navy's Impact on Culebra and Vieques, Puerto Rico**
Funding Source: **J. Curtiss Taylor '54 Endowed Student Research Fund**
Project Summary:

This summer, I was fortunate enough to conduct a self-inspired investigation with summer fellowship funding. I designed an innovative study to uncover the social, economic, environmental, and political impacts of the presence of the U.S. Navy on the two island municipalities of Vieques and Culebra, Puerto Rico.

From 1904 to 2003, the U.S. Navy utilized both islands as bombing ranges to conduct military exercises. Terror filled the homes of the people as they were forced to coexist with the ear-splitting sounds of bombs that contained heavy metals and toxic chemicals, such as depleted uranium and Agent Orange. Viequenses and Culebrenses were displaced from their homes, and the Navy took ownership of the lands that belonged to the locals. Although the Navy left Culebra in 1975, it was not until 2003 that they finally left the island of Vieques, giving it the title of "the municipality with the highest cancer rates in all Puerto Rico."

During my investigation, I visited Culebra and Vieques. I conducted 10 interviews, through which I heard the untold narratives and experiences of the people. Additionally, I visited local museums, participated in volunteer work, attended the "fiestas patronales" of Vieques, and engaged in casual conversations with locals — including educators, activists, fishermen, farmers, and more.

During my time in Culebra, I had the great honor of conversing with Teófilo "Fily" Bermúdez, who protested against the Navy in the 1970s. He shared the stories of what the people of Culebra would do to survive during the Navy's presence. The Culebrenses would put their lives on the line constantly by searching for unexploded bombs in the mountains and the waters. They would carefully deconstruct them to sell the metals and pieces back to the Navy and earn money to support their families.

Stories like Teófilo's only give a glimpse into living conditions for residents during the Navy's most active period on the islands. Nowadays, bombs are still being exploded every Tuesday and Thursday in Vieques as a "clean-up process." As most of the participants expressed, the Navy is still present in Culebra and Vieques. Culebra and Vieques want to be heard.

The stories told by the people inspired me to use both of my majors, environmental studies and theater, to raise awareness at Colgate. All 10 interviews are being used for a documentary that will be shared with the community at Colgate and hopefully beyond Hamilton, N.Y. In addition, I plan to write a fictional play based on this historical event, with the hopes of sharing it with the Colgate community by the end of my senior year. This project calls for people to *listen, empathize*, and *act*.

Research Fellow: Nicole Roitman (2024) **Concentration:** Psychological Science
Faculty Mentor: Rachel Dinero **Department:** Psychological and Brain Sciences
Title of Project: The Madison Resilience Project: The Post-Pandemic Family Experience
Funding Source: NASC Division
Project Summary:

In rural communities around the country, the COVID-19 pandemic has exacerbated problems related to mental health, employment status, and childcare needs, often resulting in local governments struggling to provide necessary aid. Although the pandemic has had unique impacts in different regions of the United States, it has increased stress for people from all walks of life, especially those already struggling. This increase in stress has been particularly potent for parents of young children, stemming from a combination of stressors associated with the pandemic, such as lack of childcare, resources and activities, lack of flexibility with employment, home-schooling demands, and lack of psychological support. Additionally, the widespread lack of public infrastructure in rural communities often further inflamed these problems and produced a distinctly problematic cocktail of vulnerabilities.

To address the issues above, our research team spent the summer developing the Madison Resilience Project, a Colgate University-affiliated community-based research project working to better understand how Madison County was affected by the pandemic. The project's interests include parental burnout, children's mental health, and information regarding which community resources benefited residents post-pandemic and which resources weren't available or accessible. Throughout the summer, we conducted informal interviews with local community leaders to obtain a clearer picture of what issues they have identified within Madison County and gain insight into the various avenues through which we could recruit community participants for our study while offering them suitable and enticing compensation. By meeting with leaders who directly engage with community members or are highly familiar with county-wide difficulties, we obtained information specific to Madison County as the first step toward building a relationship with local people that allows us to hear their needs and advocate for them effectively. In addition to gaining information regarding the community's needs, we researched parental burnout and children's mental health during the COVID-19 pandemic to build a simple yet comprehensive questionnaire that will provide us with quantitative data related to our topic. After completion, we applied for and received IRB approval for this questionnaire. Regarding recruitment, we created a website (tinyurl.com/madisonNYstrong) that will allow community members to easily access our questionnaire and more information about our research. We have also designed posters and buttons to advertise our project and website, which will be distributed around the county and at county events. Finally, our team wrote a grant proposal that would fund participant recruitment and compensation.

The foundation set during the summer, particularly the relationships built between our research team and various community leaders, will play an integral role in the continuation of this project as we begin the recruitment process in the fall. As our research aims to better understand the experiences of families with school-age children in Madison County following the COVID-19 pandemic, we hope our data collection will allow us to advocate for the creation and improvement of necessary resources that would reduce stress and generally improve the quality of life for families in Madison County. We are excited to use the information gathered this summer to work toward producing results that will help create positive change in the Madison County community and establish a research model for similar community-based research projects.

Research Fellow: **Ryan Ruan (2024)** **Concentrations:** **Physics; Applied Math**

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

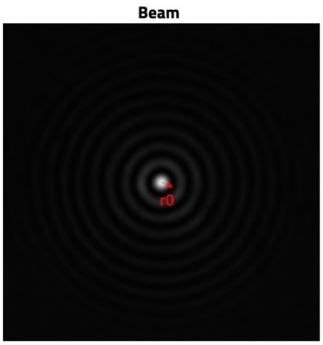
Title of Project: **Investigation on Light Beam Size with Table-Top Gravitational Lensing/ Einstein Beam Size Properties Measured Based on Table-Top Measurements**

Funding Source: **National Science Foundation**

Project Summary:

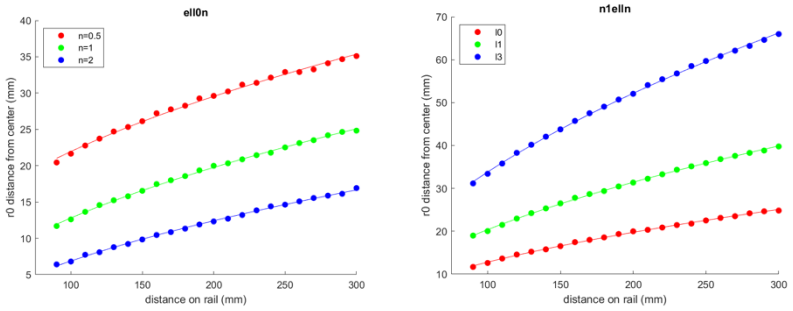
Abstract I:

Due to gravitational lensing and the distortion of light, we can observe an Einstein ring when a super massive star distorts the light of distant stars when it transmits through it. The plane observation of the beam that creates Einstein Ring gives us an Einstein Beam. Unfortunately, it is impossible to observe it under natural world settings, due to its extended magnitude. However, we can simulate and observe Einstein Ring on an optical table with lenses set up and the manipulation of Spatial Light Modulator (SLM). We have been investigating the size of the light beam with its distance transmitted for different kinds of Einstein Beams.



z = 260mm, l = 0 , n = 1, r = 1e-6

The size of the Light Beam can be measured in terms of r0, which indicates the distance to the first local minima of the Einstein Beam measured from the center of the beam. We then find out the change of r0 value for different Einstein Beams when we change the distance of the plane of measurement. Here is one example of r0 looks like on a real Einstein Beams example, with the controlling variables below the image.



The properties of an Einstein Beam can depend on several variables. The propagational distance – z; the angular momentum of the object – l; the strength of the gravity– n, which is 1 in real life, but we change it to explore more related properties, and rs– the Schwarzschild Radius.

The Einstein Beams can be approximated by the Bessel Functions of the first kind at its center, as its intensity can be written as:

$$I_{\text{asymptotic}} \propto \left| J_\ell \left(\sqrt{\frac{2k^2 r_S}{z}} \rho \right) \right|^2$$

So, we can use a Bessel Fit of the image to find out the most accurate r0 value and conduct according experiments. Here, we use a 2D fit of the Bessel Function, since this will get the data that minimize the impact of intensity fluctuations. We tried several cases of Einstein Beams, and find out that when l is held still (l=0) in the case of first graph, smaller n gives us bigger beam size, and when the n is held still (n=1) in the case of second graph, greater l value will give us bigger Beam Size. Also, for all kinds of Einstein Beams, the size of Beams can all be well approximated by a function of √z, which dissipate much slower than the ordinary Gaussian Beams that at the rate of z.

Research Fellow: **Will Russel (2024)** **Concentration:** **Molecular Biology**
Faculty Mentor: **Ahmet Ali Ay** **Department:** **Biology**
Title of Project: **Identifying morphological and genetic predictors of heat dissipation in athletic dogs**
Funding Source: **NASC Division**
Project Summary:

Dogs are an excellent species to study the relationship between thermoregulation and lifespan because their phenotypic and physiological diversity are intertwined with heat dissipation and longevity. In this study, we are seeking to analyze the associations of morphological traits, season, and training with heat dissipation in dogs, while also delineating the genetic underpinning of these associations. In our analysis, we use statistical and machine learning approaches to identify morphological and single-nucleotide polymorphism (SNP) predictors of heat dissipation, also exploring the association between SNPs and morphology to identify potential mechanisms by which genotype affects morphology, leading to differences in thermoregulatory abilities. Our findings reinforce previously identified predictors of heat dissipation, while also uncovering novel season-specific patterns, and our genetic analysis highlights important genetic determinants of thermoregulatory capacity. These findings will provide a basis for future research seeking to explore genes governing thermoregulation in dogs.

Dogs attending Syracuse Obedience Training Club were sampled in the Summer and Winter. Demographic information of dogs was collected by surveying owners, morphological measurements were collected with imaging, and tympanic membrane temperatures (Tear) and infrared thermography (Teye, Tnose, Tmouth) were used to measure ear, eye, mouth, and nose temperatures 0, 15, and 30 minutes after strenuous exercise. Temperature slopes were then calculated for linear regression, and binarized for logistic regression and association rule learning and classification analyses. Dog SNP data was determined by Embark, processed, and then used to predict morphology and heat dissipation.

Our analysis of morphological predictors demonstrates trends consistent with the literature, while also providing novel insights into season-specific effects. As in previous studies, body mass, ear length, nose dimensions, coat length, and paw width were revealed as important predictors of heat dissipation (Table 1). Mediation analysis results suggest that these associations occur independent of body mass (not shown). Additionally, we observed that more predictors appeared when the dataset was split by season. These findings were consistent with linear regression, and association rule learning which also identified these core predictors of heat dissipation, as well as season-specific predictors. We also identified novel genetic predictors and co-occurring SNP combinations that affect dog morphology and thermoregulatory capacity. These insights highlight novel and previously identified genes that have a determining role in morphology and thermoregulation.

Feature	Overall	Summer	Winter
Age			Mouth↑
Body Mass		Eye↓	Mouth↑
Dark Coat			Eye↓
Ear Length	Mouth↓	Ear↓	Mouth↓
Environmental Temp.		Ear↑	Nose↓
Eye Area			Eye↓
Furnished Coat	Ear↑		Nose↓
Long Coat	Ear↑	Ear↑	Eye↑
Nose Width			Eye↑ , Nose↑
Male			Eye↓
Paw Width		Eye↑	Mouth↑
Snout Length		Ear↑	Nose↓
Training			Mouth↓

Table 1. Table summarizes logistic regression results for morphological predictors of heat dissipation rate slopes. Logistic regression was performed for ear, eye, mouth, and nose heat dissipation slopes for the combined dataset and Summer and Winter dogs, and then a summary table was created to visualize association trends (adj. p <0.10).

Research Fellow: **Will Rye (2026)** **Concentration: Undeclared**
Faculty Mentor: **Jeff Bary** **Department: Physics and Astronomy**
Title of Project: **Near-Infrared Observations of Accretion Signatures in Low-Mass Accreting Objects**
Funding Source: **Justus '43 and Jayne Schlichting Student Research Fund**
Project Summary:

The process through which young stars gain mass, known as magnetospheric accretion, is a well-understood phenomenon in which material from the star's circumstellar disk (CSD) is funneled along its magnetic field. This falling gas heats up to temperatures capable of stimulating line emission from recombining hydrogen atoms. These line emissions can then be detected and measured to determine accretion activity. For the low-mass regime, including planets, brown dwarfs, and low-mass stars, the physical process responsible for producing hydrogen emission is potentially different from magnetospheric accretion. In order to test the applicability of the magnetospheric accretion paradigm for young, substellar-mass objects, we collected moderate-resolution near-infrared spectra of four targets. Our observations of low-mass targets in the near-infrared detect and measure this hydrogen emission, allowing for further characterization of the relationship between emission line luminosity and the mass accretion rate. In our survey, we detect accretion signatures Paschen beta, Paschen gamma, and Brackett gamma. We present preliminary measurements of line strengths as we move towards determining accretion luminosities and inferring mass accretion rates.

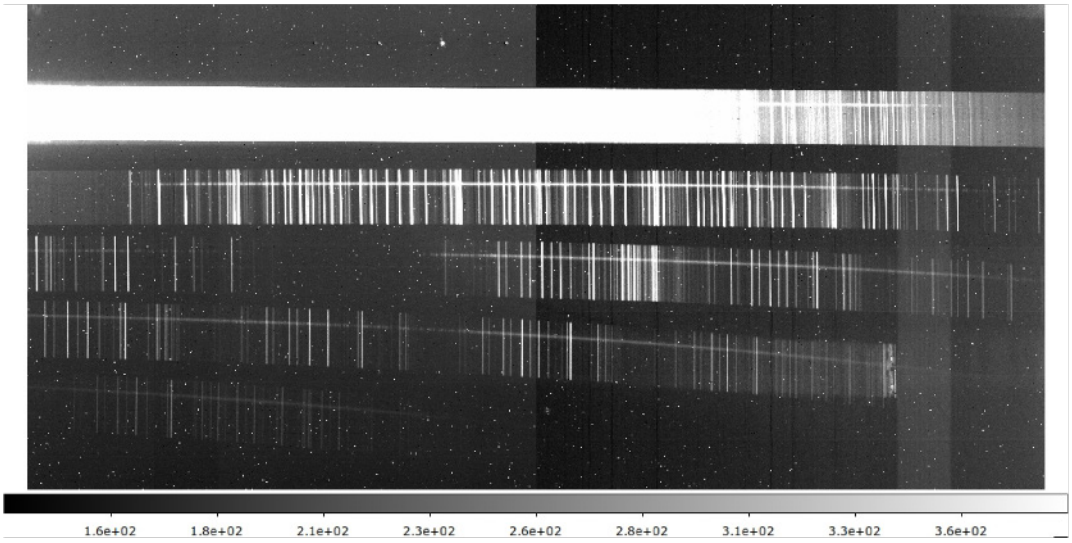


Fig 1. Initial spectrum taken on the ARC TripleSpec. Each band is one infrared order, with observable wavelengths spanning 0.95-2.46 μm. The spectrum is from detected accretor 2MASSJ16024152, observed June 21, 2023. Vertical bands of light are atmospheric, lighting up the entire slit. The horizontal strip of light, bright at some wavelengths and faint at others, is the target in the B position.

Research Fellow: Edgar Saavedra (2025) **Concentration:** Computer Science

Faculty Mentor: Linda Tseng **Department:** Environmental Studies

Title of Project: Microplastics/fibers Generation Through Simulated Human Motions

Funding Source: UNST Division

Project Summary:

Microplastics are now found ubiquitously. Some of them are invisible to the naked eye and require a microscope to detect. Due to us using different types of plastics to create appliances and clothes, past literature has shown that some of the microplastics can have potential harmful effects for humans or the environment. To improve our understanding of microplastics' effect, we need to first understand how microplastics are generated. Our experiment consisted of answering these questions: How much microfiber and microplastic do we shed from our clothes due to our daily activities? Do different motions determine how much microfiber and microplastic we produce? Do different types of material generate different amounts of microfiber and microplastic? To answer the above questions, we built devices with which we can replicate human motion of the arm such as between the armpits and elbow. We wanted to analyze the release of microplastics by motions such as bending arm and walking/running without having other microplastic contaminants,we thus built an air sealed box made of plexiglass, wood, and silicon paste. We as well 3-D printed parts to help us mimic the shape of an arm, as can be seen in both Figures 1 and 2. Both boxes are unique in order to help us obtain our goal.

The box in Figure 1 was used to mimic the movement in the armpit with the motor acting as a joint on the shoulder. The motor was controlled by the Arduino (Figure 3). We then used an airbag to measure the pressure between our arms to recreate the pressure that we needed to use in between our armpit and our torso. We kept the airbag in place using tape and ensured that we weren't adding pressure with the tape. Next, we proceeded to wrap the arm and the stationary part of the arm in place with a piece of fabric to recreate the friction we would create when walking and running. For the second box in Figure 2 we kept the bicep part of the arm stationary while making the forearm of the arm the one that moves with the help of the stepper motor. The forearm part was kept stationary using screws and it was wrapped and kept in place with clips, screws in tape to ensure that the fabric was as realistic as if we were folding our arm on the mechanism to produce accurate results.

The fabrics that we used to test these motions were olive green recycled polyester. At the beginning of the experiment we placed four glass petri dishes in the box at different distances away from our mechanism. The dishes were first cleaned with soap, then rinsed with tap and DI water. We air dried them before rinsing them with ethanol and let them air dry before use.

A control experiment was conducted to test the microplastic produced by the device before the actual experiments. We analyzed the microplastics using an optical microscope inside a laminar hood. To ensure accurate results in our petri dishes, we covered the petri dishes before removing them from the containment, and we wiped the platform of the microscope where the light shines through with ethanol as well as the outer bottom of the petri dish to remove any excess materials not obtained during the trials.
For both boxes, the controls in box 2 contained minimal to no suspected pieces of microplastics. Although, the control in box 1 contained pieces of what we suspected to be either debris or pieces of plastic from our mechanism that will be accounted for in the future. Overall, our experiment has led us to gain a better understanding of how human motion generates microplastics.

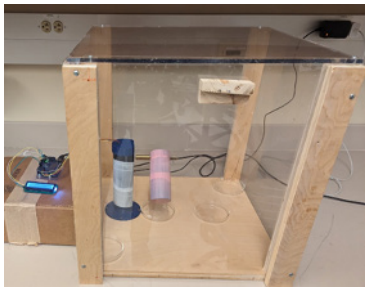


Figure 1

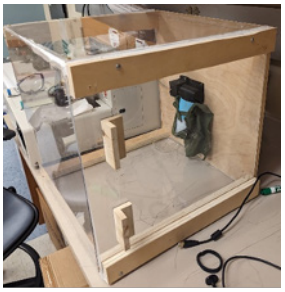


Figure 2

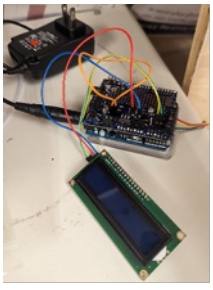


Figure 3

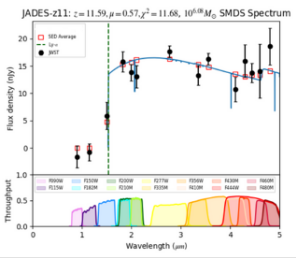
Research Fellow: **Sayed Shafaat Mahmud (2026)** **Concentration:** **Undeclared**
Faculty Mentor: **Cosmin Ilie** **Department:** **Physics and Astronomy**
Title of Project: **Using Neural Networks to Detect Dark Star Candidates in the Early Universe**
Funding Source: **Volgenau Wiley Endowed Research Fellowship**
Project Summary:

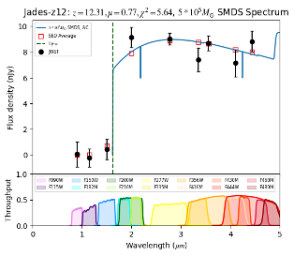
Dark Stars, hypothesized to have formed during the cosmic dawn era, are unique stellar objects that utilize dark matter annihilation as their primary source of energy against gravitational collapse. These stars can reach immense sizes, growing to millions of times the mass of our Sun, and possess luminosities on the order of trillion times that of the Sun. Dark Stars, powered by dark matter, have limited lifespans and may ultimately evolve into supermassive black holes. As such, Supermassive Dark Stars can be the precursors to the many observed supermassive black holes at high redshift, which remains an open question, many years after their discovery.

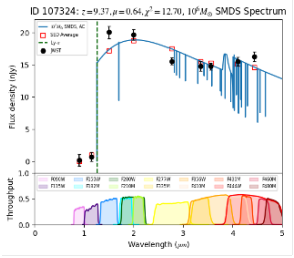
With the advent of the James Webb Space Telescope (JWST), we are now observing photometric data of too many, too massive, galaxy candidates too early in the universe. Motivated by recent findings by Ilie, Paulin, and Freese 2023 (PNAS submitted), who identified the first three Supermassive Dark Star candidates, our study aims to identify many more such candidates in the JWST data. To accomplish this we use a 'two-step' Neural network approach, that trains using ~200,000 TLUSTY simulated spectra and identifies dark star candidates based on publicly available photometric data of high redshift objects found with JWST. As a validation of our method we independently re-identified JADES-GS-z13-0, JADES-GS-z12-0, JADES-GS-z11-0 as Dark Star candidates, with similar parameters as those found via a different approach in Ilie, Paulin, and Freese 2023.

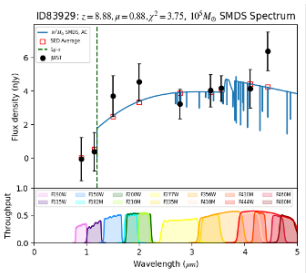
Our study presents a novel application of neural networks in the detection of Dark Star candidates. The results from our analysis demonstrate the potential of neural networks in accurately predicting the crucial parameters associated with Dark Stars. This study contributes to our understanding of early universe astrophysics and aids in the identification of elusive Dark Star objects, shedding light on the complex interplay between dark matter and stellar evolution.

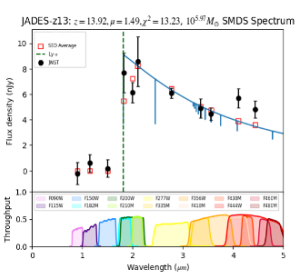
Results: Based on a chi-squared analysis, we detect the following Dark Star candidates from JWST data:











Research Fellow: **Max Shah (2024)** **Concentration:** **Undeclared**
Faculty Mentor: **Catherine Cardelús** **Department:** **Upstate Institute**
Title of Project: **Exploration of Food Security and Food Access in Hamilton County, NY**
Funding Source: **Upstate Institute**
Project Summary:

In the heart of the Adirondack Park resides Hamilton County, New York's third largest and least populated county, home to many scenic lakeside locations including Blue Mountain Lake, NY, a hamlet in the town of Indian Lake. In this hamlet lies Blue Mountain Center (BMC), an organization that hosts month-long residencies for writers, artists, and activists and contributes its administrative and hosting capacities towards projects that benefit the community and county. BMC's Hamilton Helps Project was created in 2020 with the initial desire to meet urgent, local needs surrounding the COVID-19 pandemic and has since shifted towards addressing common struggles Hamilton County residents face including food insecurity and a lack of food access. My research aimed to assess the financial and social factors that influence the prevalence of food insecurity and lack of food access in Hamilton County which would help the Blue Mountain Center stay connected to their community and give them a trajectory for their Hamilton Helps project's future endeavors.

My research employed a mixed-method approach, with a quantitative comparison of prices of common food items in Hamilton County and outside Hamilton county and a qualitative assessment of semi-structured interviews with food providers and market customers in the county. The quantitative comparison involved identifying common food items previously studied in food insecurity research, recording the available common food item prices through visits to grocery stores and convenience stores inside the county and grocery stores outside the county, and taking the difference between the average prices of the in-county food providers and outside-county grocery stores and running a significance test to determine whether a significant difference between the prices exists. I found that a significant difference existed between prices of common food items at in-county grocery stores and outside-county grocery stores but that there was no significant difference between these food item prices of in-county convenience stores and outside-county grocery stores but there were less food items available at these in-county convenience stores. The scheduled, in-person interviews I conducted with in-county food providers (including grocery store owners, farmers market managers, a food pantry owner, and local farmers) asked providers specific questions about their operations and challenges with working in Hamilton County. Interviews with farmers market customers focused on their experience with visiting the market, the role the market plays in their community, and their perspective of the common struggles Hamilton County communities face. I evaluated the interviews by listing themes of factors identified in previous food insecurity research that appeared in the responses of the Hamilton County food providers and market customers and found the most prevalent themes to be "adequacy of food available," "seasonal changes in food availability," "lack of transportation to acquire food," and "lack of affordable housing."

My research identified a difference in the expense and availability of food items between Hamilton County and its surrounding area and found that issues with sourcing fresh food products, seasonal shifts in customer base and food source options, issues with transporting food and travel distances for customers, and issues with affordable year-round housing are at the root of Hamilton County's food struggles. I highly suggest further research be put into ways to strengthen or measure the success of services that help with housing and transportation difficulties so that the overbearing issues of food insecurity and a lack of food access have less of an impact on these underpopulated, limited communities.

Research Fellow: **Kara Shepard (2025)** **Concentration:** **Anthropology**
Faculty Mentor: **Julie Dudrick** **Department:** **Upstate Institute**
Title of Project: **Small Nonprofit Capacity in Southern Madison County, New York**
Funding Source: **Upstate Institute**
Project Summary:

This summer, I worked for the Partnership for Community Development (PCD) in Hamilton, New York, a nonprofit whose mission is to enhance economic opportunity and community vitality. The PCD partners with the Village of Hamilton, the Town of Hamilton, and Colgate University to assist local businesses, seek grant funding for community development, and collaborate on community projects. In addition, the PCD is the parent organization of the Hub, which is a business incubator space that fosters economic and entrepreneurial growth in the region. The PCD communicates with numerous actors in the community from businesses to small nonprofits. Working for the PCD, I have been witness to the "behind the scenes" processes that keep the community alive and functioning. For a small, rural community the PCD sets Hamilton apart from its regional neighbors.

My research for the PCD asked what barriers small, all-volunteer nonprofits face to grow their capacity and how the PCD can help minimize these barriers. Capacity refers to the organizational structure of the nonprofit and its ability to execute its mission. To identify common issues that small nonprofits in Southern Madison County experience I interviewed nine organizations. This list includes Chenango Canal Association, Hamilton Community Chest, Southern Madison Heritage Trust, The Bell Tree, Poolville Community Center, Hamilton Chamber of Commerce, Earlville for Earlville, Hamilton Rotary Club, and the Hamilton Food Cupboard. The interviews were semi-structured. The goal of the interviews was to better understand the organization's structure, financial and nonprofit status, projects, and current challenges. After conducting interviews, I analyzed the transcripts using the coding software MaxQDA. The analysis indicated three common issues: many organizations have limited time and energy, hindering their ability to create long-term plans; organizations have limited financial resources; and small nonprofits have difficulty recruiting new members. Despite or because of these issues, many organizations lack awareness of the resources available to help them.

I used my research to create recommendations that the PCD can consider to address small, nonprofit barriers. These recommendations include: self-assessments so organizations can assess their current and future needs; capacity-building workshops; board recruitment services to facilitate board turnover; information dissemination so organizations become aware of resources; and a summit to encourage collaboration and resource sharing among local nonprofits. Resources exist within larger foundations, but not all small nonprofits are aware or feel comfortable using these resources. Thus, the PCD might direct small organizations to these external resources where they can receive help.

Research Fellow: **Sophie Smyth (2025)** **Concentration:** **Neuroscience; Mathematics**

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

Title of Project: **Exploring Youth Substance Use and Parental Perception of Risk: Conducting One-on-One Interviews with Parents and Youth in Norwich, NY**

Funding Source: **Upstate Institute**

Project Summary:

Chenango Health Network is a rural health network based in Norwich, NY whose mission is to "increase access to health and wellness information and to health care services." They house a number of different services and coalitions, including Mental Health First Aid Training, Financial Assistance for Cancer Patients, Health Insurance Assistance, Prescription Assistance, a Cancer Support Group, a Community Health Advocate, a Substance Use Disorder Community Worker, and the Drug Free Chenango Coalition, which is the coalition under which this research project falls. Chenango Health Network does work at the population level that directly improves the quality of life for the community of Norwich and Chenango County.

The research question that was the foundation of this project is, "Is there a correlation between parental perception of risk and youth perception of parental disapproval toward substance use?" This subject matter surfaced after key informant interviews and focus groups conducted by 2022 Upstate Institute Field School Fellows showed that youth substance use in Norwich is a community issue that needs to be addressed due to its dramatic increase since the COVID-19 pandemic. The 2022 Pride Survey conducted at Norwich High School revealed that youth living in Norwich tend not to believe that their parents disapprove of youth substance use habits. To explore this topic further, this research project involved conducting one-on-one interviews with parents and their youth living in Norwich.

To begin this interview process, Chenango Health Network recruited Norwich parents who have a teen between the ages of 13 and 17. The incentives for participating were $30 Amazon gift cards for the parents and $5 Stewart's gift cards for teens. As the interviews are scheduled, the parents were informed of these rewards and the nature of the interview. These interviews were conducted both in-person and over Zoom and during flexible, after-work hours to allow for maximum availability for parents and their youth. It is imperative to create an environment that is inviting while conducting the interviews. The interviews consisted of asking questions created by CADCA (Community Anti-Drug Coalitions of America) about youth substance use and parent attitudes surrounding it. Afterwards, Otter.ai technology was used to transcribe the interviews and edit their transcripts.

This project has produced data that has assisted Chenango Health Network in updating their logic models, which are to help organizations implement their solutions to community issues. They are made up of three main components: problem, root causes, and local conditions. Each aspect of a logic model requires supporting data to validate each of these components. As Chenango Health Network is entering Year 5 of the Drug Free Chenango Coalition grant, these logic models will be essential when applying for Years 6 through 10 of the grant.

Research Fellow: **Lauren Spina (2025)** **Concentration:** **Neuroscience**

Faculty Mentor: **Ernie Nolen** **Department: Chemistry**

Title of Project: **Preparation of Molecular Components for the Synthesis of a Tn Antigen Mimic**

Funding Source: **NASC Division**

Project Summary:

Tumor associated carbohydrate antigens (TACA) are found on the surface of tumor cells as a result of simplified glycosylation during cancer. One such TACA is the Tn antigen, expressed solely on cancer cells attached to a threonine or serine of a membrane protein. Tn antigen analogues with greater immunogenicity are of interest in the development of cancer vaccines designed to boost an immune response. The Nolen lab is working to form a Tn antigen mimic that is more metabolically stable while maintaining its conformational preferences and hydrogen bonding network.

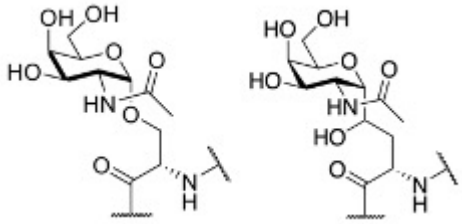


Figure 1. Tn antigen (left) and the proposed Tn antigen mimic (right).

Three reactions were performed to generate the material needed later in the synthetic process, as shown by Figure 2. This summer, a new procedure improved the yields of the intramolecular Tsuji-Trost reaction by 30% and eliminated the formation of a previously observed byproduct. The new method is more environmentally friendly as it occurs in micelles under aqueous conditions instead of in organic solvent. In addition, the new conditions use 20 times less palladium catalyst than the previous procedure.

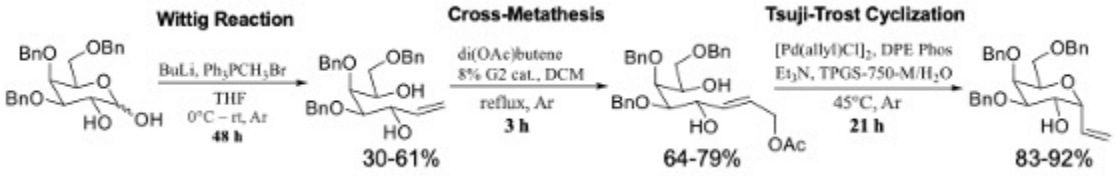


Figure 2. Partial synthetic pathway to an alcohol precursor for later synthetic use.

Research Fellow: **Meghan Subak (2025)** **Concentration:** **Political Science**
Faculty Mentor: **Meg Gardner** **Department:** **Educational Studies**
Title of Project: **Virtual Galapagos Educational Studies Research**
Funding Source: **SOSC Division**
Project Summary:

This past summer, I had the opportunity to act as the Educational Studies research assistant, helping with the development and execution of the Virtual Galapagos program. Virtual Galapagos is a joint project between the Geology Department and the Educational Studies Department, and the goal is to design a computer program that will teach third grade students about the Galapagos Islands. Through learning about the Galapagos Islands, students will gain a wider understanding of important biological concepts such as adaptations and Darwinism, biodiversity, and habitats, among other concepts. My role in this project was largely centered around observing the participants. The Educational Studies department entered the project with a goal of encouraging the development of both undergraduate and graduate students who want to be teachers, particularly those who want to teach in rural areas. I examined the group relationships and interactions, paying close attention to students' perception of self throughout the program, particularly through the lens of preparing for their professional careers.

Throughout the majority of the project, I focused on studying the interpersonal relationships between the students, which I was able to do through a variety of mediums. By creating surveys, I was able to track and compare student responses on topics such as confidence in teaching STEM topics, digital project management, group relationships, and many others. Through filming group meetings and transcribing them, I was able to collect field evidence on these topics; additionally, I had the opportunity to use unfamiliar software, such as Otter.ai and Atlas, while transcribing and analyzing the videos. As a result, the Virtual Galapagos team was able to collect both quantitative and qualitative material on the student research participants that can be used in the continuation of the project.

While the majority of my summer centered around Virtual Galapagos, I also had the opportunity to conduct my own research, and I chose to focus on climate education. I researched which methods have proved effective in teaching elementary school-aged children about the climate crisis, paying special attention to teaching about climate in a rural context. As a part of this, I conducted interviews with teachers from the surrounding area, asking them how they implement place-based teaching and a pedagogy that is unique to Central New York. The teachers I spoke with provided incredibly valuable insight, detailing how they have been able to engage students in learning about the climate crisis by providing examples specific to Madison County and encouraging students to imagine how climate change has impacted them specifically. In addition to researching educational methods employed in teaching the climate crisis, I also examined why climate education is so varied across the United States. I researched the different guidelines that different states have implemented across the country, placing emphasis on the fact that there is no federal framework for teaching about the climate crisis- explaining why students may receive incredibly different lessons on it throughout the United States. At the conclusion of my research, I created a poster with my findings, which I presented at the annual poster fair in July.

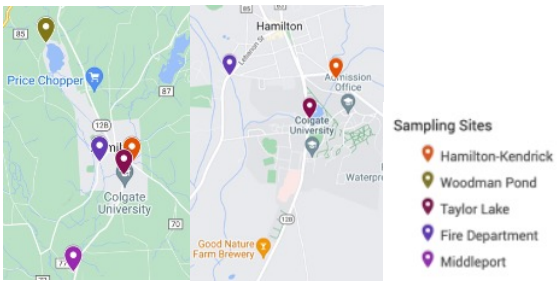
Research Fellow: Harshitha Talasila (2026) **Concentration:** Environmental Studies
Faculty Mentor: Linda Tseng **Department:** Environmental Studies; Physics and Astronomy

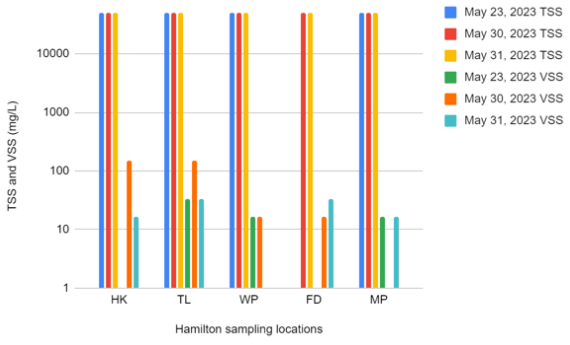
Title of Project: Water Quality Monitoring in Hamilton
Funding Source: UNST Division
Project Summary:

Water quality monitoring is necessary to ensure the well-being of people and the environment. From treated wastewater to agricultural runoff, there are various sources from which contamination of water bodies may occur. The Clean Water Act of 1972 and the Safe Drinking Water Act of 1974 (SDWA), have each created water quality standards for the health of the environment and humans, respectively. While contaminants are defined broadly as anything that is not a water molecule, there are four general categories that define them: physical, radiological, biological, and chemical. Regularly monitoring the water quality of local streams and rivers can help identify and address the pollutants in water.

Specifically, this research aims to identify suspended solids and chemical contaminants in local waterways to better understand Hamilton's water quality as well as explore Hamilton's impact on the greater Chesapeake Bay. About one liter of samples was collected from five sites (Woodman Pond, Taylor Lake, Hamilton, and Kendrick intersection, Fire Department, and a site on Middleport in Randallsville; see figure on the left below) which were selected to be monitored covering sites as close to the source water as possible, sites in Hamilton, and sites downstream from Hamilton. The sampling time was consistently in the morning to avoid any temporal variations throughout the day. Once samples were collected, about 40 ml of water was first filtered through 0.2-µm filters in preparation for cation and anion analysis; 20 mL of the samples were filtered through pre-weighed 0.45-µm glass fiber filters in order to determine total and volatile suspended solids (TSS and VSS); and the rest of the samples were filtered through 0.45-µm glass fiber filters to be used for organic chemical analysis. These filters would then be weighed again after being dried at 105° for 24 hours, and again after being furnaced at 500° for 2 hours. Our results (see figure on the right below) showed that most of the particulate matter captured by the filter was inorganic because the VSS was a small portion of the TSS. Through this, we concluded that the areas where we sampled contributed turbidity mostly as inorganic sediment to the water downstream.

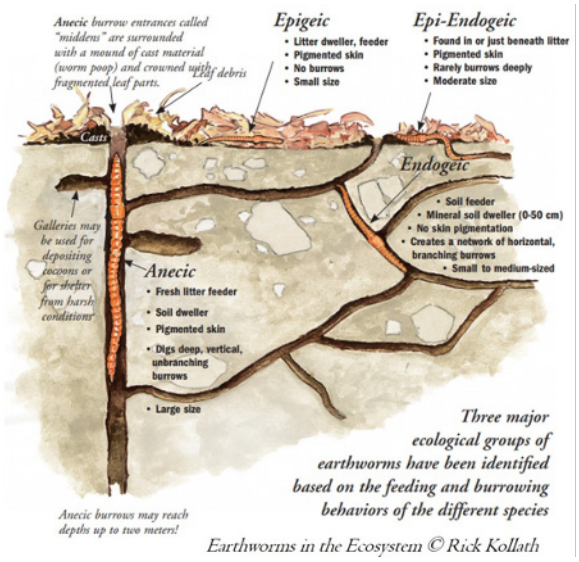
In addition to analyzing the turbidity of water, gas chromatography (GC) was used to identify chemical contaminants. This was done for the 0.45-µm filtered samples in order to prepare solid phase extraction (SPE) cartridges for the GC. The 0.45-µm filtrate was stored in the refrigerator for less than 24 hours before SPE to prevent degradation of chemicals. The primary pollutants recorded were 4-acetamidophenol (Tylenol) and the plasticizer di(2-ethylhexyl) phthalate (DEHP). These substances were recorded at all five of the sampling sites, showing their prevalence in the environment.





Research Fellow: Joy Tang (2026) **Concentration:** Undeclared
Faculty Mentor: Tim McCay **Department:** Biology; Environmental Studies
Title of Project: Isotopic Niches of Invasive Asian Jumping Worms
Funding Source: NASC Division
Project Summary:

Jumping worms have recently expanded in the northeastern United States and are considered invasive and problematic. The three species of focus in my research (Metaphire Hilgendorfi, Amynthas Agrestis, Amynthas Tokioensis) are widely abundant in New York, Vermont, and other neighboring states. The three species typically coexist with each other–the presence of one usually signaling the presence of the other two species. Jumping worms are mainly categorized as epi-endogeic, meaning they mostly occupy the top layer of organic material. Their main dietary source consists of leaf litter and other organic material. Invasive worms have become an ecological concern due to their detrimental impact on the deterioration of forest biodiversity, carbon dynamics, and increased erosion. However, even though the three species are all categorized as epi-endogeic, research by previous scientists have suggested that they differ in soil feeding and feeding ecology. Little is known about the invasive worms' niche partitioning and what variables have enabled their rapid and concerning occupation of the Northeastern United States. This study was started by a previous senior (Mieko Kim '23). The aim of my work has been to further elaborate on her findings and study the niche partitioning and feeding ecologies of the three species.



Mieko Kim had originally designed her experiment with worm samples collected from the Adirondacks, but was concerned as the worms had been preserved in ethanol for a prolonged period of time. Her other concerns included small sample size and poor homogeneity of the worm samples. Thus, my experiment was run with hand-collected samples from plots of selected land on Colgate University. Samples were prepared less than 3 days after collection, with dissection occurring less than 24 hours after the worms were placed in ethanol. The minibeater provided an effective method of pulverization, resulting in a homogeneous worm mixture that resembled powdered sugar. The mixture was then rolled and run through the mass spectrometer with assistance from Professor William Peck, chair of the Geology Department.

The results of the experiment should examine the idea of using the natural abundance of carbon and nitrogen stable isotopes (13C and 15N) to refine the widely used ecological groups of these invasive species. Results could also further explain interspecies and intraspecies interactions. Ecological niche theory has stated that invading species become established only if they are able to exploit resources unused by native species and survive random mortality. Thus, results could possibly facilitate the further discussion of how unused soil has encouraged the species successful invasion of Northeastern forests.

Research Fellow: **Mia Toribio Lantigua (2026)** **Concentration:** **Undeclared**
Faculty Mentor: **Ramesh Adhikari** **Department:** **Physics and Astronomy**
Title of Project: **Leaf-Based Triboelectric Nanogenerators**
Funding Source: **National Science Foundation**

Project Summary:

A Triboelectric Nanogenerator is a device that transforms mechanical energy into electricity. This particular project utilizes triboelectrification, where two dissimilar dielectric materials make repeated contact and generate friction. As a result, a potential difference is formed, allowing for an exchange of electric charges between the surfaces involved.

The Leaf-based triboelectric materials in this project consist of multiple components, including Natural rubber, dehydrated leaves from Northern Red Oak (Quercus rubra) and Norway Maple (Acer platanoides) trees, Polyvinylidene fluoride solution, Double-sided tape, graphite, copper tape, Polyamide Film, and Kapton tape.

To create Triboelectric materials, the leaves were first soaked in sodium hydroxide alkalized water, air dried, and then coated in a 1% PVDF solution. The coated leaves were cut into 8 x 9 cm pieces and combined with a copper or graphite electrode measuring 5 x 7 cm. During the operation of TENGs, a stepper motor-driven linear actuator controlled by an MCU ensured consistent and periodic contact between the dielectrics.

Our study involved experimenting with varying operational forces, dielectric material combinations, chemical solutions, and electrode materials to determine their impact on the output performance of the L-TENGs. The combination of 10B graphite electrodes and NaOH coating produced the best results, generating voltage levels of up to 8 volts. Moving forward, we aim to incorporate water motion into the L-TENGS and create a leaf-based film that can be applied directly to the electrode.

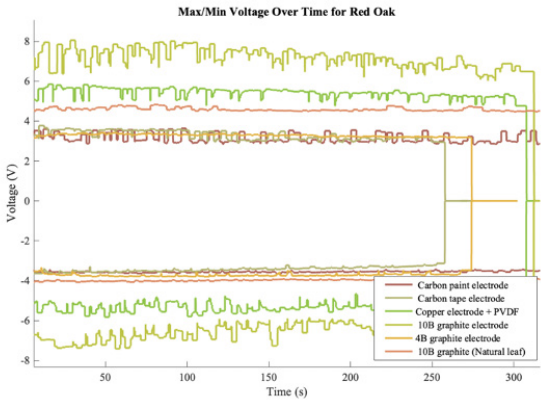


Figure 1: Voltage outputs for Red Oak Leaf

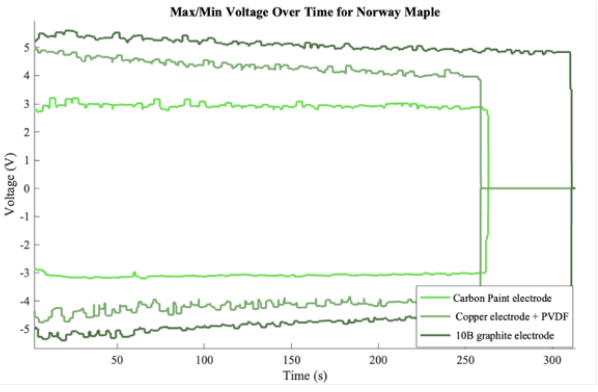


Figure 2: Voltage outputs for Norway Maple Leaf

Research Fellow: **Talia Troy (2025)** **Concentration:** **English**
Faculty Mentor: **Ariel Martino** **Department:** **English**
Title of Project: **Flowers and Spiders: Faith Through Figurative Language in Puritan Literature**
Funding Source: **AHUM Division**
Project Summary:

This project includes two parts. The first is a carefully curated, in-depth, annotated bibliography of twelve works, including writings by influential poets, theologians, and ministers such as John Owen, John Calvin, William Perkins, Jonathan Edwards, and Anne Bradstreet. The second part explores the theme and relevance of imagery and other figures of speech within Puritan literature. The primary goal of this project was to produce an annotated bibliography of works significant to Puritan ideology. While reading an array of theological and poetic writings, I noticed numerous moments of vivid imagery, personification, and metaphors where authors consistently choose to use illustrative and colorful language. Furthermore, writers often returned to the same images: Bradstreet's flowers, Owen's sickness and garden, Calvin's weeds, Edwards's spider, and his image of rotted ground.

The focal point of interest for part two of this project was William Perkins' argument about biblical language in *The Art of Prophesying*. According to Perkins, Scripture should only be read literally, and in the moments of text where authors engage with figures of speech or intense imagery, they are doing so to amplify meaning, provide a sense of literary pleasure, and nurture faith. In these works, I consistently found connections between authors' efforts to describe reality and the moments where authors employed figurative language. This relationship between language and faith piqued my interest. Part two of this project uses Perkins' ideas as a guiding framework to understand the use of similes and imagery in Puritan theology and poetry. While figurative language may be written off as deceptive or untrue, for Puritan writers and readers, figurative language was a tool to cultivate faith and address concepts that literal speech could not express.

Research Fellow: Neha Viradia (2025) **Concentration:** Physics

Faculty Mentor: Ramesh Adhikari **Department:** Physics and Astronomy

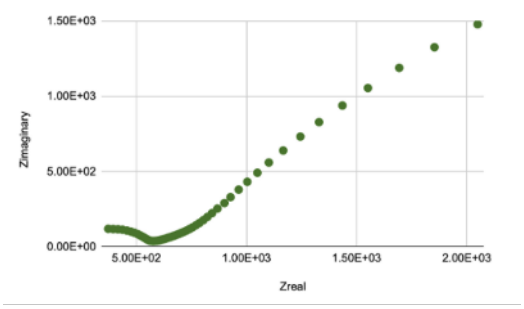
Title of Project: Development of Leaf Based Electric Double Layer Capacitors

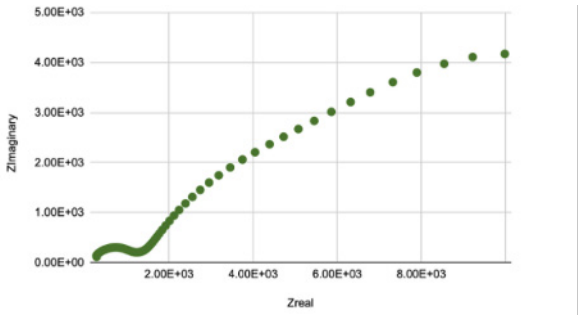
Funding Source: National Science Foundation

Project Summary:

Electronic waste presents a large issue to our environment and global public health. Therefore, biodegradable electronics are instrumental to develop in order to protect our Earth and its citizens. A certain electronic device, the capacitor, is found in almost every circuit imaginable, and has great power storage capabilities. Unlike a battery, capacitors can be charged almost instantly and can handle a much greater number of charge and discharge cycles, therefore are more long lasting and lead to less waste. The capacitor consists of two electrodes face to face, with some separation between them. Once a voltage is applied between the two electrodes, an electric field is created through the separation, thus storing charge in between the electrodes. One electrode becomes positively charged while the other becomes negatively charged due to the voltage difference between the two. The electric double layer capacitor (ELDC) comprises two electrodes with a mobile electrolyte in the space between the two electrodes. When the voltage is applied and the electrodes are charged, the electrolytes are attracted to the oppositely charged electrode, thus creating a layer of positive or negative charges on either side. This increases the capacitance of the device, as now two capacitors are present between both electrodes.

The goal of our research is to develop leaf-based EDLCs, which are biodegradable and have a large capacitance and charging capabilities. Two different methods were used in order to construct the leaf-based electrodes. The first method entailed soaking dried leaves in a polypyrrole (conducting polymer), FeCl3 and HCl solution. The second method consisted of treating carbon nanotubes (CNTs) with acid, and with heat and pressure, coating dried leaves with the CNTs. Numerous types of separators were used: polyvinyl alcohol (PVA), cellulose, and polyamide film. The electrolyte that was used was aqueous H3PO4. A solution was made using PVA and H3PO4, and cellulose was soaked in the electrolyte in order to construct an ELDC. The polyamide separator was used to construct a classic capacitor in order to test the functionality of the leaf based electrodes.





Electrochemical Impedance Spectroscopy (EIS) was one of the methods used to collect data and observe the charge carrying/storing capabilities of each device. Below, two Nyquist plots are shown for two different capacitors. The real impedance of each device is on the x-axis, and the imaginary impedance is on the y-axis.The semicircle in the higher frequency portion of the graph signifies the presence of some large source of resistance in conjunction with some level of capacitance. As the frequency decreases, the graph extends at a phase angle of 45 degrees. A phase of 45 degrees suggests the presence of a Warburg Diffusion Element, meaning that there is some loss of charge through one side of the capacitor via diffusion. These EIS plots show that the devices constructed have significant resistive behavior and passage of charges through the device. One possible source of resistance in the device could be from redox reactions occurring due to the presence of the electrolyte, as many of the EIS plots collected look similar to those of a battery. The EIS plots of capacitors made with the same electrodes but no electrolyte have phases angles of about 90. Therefore, we could assume that the electrolyte is the causing a large amount of resistance in the device by causing charge transfer (redox) reactions.

Our largest goal for our research is to eliminate the source of resistance by stopping the transfer of charge across our device caused by redox reactions. Our devices need significant improvement in regards to increasing the capacitive behavior and eliminating the sources of resistance as much as possible.

Research Fellow: Dylan Vlasak (2025) **Concentration:** Neuroscience

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

Title of Project: Measuring Perceptions of Within- and Between-Group Status: A New Measure, Replication, and Extension Exploring the Effects of Subjective Within-Group Status and Health among White Americans

Funding Source: NASC Division

Project Summary:

The United States has high racial economic inequality: for example, the median White family has significantly more wealth than the median Black and Hispanic family (Bhutta et al., 2020). This economic gap has helped to form and perpetuate the stereotype that White people in the United States are wealthy (Skinner et al., 2022). While U.S. racial economic inequality most clearly harms racially minoritized groups, in my summer research, I explored whether this inequality may also harm White people who upwardly compare to the perceived high-status of their racial group. Indeed, previous research has found that White Americans, independent of their objective status (i.e., income and education), tend to feel they are falling behind "most White people." And, these perceptions of falling behind predict worse mental and physical health (Cooley et al., 2021; Cooley et al., 2023). These findings suggest that how White people subjectively feel about their status may be a more powerful predictor of important life outcomes (e.g., health) than their objective status.

Figure 1: A sliding scale measure of within and between-group status

Figure 2: The MacArthur Ladder

To build upon these ideas, I first ran a pilot study that both replicated prior findings and worked to improve the measurement of subjective within-group status by developing a new measure (see Figure 1). In the past, researchers have used the MacArthur Ladder (see Figure 2) to assess subjective status (Adler et al., 2000). In this measure, those on the highest rung represent people with the highest status, and those on the lowest rung represent people with the lowest status. When assessing perceptions of within-group status (i.e., how do White people feel they compare to their racial group), researchers would ask participants to complete this ladder twice, once when thinking about the self and once when thinking about other White people; they then measured the perceived discrepancy between the rung people chose for the self vs. the rung they chose for their racial group. Figure 1 assesses this same psychological construct, but in a single scale and with more racial groups included. As such, this measure allows us to simultaneously compare perceptions of within- and between-group status, a design that may be more applicable to actual status comparisons made in the real world. For example, this scale can capture the perception of being simultaneously behind one's own racial group and slightly ahead of other racial groups. It enables nuance in other ways too, such as allowing more variability in participants' ratings due to the 100-point scale (vs. 10 ladder rungs).

In addition to testing our new measure, and ensuring it improved upon the psychometric properties of the ladder measure, we also replicated prior work to find that most White participants perceived themselves to be lower status than "most White people." Moreover, these feelings of low within-group status predicted the experience of fewer positive emotions, which then predicted worse self-reported mental and physical health. Feelings of lower-within group status also predicted increased anxiety and worse emotional regulation--outcomes that had not been explored in prior work. Together, these results support the hypothesis that perceptions of within-group status among White Amercians predict important facets of health. In order to move beyond self-reported health measures, I next designed a longitudinal follow-up study that measures perceptions of within-group status using our new measure (Figure 1), as well as a variety of physiological health markers, including respiratory sinus arrhythmia (RSA), pre-ejection period (PEP), skin conductance, and cortisol. These health indices will allow us to analyze functioning of the autonomic nervous system and the HPA axis, and assess their relation to perceptions of within-group status. We will launch this study in 2024 once the Olin Hall renovation is complete.

Research Fellow: Maxwell Walker (2026) **Concentration:** Undeclared
Faculty Mentor: William Peck **Department:** Earth and Environmental Geosciences
Title of Project: Zinc Oxide Search in Mesoproterozoic Grenville Province Marble Samples
Funding Source: Doug Rankin '53 Endowment - Geology Research Fund
Project Summary:

Zinc is a widely-used and important mineral. About three-fourths of zinc is used industrially to galvanize and alloy other metals, and the remaining one-fourth is used by the rubber, paint, chemical and agricultural industries, among others. Most zinc (around 95%), is mined from an ore called sphalerite, which has a chemical composition of ZnS. When zinc is separated from sphalerite, sulphuric acid is also created. Sulfuric acid has various uses, but uncontrolled acid release into the environment, which happens before, during, and after mining, can cause a wide array of environmental and health hazards. Because of this, the mining industry is interested in discovering deposits of zinc oxides, silicates, and carbonates, which do not produce acid when exposed to the surface environment. These ores can be identified in samples by the use of a compound called "Zinc Zap", a zinc-sensitive organic reagent which stains them bright red. The goal of this project was to conduct a search for zinc oxides in Colgate University's collection of marble samples from the Mesoproterozoic Grenville Province of New Jersey, Ontario, and Quebec, many of which were collected in areas with potential or known deposits of zinc oxides.

I began this project by mixing the components I needed for my Zinc Zap. The compound itself deteriorates fairly quickly so I had to keep it in two separate parts and mix a new small batch every day. Once that was done I identified the samples that I would be working with: about 700-800, which were scattered across around a dozen drawers in the school archives. These I carted up to the lab in batches of about a hundred, where I cataloged them and applied a spot test of the zinc zap. Then I would check the samples for stains, write down my observations (if any), separate the samples with positive results, and repeat the process. Some localities had a higher tendency than others to produce positive tests, but on average 1 out of every 50 samples tested showed positive results. When I had tested all of the available samples and accumulated a collection of samples with positive results, I cut them with a wet slab saw, polished them with sandpaper wheels, and put them through a carbon coater. These preparations allowed me to examine them using a scanning electron microscope, which allowed me to navigate around the sample surface and identify the minerals based on the characteristic X-rays emitted under the electron beam. Then I would look for the candidate zinc minerals and identify as many distinct minerals as I could in the sample. In this reconnaissance survey of 14 positive samples, ZnO, ZnSiO, ZnGaMo, and ZnSiO with Mg/Fe were identified, in addition to ZnS (Sphalerite) in 4 of the samples.

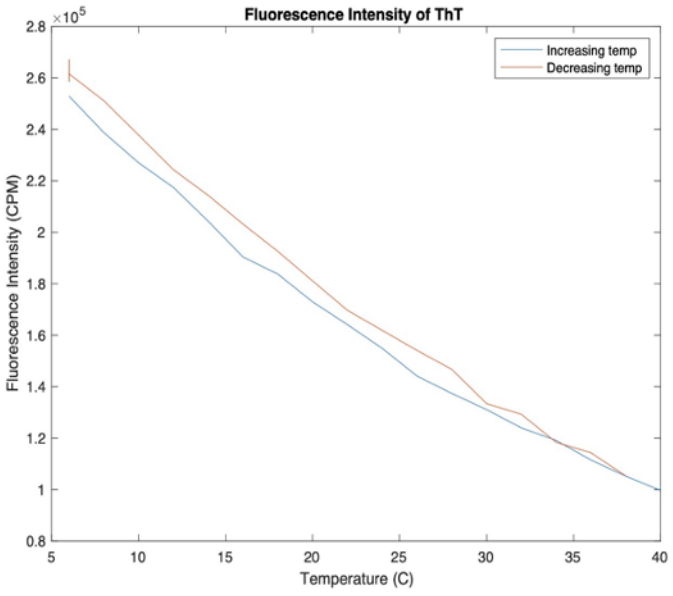
All of the samples from New Jersey that were ZincZap positives showed either ZnO or ZnSiO as a constituent mineral, and two of them also had sphalerite. None of the samples from the Tichbburne quadrangle (TE) in Ontario that had positive reactions to the ZincZap showed any traces of zinc minerals in the SEM. It is likely that this was because I falsely identified them as positive, especially considering that none had very strong apparent reactions. One sample from Long Lake showed only sphalerite, one showed no zinc at all, and the third exhibited zinc minerals seen nowhere else in this study, seemingly formed because of a high concentration of gallium and molybdenum in the sample. These always formed in areas of the sample with an excess of lead. The other samples were from a variety of other localities and were largely unremarkable, with either no zinc or only one identifiable instance. The analyzed samples were therefore just over half true positives, though it is possible that the true amounts of zinc were not represented by the portion analyzed.

Research Fellow: **Katherine Wand (2024)** **Concentration:** **Biochemistry**
Faculty Mentor: **Eric Muller** **Department:** **Chemistry**
Title of Project: **Nanoscale Structure and Folding of Ice-nucleating proteins**
Funding Source: **NASC Division**
Project Summary:

Proteins are complex structures that are located in cells of all living organisms and can serve many functions. Proteins that are bound to the membrane of cells, which are found difficult to study and image. Specifically, ice nucleating proteins enable bacteria to promote ice formation at higher temperatures. This bacterial protein is found in nature on the surfaces of plants and in the atmosphere. Their purpose is known, however there is little knowledge on the mechanism in which water is altered. There have been multiple studies looking at the interfacial water ordering around active ice nucleating proteins.

We investigate some of the stressors that could affect the ice nucleating activity in SnoMax using a fluorometer; stressors include temperature and pH. A fluorophore is needed in order to visualize the Snomax within a solution. Using thioflavin T, we found that as the temperature increases, the fluorescence intensity decreases simultaneously. This indicates the denaturing or unfolding of the proteins.

To image ice nucleating proteins we are using IR s-SNOM and atomic force microscopy. We look to further our knowledge on the stressors of SnoMax through fluorimetry, and find the best way to use AFM and IR s-SNOM to image the membrane bound proteins.



Temperature hysteresis assay of the fluorescent intensity of SnoMax using Thioflavin T. Temperature 6°C to 40°C, and back down to 6°C.

Research Fellow: **Andy Weinstein (2024)** **Concentrations:** **Political Science; Art and Art History**

Faculty Mentor: **Masha Hedberg** **Department:** **Political Science**

Title of Project: **From the Printing Press to Twitter Posts: Analyzing the Impact of Technology on the Effectiveness of State Propaganda**

Funding Source: **Center for Freedom and Western Civilization, James Madison Fellow**

Project Summary:

AI, like previously transformative technologies such as the printing press, film, and the internet, holds the potential to revolutionize the landscape of information and communication. Already, dystopian visions of AI-powered propaganda and disinformation campaigns—from deepfake technology, to social media bots, to targeted and personalized algorithms—have made mainstream headlines. The general consensus surrounding these technological innovations seems to be that they will invariably create tools that governments can use to sway public opinion more effectively and easily. But is this really true? Has this been the case in regards to past technological innovation? While we cannot know what the AI-future holds, we can learn valuable lessons from history.

This research examines prior leaps in information and communication technology, beginning with the printing press and ending with the explosion of social media, in order to understand whether governments can or cannot harness technological progress to enhance state propaganda. Specifically, I have traced the effect of technological innovation on Russian and Soviet propaganda during the 20th and early 21st Century. Although my research draws on numerous country cases, Russia features most prominently because of its long-standing use of propaganda. The focus on Russia's history enables me to investigate a case where the government has consistently turned to propaganda to control society, utilizing many different technological mediums over time to do so.

This paper's findings suggest that historically, technological advancements have predominantly amplified the effectiveness of state propaganda by providing governments powerful tools to mold public opinion with little countervailing dissent. However, recent technological strides have democratized these tools, allowing the public to challenge state narratives. It follows then that the extent to which a technological advancement enhances propaganda efforts is contingent upon a state's degree of control over how their population interfaces with said technology, an argument central to this paper.

Research Fellow: **Jessica Wen (2024)** **Concentration:** **Geology**

Faculty Mentor: **Aubreya Adams** **Department:** **Earth and Environmental Geosciences**

Title of Project: **Investigating the Hydration of the Alaskan Subduction Zone with Radial Anisotropy**

Funding Source: **Norma Vergo Prize**

Project Summary:

The Alaskan Subduction Zone is one of the most seismically and volcanically active areas in the world. Variability east-to-west along the subduction zone has resulted in non-uniform distribution of larger magnitude earthquakes (> 7.9) clustered in the eastern Semidi Segment due to interplate locking. This project explores the observed variability using ground motion data recorded on land and ocean bottom seismometers collected between 2018-2019 from regional seismic networks, including the Alaska Amphibious Community Seismic Experiment and the Alaska Transportable Array. This summer, we investigated the hydration of Alaskan Subduction by observing changes in radial anisotropy at various depths to understand the east-to-west variability of the Alaskan Subduction Zone.

Seismic anisotropy observations can provide information about subduction deformation, mantle dynamics, and crystallographic orientation of mantle minerals. Radial anisotropy is utilized in this project to observe the anisotropy due to lattice-preferred orientation (LPO) in olivine, specifically the change from A-type to hydrous B-type olivine. Radial anisotropy measures the differences between the propagation speeds between the horizontal

Research Fellow: **Sam Wilder (2025)** **Concentration:** **Physics**

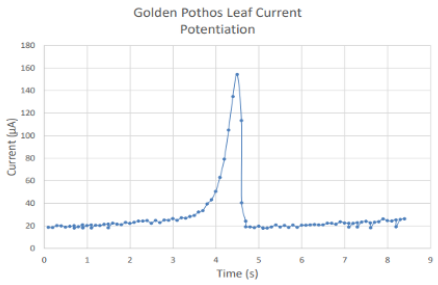
Faculty Mentor: **Ramesh Adhikari** **Department:** **Physics and Astronomy**

Title of Project: **Bio-based Memristor Creation, Characterization, and Neural Plasticity Mimicking**

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

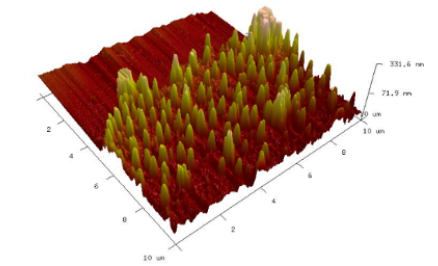
Project Summary:

A memristor is an electrical component with a resistance dependent on the past history of the device. This phenomenon is known as resistive switching. By applying different voltages to the device, it is possible to control the current response of the memristor. These responses are classified as an "ON" or "OFF" state and allow the memristor to store data based on a traditional computing "0" or "1" system. Memristors may also exhibit repeated and prolonged conductance increases or decreases after the application of voltage pulses. These responses are similar to the potentiation (increase) or depression (decrease) of synaptic weight between neurons based on the frequency of electrical signals across the synapse. This type of behavior is known as neural plasticity mimicking. The unique properties of memristors make them useful in a variety of computing applications.



Current over time graph obtained by sending rapid -10 V "ON" pulses (15 ms pulse width) immediately followed by 3 V "read" pulses (25 ms pulse width) with an 100 ms period across a Golden Pothos leaf. Measurements are taken once per period during the read pulse.

Our goal was to further investigate the memristive behavior of the Golden Pothos plant leaf, including neural plasticity mimicking, and our research evolved to refining our bio-based memristor creation methods. We used an arbitrary function generator to send continuous pulses to verify the neuromorphic behavior of the Golden Pothos leaf. We found the leaf will exhibit short-term potentiation (STP) behaviors for a short period until there is a "breakdown" of current wherein the current suddenly and rapidly decreases. This pattern repeats indefinitely under constant pulsing.



3D AFM image comparing a 10 μm by 10 10 μm section of the wafer without any coating and a section containing the silver coating with tryptophan growths. Height scale is provided on the right edge.

We also investigated the usage of L-tryptophan as a memristor component. We created a solution of 25 mg/mL deionized water and L-tryptophan and drop coated the solution onto a silver wafer to create both an electrode and a resistive switching layer for the memristor. Using L-tryptophan as the resistive switching layer of a memristor yielded a hysteric I-V curve that is typical of memristors. Additionally, the curve showed a high ON-OFF ratio. However, the drop coating method did not produce consistent results due to the thickness of the L-tryptophan layer. By instead evaporating the L-tryptophan in vacuum conditions at a temperature of 205°, a L-tryptophan layer in the nanometer range formed on the silver wafer. L-tryptophan shows great promise as a memristor and thin-film component, but more research is necessary to fully characterize the L-tryptophan memristor and to understand the true nature of the Golden Pothos leaf's current breakdown behavior.

Research Fellow: Sophia Wlodek (2025) **Concentration:** Biochemistry
Faculty Mentor: Ernie Nolen **Department:** Chemistry
Title of Project: Preparation for a Cross-Metathesis Reaction to Synthesize a Tn Antigen Mimic
Funding Source: NASC Division
Project Summary:

A significant characteristic of cancer cells is the presence of Tn antigens on their cells' surface which are weakly immunogenic. However, a synthetic Tn antigen mimic that replaces the natural carbon-oxygen bond with a carbon-carbon bond has the potential to be strongly immunogenic which can lead to the development of cancer diagnosis and treatment techniques. In the Nolen Lab this summer, our target Tn antigen mimic results from the cross-metathesis of a carbohydrate and an amino acid component, synthesized from galactose and D-serine respectively.

To produce the desired galacto-heptenitol, we first added a tert-butyldiphenylsilyl protecting group to the primary hydroxyl group (Figure 1. A), to ensure the acetal will be added to the secondary hydroxyl groups in the proceeding step. Then, the protected galactose was reacted with acetone to form an acetal on neighboring axial and equatorial hydroxyl groups (Figure 1. B). Finally, the alkene was formed through a Wittig reaction and the formation of the galato-heptenitol (Figure 1. C) was confirmed through NMR testing.

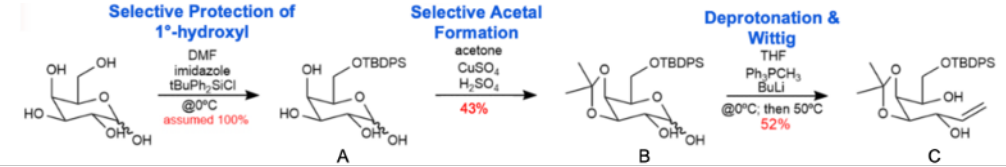


Figure 1. The synthetic route from galactose to galacto-heptenitol. Percent yields are reported.

The cyclic carbonate was prepared by first forming Garner's aldehyde from the starting material D-ser-ester. This was achieved by adding protecting groups to the primary amine and hydroxyl groups (Figure 2. A and B), after which diisobutylaluminium hydride was used to reduce the ester into an aldehyde (Figure 2. C). With the formed Garner's aldehyde, a Grignard reaction added a vinyl alkene group (Figure 2. D). Lastly, the resulting diol (Figure 2. E) was cyclized using disuccinimidyl carbonate and the two hydroxyl groups (Figure 2. F). The formation of the cyclic carbonate was confirmed through NMR testing.

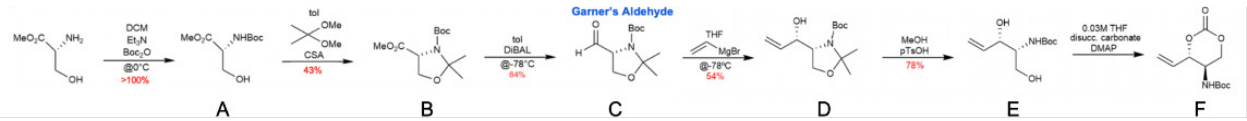


Figure 2. The synthetic route from D-Ser-Ester to a cyclic carbonate via Garner's Aldehyde. Percent yields are reported.

In the future, both the galacto-heptenitol and the cyclic carbonate syntheses will be repeated with the intent to increase the percent yields. Furthermore, the cyclic carbonate synthesis will also be run with an adapted procedure in an attempt to eliminate the production of an unusable isomer of the cyclic carbonate that is a product of the current method.

Research Fellow: **Wendy Wu (2025)**
Faculty Mentors: **Padma Kaimal**
John Crespi

Concentration: **Art and Art History**
Department: **Art and Art History**
Departments: East Asian Languages and Literatures; Asian Studies

Title of Project: **Motion in the Art During the Han Dynasty**
Funding Source: **AHUM Division**
Project Summary:

I researched with Professor Kaimal and Crespi on motion concepts in performer (Baixi) figurines, stone and brick reliefs, and bronze cowrie containers during Han Dynasty China and the ancient Dian state in today's Yunnan province. Motion is a shared feature across different media of these objects.

I started on campus with scholarly sources about the theory of motion in clay Baixi figurines and jade dancers. As I learned more when the research proceeded, I extended my focus to new media, including bronze objects that demonstrate motion. For the second half of my research, I clarified and developed my thoughts by visiting the tomb sites and museums in Changsha, Shaanxi, Henan, and Beijing in China and using museum databases. I organized and output the findings by designing a website-based exhibition centering around my research. https://hanyunexhibition.com/exhibits

Motion is revealed differently in each type of art covered in my research. In Baixi and performer figurines, instantaneous gestures captured by the artists suggest big and continuous movements, thus conveying a sense of vivid expression and motion. In pictorial stone and brick reliefs, the images suggest motion as they emphasize tension and dramatic power dynamics. In some reliefs with performing topics such as Baixi reliefs, more complex movements must be demonstrated in the single image of the brick's surface. The different gestures or positions of resemblant figures suggest the movement's progress, and thus the motion is conveyed. Motion exists in the bronze cowrie container as the viewer interacts with the object. The cylinder shape of the cowrie containers creates a visual effect that human or animal figures decorated on top of the containers are animated and moving. The composition of the figures suggests hierarchy. The supreme ones are still even when the container rotates or the viewer observes it in a circular course.

Research Fellow: David Xiu (2024) **Concentrations: English; Philosophy**

Faculty Mentor: Peter Balakian **Department: English**

Title of Project: Bei Dao's exile poems: the hermetic imagery of secrecy and alienation

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

Project Summary:

Bei Dao is one of the most acclaimed Chinese-language poets of the generation. His early poetry stands against the mechanical social realism concept of art and creates a kind of poetry in a minimalist style marked by the use of metaphor and symbols. The Chinese communist party exiled him due to the influence of his advocacy and writing, though he did not directly participate in the 1989 Tiananmen Square Protests. After 1989, he entered a period of exile in the West, living and teaching in numerous countries including Western Europe and the United States. During this period, his poetry went through dramatic changes, evolving into an allusive and complex form known for its "wholly original poetic language composed of mysterious and arresting images tuned to a distinctive musical key". In my essay, I will show how Bei Dao's poems have evolved by examining six poems by Bei Dao from his early poem "The Answer" to his post-exile works in the poem collection *Old Snow and Forms of Distance*.

To give a clearer view, I hope to show how an authoritarian political system has impacted his poetic imagination by providing a biographical background of Bei Dao's life: his participation in the Misty Poets Movement and the composition of *Jintian* Journal, and how his poetry rejects Maoist principles of socialist realism. I will form an argument with a detailed analysis of Bei Dao's early poem "The Answer" which was created out of his incisive reflection on the political turmoil of The Cultural Revolution. In this, I hope to show how an authoritarian political system has impacted the poetic imagination that makes Bei Dao develop his distinct hermetic and secretive poetic imagery to avoid the state's censorship; and how his highly subjective, imaginative, and modernistic poetry rebels against the state's suppression on art. In the second half of my essay, I will examine a selection of poems from his post-exile work in the collections *Old Snow and Forms of Distance* to show how his poem evolved to a new level that takes his readers deep into a psychological and emotional state. In short, I will explore how Bei Dao internalizes the poetic form he developed in his early life living under the political oppression of 1980s China. I will also show how his introspection about his experience in expatriation renders another layer of solitude, a sense of displacement, and an intense longing for China into his poetry.

[1] Bei Dao. The Rose of Time. Trans. by Eliot Weinberger, Anvil Press Poetry, 2010.

Research Fellow: Marisa Zarcone (2025) **Concentration:** Mathematics

Faculty Mentor: Gabe Sosa Castillo **Department:** Mathematics

Title of Project: The Reconstruction of Monomial Orders

Funding Source: NASC Division

Project Summary:

An order is a ranking of objects according to a particular sequence or set of criteria. Whether those objects are words and we are alphabetizing titles for a research paper, or they are soccer players and we are trying to rank the top ten of all time, orders are quite common in our everyday lives.

One way of ordering involves assigning weights to different characteristics. For example, an objective ranking of the top ten soccer players of all time may vary depending on how the graded achievements of each player are weighted. We can represent these characteristics as variables—say x, y, and z—where x represents World Cup wins, y represents total goals scored, and z represents Ballon d'Or recognitions. A player with 2 World Cup wins, 75 goals scored, and 1 Ballon d'Or would be represented by the vector $[2\ 75\ 1]^T$ or, equivalently, the monomial $x^2y^{75}z$, while a player with 1 World Cup win, 112 goals scored, and 2 Ballon d'Ors would be represented by the vector $[1\ 112\ 2]^T$ or the monomial $xy^{112}z^2$. If the number of World Cup Wins is assigned a higher weight than total goals scored and Ballon d'Ors, the player with 2 World Cup wins would be ranked above the player with just 1 World Cup win. However, if goals scored is assigned the highest weight of the three achievements, the player with 112 goals would be ranked the best. Each ranking depends on devising a system that assigns a unique weighted value to a specific ordered vector where each entry corresponds to the grade of its associated characteristic. This ranking system, when applied to the set of all monomials in n variables, is known as a monomial order.

The lexicographic order is one common type of monomial order that ranks monomials according to how high the power of its variables when written in alphabetical order are, hence the name. This means that $z^2 <_{lex} yz <_{lex} xy^4 <_{lex} x^2yz <_{lex} x^3y <_{lex} x^4$, and it is analogous to valuing World Cup wins (x) over total goals scored (y), and total goals scored (y) over Ballon d'Ors (z). It is a known fact that there are infinitely many monomial orders for monomials in n variables, whenever $n \geq 2$.

During the first two weeks of our project, we learned about some important concepts in the fields of Algebraic Geometry and Commutative Algebra in order to better understand the applications of our research. We then discussed several known results about monomial orders that would guide our project.

By the end of the first two weeks, we began to center our attention on the concept of reconstruction—our main research question. A monomial order is reconstructible if it is uniquely determined by its induced orders; given a monomial order, $<_\tau$, in n variables, we can define its i^{th} induced ordering, $<_{\tau,i}$, as the monomial order in the $n-1$ variables that are obtained when the i^{th} variable is removed, i.e. $\alpha_{[-i]} <_{\tau,i} \beta_{[-i]}$ if and only if $\alpha <_\tau \beta$, whenever α and β are monomials with 0 in the i^{th} position. A monomial order in n variables has n induced orders. It is known, by Robbiano's Theorem, that a monomial order can be represented as a matrix where the first nonzero entry in every column is positive, and the only vector with integer entries in the nullspace of that matrix is the zero vector. It is also true that if an invertible matrix has entries in the rational numbers and the first nonzero entry in every column is positive, then that matrix defines a monomial order. The ability to represent monomial orders as matrices allows us to turn this abstract topic into something more computationally favorable. Since matrices with entries in the rational numbers can be reduced to a unique form where each reduced matrix represents a different monomial order, our project exclusively deals with Monomial Orders Represented by Matrices with Only Rational Entries (MORMOREs). We refer to the reduced matrix as the Adjusted Reduced Row Echelon (ARRE) form, and all matrices representing the same MORMORE possess the same ARRE form. Given a MORMORE, we can find the matrix defining its induced i^{th} ordering by deleting its i^{th} column, and then deleting the first row that can be written as a linear combination of the rows above it.

I spent the next few weeks of the project examining monomial orders with one of my peers in order to determine which ones were reconstructible, until we were able to develop a theorem that characterizes all MORMOREs that are reconstructible in any number of variables. We found that given a MORMORE, $<_\tau$, in n variables with $n \geq 3$, where M is the ARRE form of a matrix representing $<_\tau$ and M is the matrix obtained by rearranging the columns of M to obtain an upper triangular matrix, the MORMORE, $<_\tau$, is reconstructible if and only if, when the i^{th} column of M is eliminated for some $1 \leq i \leq n-2$, and we denote the matrix that is obtained M_i, there is a row j of M_i with $1 \leq j \leq n-2$ such that j is a linear combination of one of the rows above it.

We were especially interested in monomial orders for this project because they play an important role in the computation of a Gröbner basis, which requires a fixed monomial ordering. Gröbner bases enable simple algorithmic solutions to many fundamental problems in mathematics and the natural sciences, including optimization, coding, robotics, molecular biology, and more. Furthermore, the reconstructibility of the graded reverse lexicographic order (in four variables or more) is equivalent to a property of ideals called "Shifting". Shifting ideals possess algebraic properties that have allowed for new proof techniques in Commutative Algebra.

Research Fellow: Cole Zeh (2025) **Concentration:** Molecular Biology

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

Title of Project: KLF4 Positively Regulates Ferroptosis Related Genes in Mouse Embryonic Fibroblasts and Colorectal Cancer Cells

Funding Source: NASC Division

Project Summary:

Cancer is the second leading cause of death in the US, accounting for 605,213 fatalities in 2021. Among these cancer deaths are colon and rectal cancer (CRC) related deaths which accounted for the second most behind lung cancer. CRC, like all cancers, is caused by unregulated cell growth caused by mutations and genetic predispositions. Cells have genes encoded into their DNA called tumor suppressor genes that protect the genome against mutations that can result in this uncontrolled cell growth. Kruppel-like Factor 4 (KLF4) is a vital tumor suppressor gene in the epithelial tissue of the intestines and is often downregulated in CRC. One mechanism of tumor suppression used by genes like KLF4 is programmed cell death. Ferroptosis is a newly characterized form of induced cell death that is independent of well established forms like apoptosis and autophagy. This summer we investigated if KLF4 enlists ferroptosis as one of its mechanisms for tumor suppression in CRC.

Ferroptosis involves a combination of excess iron build up and an increase in reactive oxygen species via the knock down of cellular antioxidant defense to cause phospholipid peroxidation that destroys the cell membranes. In order to determine the expression of proteins associated with ferroptosis, we used mouse embryonic fibroblasts (MEFs) that were wild-type for KLF4 (+/+) and compared them with MEFs that do not have functional KLF4 (-/-). We treated both types of MEFs with erastin, a drug that induces ferroptosis. Using western blots, we determine levels of proteins that are involved in ferroptosis. We found that xCT, a protein that inhibits ferroptosis via the synthesis of antioxidant defense enzymes, was upregulated in the cells that are null for KLF4 compared with the wildtype +/+ MEFs. In addition, the expression of DMT1, a protein that imports iron into cells, is upregulated in +/+ MEFs compared to the - /-MEFs. Furthermore, we found that NCOA4, a protein that degrades the iron storage protein ferritin in cells to release stored iron, was overexpressed in +/+MEFs compared with the -/ - MEFs. Our results strongly suggest that cells with KLF4 respond more aggressively to ferroptosis inducing treatments with an increase in iron and decrease in antioxidant defense. Consistent with our finding in MEFs, we also found similar results in RKO samples, colorectal cancer lines. The expression of NCOA4 is upregulated, while xCT is downregulated in RKO cells treated with a PON-A, a drug that induces KLF4.

We also used immunostaining of +/+ MEFs and -/-MEFs for xCT to visualize expression of this antioxidant defense gene in a population of cells. We found that 2.67% of +/+MEF cells were positive for xCT, while 6.00% of -/-MEF cells were positive for xCT. This result confirms our prior findings that cells with KLF4 have a weakened antioxidant defense, suggesting that KLF4 leads to a higher concentration of the reactive oxygen that is required for ferroptosis. Representative samples can be seen in figure 2.

The results of our summer project provided evidence that KLF4 employs ferroptosis as one of its mechanisms for tumor suppression in CRC.

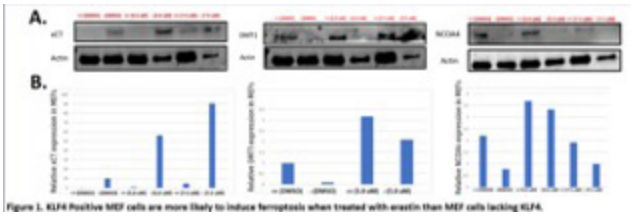


Figure 1. KLF4 Positive MEF cells are more likely to induce ferroptosis when treated with erastin than MEF cells lacking KLF4.

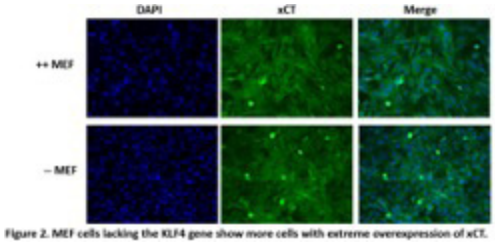


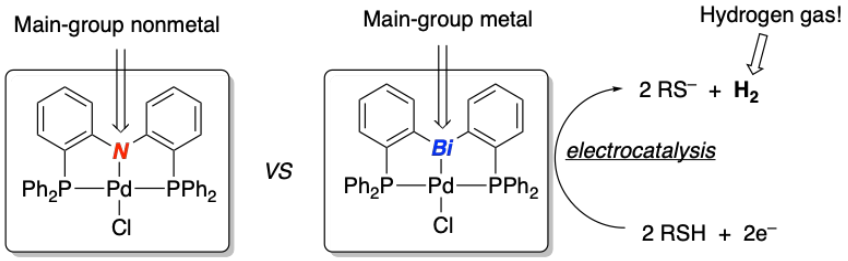
Figure 2. MEF cells lacking the KLF4 gene show more cells with extreme overexpression of xCT.

Research Fellow: Rebecca Zhu (2024) **Concentration:** Biochemistry
Faculty Mentor: Gongfang Hu **Department:** Chemistry
Title of Project: Electrocatalytic Hydrogen Evolution Using a Bimetallic Palladium Complex Containing a Bismuth-Based Ligand
Funding Source: NASC Division
Project Summary:

Fossil fuels currently constitute 80% of the world's energy sources. The extraction and utilization of fossil fuels such as oil, coal, and natural gas, result in the emission of carbon dioxide and other waste, playing a significant role in global climate change and pollution. Scientists are actively exploring cleaner, renewable, and more sustainable energy alternatives like solar, wind, and hydroelectric power. Molecular hydrogen gas (H2) emerges as a particularly promising fuel option. With the highest gravimetric energy density and solely pollution-free water as its combustion byproduct, H2 serves as an ideal energy carrier and a potential candidate for future low-carbon energy systems. Electrochemical hydrogen-evolution reactions, producing H2, are recognized as a clean, efficient, and sustainable strategy to replace fossil fuels, wherein renewable energy-generated electricity powers the H2 production reaction.

Similar to other chemical reactions, electrochemical processes for H2 production require energy input to overcome the activation barriers. Consequently, chemical catalysts, especially electrochemical catalysts, are indispensable for reducing energy barriers, minimizing energy costs, and enhancing the overall efficiency of hydrogen-evolution reactions. Despite the multitude of catalysts available for efficient electrochemical H2 production, molecular catalysts with well-defined structures hold special significance. They provide insights into the fundamental workings of catalysts and offer crucial design principles for the next generation of catalytic materials.

Traditionally, molecular catalysts contain a transition metal center coordinated with some main-group non-metallic elements. In contrast, catalysts featuring main-group metals, like bismuth, have remained relatively unexplored in this field. To investigate the influence of main-group metal elements on catalysis, we synthesized the bimetallic bismuth–palladium complex depicted in the diagram. Our investigations revealed this complex to be an active electrochemical H2 evolution catalyst, using thiols as the source of hydrogen during this summer. Bulk electrolysis demonstrated nearly quantitative H2 generation efficiency. Cyclic voltammetry experiments indicated thiol substitution for the chloride ligand prior to electrochemical reduction, yielding the actual catalytically active species. The equilibrium between the chloride-bound and the thiol-bound molecules was characterized using NMR spectroscopy. Ongoing kinetic studies, employing electrochemical methods, to set to determine the catalysis rate and offer validated insights into the electrochemical reduction's mechanism. Additionally, density-functional-theory calculations are applied to identify potential reaction pathways and transition states. This summer, we also synthesized an analogous compound wherein bismuth was replaced with a non-metal nitrogen atom. Comparative studies between the two molecules will illuminate the role of bismuth in this chemical context.



Research Fellow: **Melly Zhuang (2026)** **Concentration:** **Undeclared**

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

Title of Project: **How does microlite number density correlates with explosivity of intermediate arc volcanoes? Evidence from the Holocene record at Augustine Volcano, Alaska**

Funding Source: **National Science Foundation**

Project Summary:

Augustine Volcano is an active volcano and a natural laboratory located in the Cook Inlet. As part of this summer project, students from Colgate University collaborated with Alaska Volcano Observatory to study factors that influence the eruption size and style of intermediate arc volcanoes. Our work focuses on the 400-1100 ybp eruptions of Tephra B, M, and C, which have not received much attention before. My work focuses on Tephra C, to analyze the high-silica andesites (HSA) that are most responsible for the explosive nature of eruptions and compare data from the recent 2006 eruption to gain a deeper understanding of how explosivity and magma ascent rate vary through time.

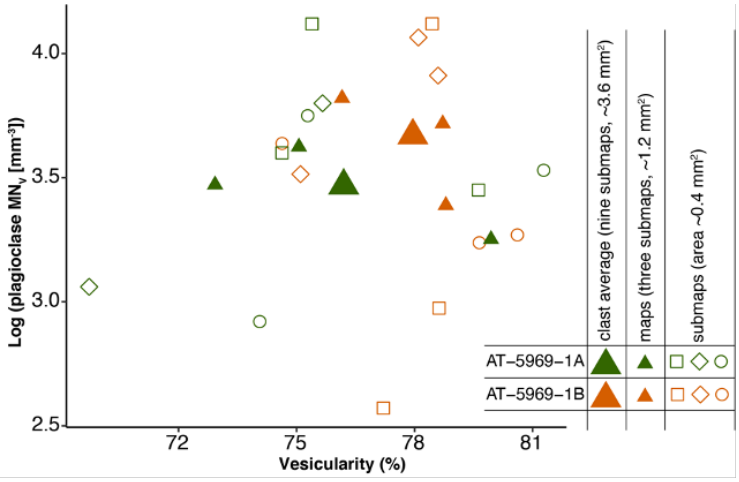


Fig. 1: Three-dimensional microlite number density and vesicularity for two HSA clasts from Tephra C.

We investigate Tephra C from both grain size distribution and microlite number density (MND) perspectives. For grain size analysis, we wet-sieved the tephra from a maximum of >32 mm to a minimum of <0.125 mm. Each sieved sample was dried for at least 24 hours and then weighed. For MND data, we selected three representative clasts from three different layers within Tephra C (early, middle, and late) and mounted them in epoxy. After polishing the epoxy, we used Colgate's scanning electron microscope to obtain images of clasts. We randomly selected three regions in each clast for imaging, and imaged three random areas within each region to reduce possible data biases.

With Photoshop and ImageJ, we collected complete datasets including MND, crystallinity, and vesicularity for clasts AT-5969-1A and AT-5969-1B. In clast 1A, MND at nine different locations varies within the range of 3.48 ±0.5, whereas MND at eight locations in clast 1B (the ninth location was microlite-free) has a slightly higher average of 3.53 but a lower standard deviation of 0.4. Vesicularity is 78 ± 2% in clast 1A and 76 ± 3% in clast 1B. There is an inverse relationship with MND and vesicularity between high- and low-silica andesite from Augustine, but my data show that there is no correlation between MND and vesicularity within a single clast. We find that microlites in HSA from Tephra C tend to be larger but less abundant than microlites in HSA from the 2006 eruption at Augustine. It has been hypothesized that microlite-poor pumice is produced by pressure and water disequilibrium during ascent, but the exact explanation is still unknown. Why MNDs are low in some samples from explosive eruptions, and how their differences correlate with magma ascent rate, are questions that can continue to be explored in future studies.

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: **199**

Distribution of Students by Concentration (students with double majors are included twice)

Africana and Latin American Studies	1
Anthropology	4
Applied Math	7
Art and Art History	5
Arts and Humanities	1
Astrogeophysics	7
Astronomy/Physics	7
Biochemistry	12
Biology	10
Chemistry	7
Chinese	1
Classical Studies	2
Computer Science	18
Computer Science / Mathematics	1
Economics	10
Educational Studies	2
English	8
Environmental Biology	2
Environmental Geography	2
Environmental Geology	1
Environmental Studies	7
Film and Media Studies	1
German	2
Geography	3
Geology	9
History	9
International Relations	8
Mathematics	6
Middle East and Islamic Studies	1
Molecular Biology	9
Neuroscience	9
Peace and Conflict Studies	1
Philosophy	6
Physics	10
Political Science	11
Psychological Science	8
Russian and Eurasian Studies	1
Sociology	2
Spanish	2
Theater	2
Undeclared	27

Arts and Humanities	**29**
Art and Art History	5
Arts and Humanities	1
Chinese	1
Classical Studies	2
English	8
German	2
Philosophy	6
Spanish	2
Theater	2
Natural Sciences and Mathematics	**120**
Applied Math	7
Astrogeophysics	7
Astronomy/Physics	7
Biochemistry	12
Biology	10
Chemistry	7
Computer Science	18
Computer Science/ Mathmatics	1
Geology	9
Mathematics	6
Molecular Biology	9
Neuroscience	9
Physics	10
Psychological Science	8
Social Sciences	**49**
Anthropology	4
Economics	10
Educational Studies	2
Geography	3
History	9
International Relations	8
Political Science	11
Sociology	2
University Studies	**18**
Africana and Latin American Studies	1
Environmental Biology	2
Environmental Geography	2
Environmental Geology	1
Environmental Studies	7
Film and Media Studies	1
Middle East and Islamic Studies	2
Peace and Conflict Studies	1
Russian and Eurasian 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	**13**
Art and Art History	3
Classics	1
East Asian Languages and Literatures	1
English	4
Philosophy	2
Religion	1
Theater	1
Natural Sciences and Mathematics	**129**
Biology	21
Chemistry	27
Computer Science	8
Earth and Environmental Geosciences	24
Mathematics	11
Physics and Astronomy	24
Psychological and Brain Sciences	14
Social Sciences	**30**
Economics	2
Educational Studies	7
Geography	1
History	4
Political Science	13
Sociology and Anthropology	3
University Studies	**25**
African and Latin American Studies	2
Asian Studies	1
Environmental Studies	14
Peace and Conflict Studies	8
Other	**44**
Center for Freedom and Western Civilization	11
Lampert Institute for Civic and Global Affairs	2
Upstate Institute	31

Distribution of Students by Funding Source

Internal	**126**
Center for Freedom and Western Civilization	11
Communications	1
Division of the Arts and Humanities	2
Division of Natural Sciences and Mathematics	65
Division of Social Sciences	12
Division of University Studies	2
Lampert Institute for Civic and Global Affairs	2
Upstate Institute	31
Endowed	**51**
Bob Linsley/James McLelland Fund	2
Doug Rankin ’53 Endowment-Appalachian Research	2
Doug Rankin ’53 Endowment-Geology Research	4
Hackett-Rathmell 1968 Memorial Fund	1
Holden Endowment Fund	1
J. Curtiss Taylor ’54 Endowed Student Research Fund	2
Justus ’43 and Jayne Schlichting Student Research Fund	16
Michael J. Wolk ’60 Heart Foundation	7
Miller-Cochran Fund	1
Mind, Brain and Behavoir Scholars Award	1
Norma Vergo Prize	2
Oberheim Memorial Fund	1
Picker Interdisciplinary Science Institute	1
Stickles Fund	1
Tom and Liz Brackett Endowed Fund for Diversity, Equity, and Inclusion in Computer Science	1
Volgenau Wiley Endowed Research Fellowship	4
Walter Broughton ’63 Research Fund	2
Warren Anderson Fund	2
External	**20**
Los Alamos National Lab LDRD Reserve Grant	2
NASA New York Space Grant	3
National Institutes of Health (NIH) Area Grant	1
National Science Foundation Grant	13

Northeastern States Research Cooperative Grant	1
Total Number of Participating Faculty:	**78**

(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	**12**
Art and Art History	3
Classics	1
East Asian Languages and Literatures	1
English	3
Philosophy	2
Religion	1
Theater	1
Natural Sciences and Mathematics	**45**
Biology	9
Chemistry	8
Computer Science	3
Earth and Environmental Geosciences	7
Mathematics	5
Physics and Astronomy	7
Psychological and Brain Sciences	6
Social Sciences	**17**
Economics	1
Educational Studies	1
Geography	1
History	2
Political Science	10
Sociology and Anthropology	2
University Studies	**9**
African and Latin American Studies	1
Asian Studies	1
Environmental Studies	6
Peace and Conflict Studies	1
Other	**14**
Center for Freedom and Western Civilization	11
Lampert Institute for Civic and Global Affairs	1
Upstate Institute	2

Distribution of Faculty by Funding Source

(Faculty with more than one funding source are counted multiple times)

Internal	**58**
Center for Freedom and Western Civilization	11
Communications	1
Division of the Arts and Humanities	4
Division of Natural Sciences and Mathematics	30
Division of Social Sciences	8
Division of University Studies	1
Lampert Institute for Civic and Global Affairs	1
Upstate Institute	2
Endowed	**41**
Bob Linsley/James McLelland Fund	1
Doug Rankin ’53 Endowment-Appalachian Research	1
Doug Rankin ’53 Endowment-Geology Research	4
Hackett-Rathmell 1968 Memorial Fund	1
Holden Endowment Fund	1
J. Curtiss Taylor ’54 Endowed Student Research Fund	2
Justus ’43 and Jayne Schlichting Student Research Fund	10
Michael J. Wolk ’60 Heart Foundation	6
Miller-Cochran Fund	1
Mind, Brain and Behavoir Scholars Award	1
Norma Vergo Prize	3
Oberheim Memorial Fund	1
Picker Interdisciplinary Science Institute	1
Stickles Fund	1
Tom and Liz Brackett Endowed Fund for Diversity, Equity, and Inclusion in Computer Science	1
Volgenau Wiley Endowed Research Fellowship	2
Walter Broughton ’63 Research Fund	2
Warren Anderson Fund	2
External	**11**
Los Alamos National Lab LDRD Reserve Grant	1
NASA New York Space Grant	1
National Institutes of Health (NIH) Area Grant	1
National Science Foundation Grant	7
Northeastern States Research Cooperative Grant	1

COLGATE