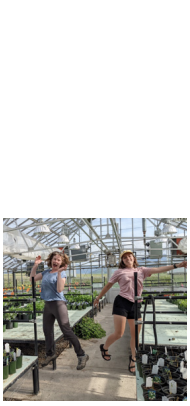
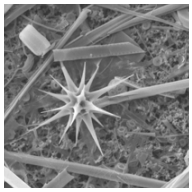
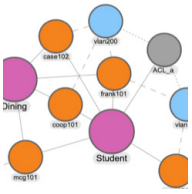
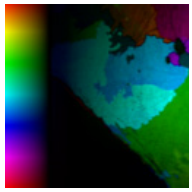
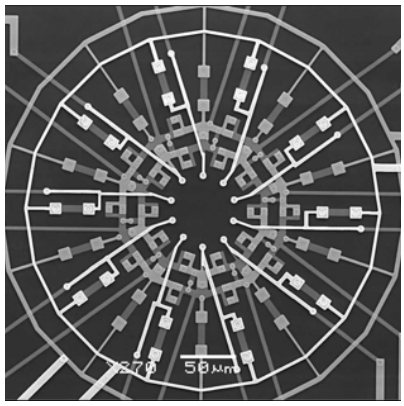
COLGATE UNIVERSITY

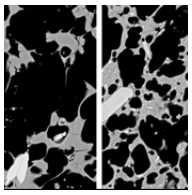
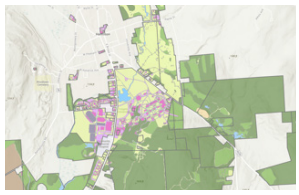
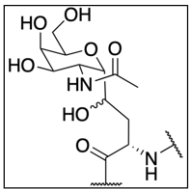
SUMMER UNDERGRADUATE RESEARCH DIRECTORY

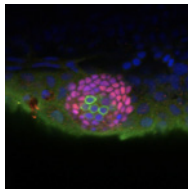




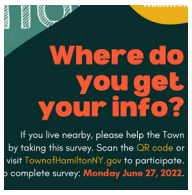








Volume 29
2022

Cover photos: Each of these images was taken from student abstracts found in this 2022 Directory.
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A special thanks to Mona Dunn for creating the front cover and for compiling the research directory.

Colgate University Summer Undergraduate Research Directory

Volume 29
2022

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: Jordan Hurt 2024 (Art and Art History)
Faculty Mentor: Carolyn Guile (Art and Art History)
Title of Project: *Analyzing Cultural Heritage Policy through the Example of Ukraine*
Funding Source: Center for Freedom and Western Civilization

Research Fellow: Aleksia Taci 2025 (Undeclared)
Faculty Mentor: Meredyth Winter (Art and Art History)
Title of Project: *The Sultan's Silks: Archaeological Textiles from Medieval Iranian Tombs*
Funding Source: AHUM Division

Department of the Classics

Research Fellow: Tate Wright 2023 (Classics)
Faculty Mentor: Naomi Rood (Classics)
Title of Project: *Bucolic Notions of Unrequited Love*
Funding Source: Center for Freedom and Western Civilization

Department of East Asian Languages and Literatures

Research Fellow: Maoreen Gao 2025 (Undeclared)
Faculty Mentor: Jing Wang (East Asian Language & Literature)
Title of Project: *The Needham Questioning: of the Unquestionable*
Funding Source: AHUM Division

Research Fellow: Olivia Malcomson 2024 (Computer Science)
Faculty Mentor: Jing Wang (East Asian Language & Literature)
Title of Project: *The Needham Questioning: of the Unquestionable*
Funding Source: AHUM Division

Department of English

Research Fellow: Max Gardinier 2024 (English)
Faculty Mentor: Jennifer Brice (English)
Title of Project: *Creative Writing Fellows*
Funding Source: AHUM Division

Research Fellow: Josh Kim 2023 (English)
Faculty Mentor: Jennifer Brice (English)
Title of Project: *Creative Writing Fellows*
Funding Source: AHUM Division

Research Fellow: MacKenzie Lahren 2024 (English)
Faculty Mentor: Jennifer Brice (English)
Title of Project: *Creative Writing Fellows*
Funding Source: AHUM Division

Research Fellow: Lita Wright 2023 (English)
Faculty Mentor: Jennifer Brice (English)
Title of Project: *Creative Writing Fellows*
Funding Source: AHUM Division

Department of Philosophy

Research Fellow: Dean Kardas 2024 (Mathematics; Philosophy)
Faculty Mentor: David Dudrick (Philosophy)
Title of Project: *Resurrection and Rationality: A Study of Opposing Epistemic Attitudes*
Funding Source: Center for Freedom and Western Civilization

Department of Religion

Research Fellow: Aranya Pal 2024 (Mathematics)
Faculty Mentor: Harvey Sindima (Religion)
Title of Project: *A Phenomenological Dive into Durga Puja and its Impact on Bengal Society*
Funding Source: J. Curtiss Taylor ‘54 Endowed Student Research Fund

Department of Theater

Research Fellow: Chris Mardirossian 2024 (Film & Media Studies)
Faculty Mentor: April Sweeney (Theater)
Title of Project: *Rewilding: A Micro Festival of Works by Romina Paula: LABORATORY #1*
Funding Source: AHUM Division

Research Fellow: Jorge Rochet 2025 (Undeclared)
Faculty Mentor: April Sweeney (Theater)
Title of Project: *Rewilding: A Micro Festival of Works by Romina Paula in Two Parts: Laboratory #1 & #2*
Funding Source: AHUM Division

DIVISION OF NATURAL SCIENCES AND MATHEMATICS (NACS)

Department of Biology

Research Fellow: Thanh Dang 2025
Faculty Mentor: Ahmet Ay (Biology; Mathematics)
Title of Project: *Risk for Seasonal Affective Disorder (SAD) and Depression Linked to Clock Gene Variants*
Funding Source: Michael J. Wolk ‘60 Heart Foundation

Research Fellow: Kyleigh Frank 2024 (Biology)
Faculty Mentor: Tim McCay (Biology; Environmental Studies)
Title of Project: *Jumping Worm Invasion and Impact in the Northern Forest*
Funding Source: Oberheim Memorial Fund

Research Fellow: Aaron Jaynes 2023 (Biology)
Faculty Mentor: Ken Belanger (Biology)
Title of Project: *Analyzing changes in the gut microbiome of Ethiopian children at risk of parasitic worm infection*
Funding Source: Michael J. Wolk '60 Heart Foundation

Research Fellow: Natalia Kim 2024 (Molecular Biology)
Faculty Mentor: Priscilla Van Wynsberghe (Biology)
Title of Project: *Investigating the role of KIN-20 in miRNA production*
Funding Source: Michael J. Wolk '60 Heart Foundation

Research Fellow: Teagan Krane 2023 (Environmental Biology)
Faculty Mentor: Tim McCay (Biology)
Title of Project: *Surveying Gardens for Invasive Pheretimoid Earthworms in Central New York*
Funding Source: NASC Division

Research Fellow: Catie Lang 2024 (Biology)
Faculty Mentor: Tim McCay (Biology; Environmental Studies)
Title of Project: *Sparganophilus Distribution in the Watersheds of the Northeast*
Funding Source: NASC Division

Research Fellow: Jasper Lim-Goyette 2023 (Biochemistry; Molecular Biology)
Faculty Mentor: Geoff Holm (Biology)
Title of Project: *Cellular Metabolic Responses to Mammalian Reovirus Infection*
Funding Source: Beckman Scholars Program

Research Fellow: Kaitlyn Macdonald 2023 (Biology)
Faculty Mentor: Ken Belanger (Biology)
Title of Project: *Investigating the effect of oral glucosamine supplements on the gut microbiome of sled dogs*
Funding Source: Michael J. Wolk '60 Heart Foundation

Research Fellow: Jack McGrath 2023 (Biology)
Faculty Mentor: Tim McCay (Biology; Environmental Studies)
Title of Project: *Effects of Invasive Earthworms on Water Infiltration and Nutrient Cycling*
Funding Source: NASC Division

Research Fellow: Ariel Missaghieh 2024 (Molecular Biology)
Faculty Mentor: Priscilla Van Wynsberghe (Biology)
Title of Project: *Kinase 20 and its Impact on the LIN-42 Period Protein*
Funding Source: National Institutes of Health

Research Fellow: Wael Mohamed 2024 (Computer Science)
Faculty Mentor: Ahmet Ay (Biology; Mathematics)
Title of Project: *Machine learning analyses to identify circadian-related genotypes predictive of anxiety*
Funding Source: Michael J. Wolk ‘60 Heart Foundation

Research Fellow: Kailey Paul 2023 (Natural Sciences)
Faculty Mentor: Ana Jimenez (Biology)
Title of Project: *How do dogs of different body masses, ages, and coats regulate body temperature before and after exercise across different seasons?*
Funding Source: NASC Division

Research Fellow: Cameron Patrick 2022 (Molecular Biology; Anthropology)
Faculty Mentor: Fernando Diaz Gonzalez (Biology)
Title of Project: Transcriptomic Analysis of Thermal Plasticity and Heat Shock Response in Ecologically Distinct Populations of *D. mojavensis*
Funding Source: NASC Division

Research Fellow: Sophie Pedzich 2024 (Environmental Biology)
Faculty Mentor: Tim McCay (Biology; Environmental Studies)
Title of Project: *Effect of Invasive Pheretimoid Earthworms on Litter Macroinvertebrates in Upstate New York*
Funding Source: NASC Division

Research Fellow: Zack Pelland 2023 (Neuroscience)
Faculty Mentor: Ken Belanger (Biology)
Title of Project: *Investigation of the Effects of Head Impacts on the Gut Microbiome Among Collegiate Football Players*
Funding Source: Michael J. Wolk ‘60 Heart Foundation

Research Fellow: Jim Perry 2024 (Computer Science; Russian & Eurasian Studies)
Faculty Mentor: Ahmet Ay (Biology; Mathematics)
Title of Project: *Undernutrition Outcomes in Ethiopian Schoolchildren: A machine learning based risk factor analysis utilizing epidemiological survey data*
Funding Source: Michael J. Wolk ‘60 Heart Foundation

Research Fellow: Geddy Rerko 2023 (Biology)
Faculty Mentor: Ana Jimenez (Biology)
Title of Project: *Thermal relations in sled dogs after exercise and across seasons.*
Funding Source: NASC Division

Research Fellow: Will Russel 2024 (Molecular Biology)
Faculty Mentor: Ahmet Ay (Biology; Mathematics)
Title of Project: *Predicting Schizophrenia from Human Gut Microbiome*
Funding Source: Michael J. Wolk ‘60 Heart Foundation

Research Fellow: Will Russell 2024 (Molecular Biology)
Faculty Mentor: Ahmet Ay (Biology; Mathematics)
Title of Project: *Risk for Seasonal Affective Disorder (SAD) and Depression Linked to Clock Gene Variants*
Funding Source: Michael J. Wolk ‘60 Heart Foundation

Research Fellow: Will Russel 2024 (Molecular Biology)
Faculty Mentor: Ahmet Ay (Biology; Mathematics)
Title of Project: *Undernutrition Outcomes in Ethiopian Schoolchildren: A machine learning based risk factor analysis utilizing epidemiological survey data*
Funding Source: Michael J. Wolk ‘60 Heart Foundation

Research Fellow: Leslie Sanchez-Gonzalez 2025 (Undeclared)
Faculty Mentor: Jason Meyers (Biology; Neuroscience)
Title of Project: *Zebrafish Neuromasts Regeneration post full Ablation?*
Funding Source: Michael J. Wolk ‘60 Heart Foundation; NASC Division

Research Fellow: Leslie Sanchez-Gonzalez 2025 (Undeclared)
Faculty Mentor: Jason Meyers (Biology; Neuroscience)
Title of Project: *Early Development of Cavefish and Surface Fish Lateral Lines*
Funding Source: Michael J. Wolk ‘60 Heart Foundation: NASC Division

Research Fellow: Cole Ventresca 2023 (Computer Science)
Faculty Mentor: Ahmet Ay (Biology; Mathematics)
Title of Project: *Machine learning analyses to identify circadian-related genotypes predictive of anxiety*
Funding Source: Michael J. Wolk ‘60 Heart Foundation

Research Fellow: Dong Wang 2023 (Computer Science; Applied Math)
Faculty Mentor: Ahmet Ay (Biology; Mathematics)
Title of Project: *Predicting Schizophrenia from Human Gut Microbiome*
Funding Source: Michael J. Wolk ‘60 Heart Foundation

Research Fellow: Triniti West 2023 (Biology)
Faculty Mentor: Priscilla Van Wynsberghe (Biology)
Title of Project: *Molecular Analysis of Development in C. elegans*
Funding Source: National Institutes of Health

Research Fellow: Eva Wiener 2023 (Neuroscience)
Faculty Mentor: Jason Meyers (Biology; Neuroscience)
Title of Project: *Early Development of Cavefish and Surface Fish Lateral Lines*
Funding Source: Michael J. Wolk ‘60 Heart Foundation; NASC Division

Research Fellow: Bella Yu 2024 (Molecular Biology)
Faculty Mentor: Priscilla Van Wynsberghe (Biology)
Title of Project: *Gustatory Receptors LITE-1 and GUR-3 Affect Circadian Clock Genes in C. elegans*
Funding Source: Oberheim Memorial Fund

Department of Chemistry

Research Fellow: Emily Amano 2022 (Computer Science; Chemistry)
Faculty Mentor: Jason Keith (Chemistry)
Title of Project: *Ligand K-edge XAS of Metal Borohydride Complexes*
Funding Source: Warren Anderson Fund

Research Fellow: Katerina Atallah-Yunes 2023 (Biochemistry)
Faculty Mentor: Anthony Chianese (Chemistry)
Title of Project: *Understanding How Ruthenium Catalyzed Reactions Work*
Funding Source: NASC Division

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

Research Fellow: Olivia Borden 2023 Biochemistry)
Faculty Mentor: Anthony Chianese (Chemistry)
Title of Project: *Understanding How Ruthenium Catalyzed Reactions Work*
Funding Source: NASC Division

Research Fellow: Jian Chen 2023 (Biochemistry)
Faculty Mentor: Jenny Peeler (Chemistry)
Title of Project: *Study of SelenoproteinO Using Genetic Code Expansion*
Funding Source: NASC Division

Research Fellow: James Clark 2023 (Biochemistry)
Faculty Mentor: Jenny Peeler (Chemistry)
Title of Project: *Study of SelenoproteinO Using Genetic Code Expansion*
Funding Source: NASC Division

Research Fellow: Camden Di Carlo 2024 (Biochemistry)
Faculty Mentor: Ernie Nolen (Chemistry)
Title of Project: *Oxime Cyclization and Chiral Enolate Approach Toward the Synthesis of a Tn Antigen Mimic*
Funding Source: Justus ‘43 and Jayne Schlichting Student Research Fund

Research Fellow: Wesley Dorow 2023 (Biochemistry)
Faculty Mentor: Ephraim Woods (Chemistry)
Title of Project: *Ozone Adsorption on Aerosol Surface Iodide*
Funding Source: NASC Division

Research Fellow: Abby Getz 2024 (Biochemistry)
Faculty Mentor: Jenny Peeler (Chemistry)
Title of Project: *Study of SelenoproteinO Using Genetic Code Expansion*
Funding Source: NASC Division

Research Fellow: Eric Goodney 2024 (Biochemistry)
Faculty Mentor: Rick Geier (Chemistry)
Title of Project: *Investigation of the Reaction of Pyrrole and Hexanal Leading to a Meso-Substituted Porphyrin and N-Confused Porphyrin*
Funding Source: NASC Division

Research Fellow: Jadan Hand 2024 (Spanish)
Faculty Mentor: Liangyong Mei (Chemistry)
Title of Project: *Synthesis of Indole-Fused Heterocycles through a Cascade Thiocyanation and Cyclization*
Funding Source: NASC Division

Research Fellow: Maddie Handley 2025 (Undeclared)
Faculty Mentor: Eric Muller (Chemistry)
Title of Project: *Towards Understanding Heterogeneous Ice Formation in Atmospheric Clouds: Nanoscale Imaging of Bacterial Ice-nucleating Membrane-bound Protein*
Funding Source: NASC Division

Research Fellow: Mina Head 2023 (Philosophy; Chemistry)
Faculty Mentor: Anthony Chianese (Chemistry)
Title of Project: *Understanding How Ruthenium Catalyzed Reactions Work*
Funding Source: National Science Foundation

Research Fellow: Anna Hill 2024 (Biochemistry)
Faculty Mentor: Jacob Goldberg (Chemistry)
Title of Project: *New Chemical Tools to Study Biological Systems*
Funding Source: Warren Anderson Fund

Research Fellow: Steph Jacoby 2023 (Chemistry)
Faculty Mentor: Anne Perring (Chemistry)
Title of Project: *Measurements of Ambient Aerosol*
Funding Source: NASC Division

Research Fellow: Ben Joseph 2023 (Biochemistry)
Faculty Mentor: Anthony Chianese (Chemistry)
Title of Project: *Understanding How Ruthenium Catalyzed Reactions Work*
Funding Source: National Science Foundation

Research Fellow: Ayub Khan 2023 (Undeclared)
Faculty Mentor: Ephraim Woods (Chemistry)
Title of Project: *Ozone Adsorption on Aerosol Surface Iodide*
Funding Source: NASC Division

Research Fellow: Sohee Kim 2025 (Undeclared)
Faculty Mentor: Eric Muller (Chemistry)
Title of Project: *Towards Understanding Heterogeneous Ice Formation in Atmospheric Clouds: Nanoscale Imaging of Bacterial Ice-nucleating Membrane-bound Protein*
Funding Source: NASC Division

Research Fellow: Edward Lynch 2023 (Chemistry)
Faculty Mentor: Jason Keith (Chemistry)
Title of Project: *Density Functional Theory Examination of Electronic Structure, Spectroscopy and Mechanism in Transition Metal Systems*
Funding Source: NASC Division

Research Fellow: Agrim Mangla 2024 (Molecular Biology)
Faculty Mentor: Liangyong Mei (Chemistry)
Title of Project: *Synthesis of Indole-fused Heterocycles through a Cascade Thiocyanation and Cyclization*
Funding Source: NASC Division

Research Fellow: Frankie McLaughlin 2024 (Biochemistry)
Faculty Mentor: Ernie Nolen (Chemistry)
Title of Project: *Enolate Alkylation Approach Toward Tn Antigen Analog*
Funding Source: Justus ‘43 and Jayne Schlichting Student Research Fund

Research Fellow: Felix Mo 2024 (Chemistry)
Faculty Mentor: Eric Muller (Chemistry)
Title of Project: *Towards Understanding Heterogeneous Ice Formation in Atmospheric Clouds: Nanoscale Imaging of Bacterial Ice-nucleating Membrane-bound Protein*
Funding Source: NASC Division

Research Fellow: Derrick Qu 2023 (Philosophy)
Faculty Mentor: Eric Muller (Chemistry)
Title of Project: *Towards Understanding Heterogeneous Ice Formation in Atmospheric Clouds: Nanoscale Imaging of Bacterial Ice-nucleating Membrane-bound Protein*
Funding Source: Justus ‘43 and Jayne Schlichting Student Research Fund

Research Fellow: Ethan Riggs 2025 (Undeclared)
Faculty Mentor: Jenny Peeler (Chemistry)
Title of Project: *Study of SelenoproteinO Using Genetic Code Expansion*
Funding Source: NASC Division

Research Fellow: Nicole Rodgers 2025 (Undeclared)
Faculty Mentor: Jacob Goldberg (Chemistry)
Title of Project: *New Chemical Tools to Study Biological Systems*
Funding Source: Michael J. Wolk ‘60 Heart Foundation; NASC Division

Research Fellow: Amelia Seasholtz 2023 (Biochemistry)
Faculty Mentor: Rick Geier (Chemistry)
Title of Project: *Investigation of the Reaction of Pyrrole and Hexanal Leading to a Meso-Substituted Porphyrin and N-Confused Porphyrin*
Funding Source: Warren Anderson Fund; NASC Division

Research Fellow: Nilesh Shah 2025 (Biochemistry)
Faculty Mentor: Jacob Goldberg (Chemistry)
Title of Project: *New Chemical Tools to Study Biological Systems*
Funding Source: Picker Interdisciplinary Science Institute

Research Fellow: Drew Tompkins 2023 (Chemistry)
Faculty Mentor: Jason Keith (Chemistry)
Title of Project: *Density Functional Theory Examination of Electronic Structure, Spectroscopy and Mechanism in Transition Metal Systems*
Funding Source: NASC Division

Research Fellow: Morgan Usselman 2024 (Chemistry)
Faculty Mentor: Anne Perring (Chemistry)
Title of Project: *Measurements of Ambient Aerosol*
Funding Source: Miller-Cochran Fund

Research Fellow: Esther Wu 2023 (Biochemistry; Neuroscience)
Faculty Mentor: Jacob Goldberg (Chemistry)
Title of Project: *New Chemical Tools to Study Biological Systems*
Funding Source: NASC Division

Department of Computer Science

Research Fellow: Sara Alam 2023 (Computer Science)
Faculty Mentor: Aaron Gember-Jacobson (Computer Science)
Title of Project: *Learning from Network History*
Funding Source: National Science Foundation

Research Fellow: Mohammad Asghar 2023 (Computer Science; Economics)
Faculty Mentor: Reyan Ahmed (Computer Science)
Title of Project: *Network Visualization*
Funding Source: NASC Division

Research Fellow: Jyotirmay Chauhan 2023 (Computer Science; Mathematical Economics)
Faculty Mentor: Aaron Gember-Jacobson (Computer Science)
Title of Project: *Learning from Network History*
Funding Source: National Science Foundation

Research Fellow: Zhaoyang Liu 2023 (Computer Science)
Faculty Mentor: Aaron Gember-Jacobson (Computer Science)
Title of Project: *Learning from Network History*
Funding Source: Holden Endowment Fund

Research Fellow: Emma Pizer 2023 (Computer Science; Mathematics)
Faculty Mentor: Georgiana Haldeman (Computer Science)
Title of Project: *Code Tracing Visualization Tool for Teaching Time Complexity Analysis of For-Loops to Novice Programmers*
Funding Source: Tom and Liz Brackett Endowed Fund for Diversity, Equity, and Inclusion in Computer Science

Research Fellow: Mary Ring 2023 (Computer Science)
Faculty Mentor: Georgiana Haldeman (Computer Science)
Title of Project: *Educational Memory Visualization Tool for Introductory CS Courses*
Funding Source: NASC Division

Department of Geology

Research Fellow: Ian Andrews 2025 (Undeclared)
Faculty Mentor: Alison Koleszar (Geology)
Title of Project: *Characterizing Modern Ash-Soil Layers at Augustine Volcano through Grain Size & SEM analysis*
Funding Source: Norma Vergo Prize

Research Fellow: Jose Arriaza 2025 (Undeclared)
Faculty Mentor: Karen Harpp (Geology; Peace and Conflict Studies)
Title of Project: *Virtual Galapagos: Design and Development of an Interactive Online Educational Resource for Children to Learn Science*
Funding Source: NASC Division

Research Fellow: Carissa Edwards-Mendez 2023 (Biology)
Faculty Mentor: Karen Harpp (Geology; Peace and Conflict Studies)
Title of Project: *Virtual Galapagos: Design and Development of an Interactive Online Educational Resource for Children to Learn Science*
Funding Source: NASC Division

Research Fellow: Jessie Farrell 2024 (English)
Faculty Mentor: Alison Koleszar (Geology)
Title of Project: *Investigating Drivers of Variation in Explosivity at Augustine Volcano*
Funding Source: NASC Division

Research Fellow: Charlotte Filipovich 2023 (Geology)
Faculty Mentor: Paul Harnik (Geology)
Title of Project: *Live-Dead Analysis of Marine Mollusks in the Gulf of Mexico*
Funding Source: NASC Division; Doug Rankin ‘53 Endowment - Geology Research

Research Fellow: Juan Gómez 2024 (Environmental Geology)
Faculty Mentor: Paul Harnik (Geology)
Title of Project: *Live-Dead Analysis of Marine Mollusks in the Gulf of Mexico*
Funding Source: NASC Division

Research Fellow: Trevor Guerrina 2023 (Molecular Biology)
Faculty Mentor: Amy Leventer (Geology)
Title of Project: *Antarctic Paleoclimate Records*
Funding Source: Norma Vergo Prize

Research Fellow: Izzy King 2023 (Geology)
Faculty Mentor: Joe Levy (Geology)
Title of Project: *Water Tracks Come Salty Only*
Funding Source: National Science Foundation

Research Fellow: Matthew King 2023 (Geology; Economics)
Faculty Mentor: William Peck (Geology)
Title of Project: *Genesis of Adirondack graphite deposits*
Funding Source: NASC Division; Doug Rankin'53 Endowment- Appalachian Research

Research Fellow: Shane Knopp 2023 (Computer Science)
Faculty Mentor: Aubreya Adams (Geology)
Title of Project: *Seismic Imaging of the Alaskan Subduction Zone*
Funding Source: National Science Foundation

Research Fellow: Gary Kuang 2023 (Geology; Geography)
Faculty Mentor: Joe Levy (Geology)
Title of Project: *Water Tracks Come Salty Only*
Funding Source: NASC Division

Research Fellow: Adam Limoges 2024 (Environmental Geology)
Faculty Mentor: Paul Harnik (Geology)
Title of Project: *Live-Dead Analysis of Marine Mollusks in the Gulf of Mexico*
Funding Source: Hackett-Rathmell 1968 Memorial Fund

Research Fellow: Henry Lin 2024 (Astrogeophysics)
Faculty Mentor: William Peck (Geology)
Title of Project: *Tectonic affinity of the Frontenac terrane, Ontario*
Funding Source: NASC Division

Research Fellow: Abigail Melican 2023 (Geology)
Faculty Mentor: Alison Koleszar (Geology)
Title of Project: *Main Drivers of Explosivity on Augustine Volcano*
Funding Source: Doug Rankin '53 Endowment - Geology Research

Research Fellow: Sophie Naylor 2024 (Geology)
Faculty Mentor: Joe Levy (Geology)
Title of Project: *Water Tracks Come Salty Only*
Funding Source: National Science Foundation

Research Fellow: Tom Richards 2024 (Geology)
Faculty Mentor: Aubreya Adams (Geology)
Title of Project: *Seismic Imaging of the Alaskan Subduction Zone*
Funding Source: National Science Foundation

Research Fellow: Jacob Steinberg 2023 (Environmental Geology)
Faculty Mentor: William Peck (Geology)
Title of Project: *Genesis of Adirondack graphite deposits*
Funding Source: NASC Division; Doug Rankin'53 Endowment - Appalachian Research

Research Fellow: Tommy Subak 2023 (Astrogeophysics)
Faculty Mentor: Joe Levy (Geology)
Title of Project: *Water Tracks Come Salty Only*
Funding Source: Hackett-Rathmell 1968 Memorial Fund

Research Fellow: Cha Thompson 2025 (Environmental Studies)
Faculty Mentor: Amy Leventer (Geology)
Title of Project: *Antarctic Paleoclimate Records*
Funding Source: NASC Division

Research Fellow: Alexa Trubiano 2023 (Geology)
Faculty Mentor: Aubreya Adams (Geology)
Title of Project: *Seismic Imaging of the Alaskan Subduction Zone*
Funding Source: Doug Rankin '53 Endowment - Geology Research

Research Fellow: Victor Unnone 2023 (Natural Sciences)
Faculty Mentor: Paul Harnik (Geology)
Title of Project: *Live-Dead Analysis of Marine Mollusks in the Gulf of Mexico*
Funding Source: NASC Division

Research Fellow: Katie Victor 2025 (Undeclared)
Faculty Mentor: Karen Harpp (Geology; Peace and Conflict Studies)
Title of Project: *Virtual Galapagos: Design and Development of an Interactive Online Educational Resource for Children to Learn Science*
Funding Source: Bob Linsley; James McLelland Fund

Research Fellow: Jessica Zehner 2023 (Geology)
Faculty Mentor: Alison Koleszar (Geology)
Title of Project: *Fieldwork and Laboratory Research Investigating Pre-Contact Eruption Dynamics on Augustine Volcano*
Funding Source: NASC Division

Department of Mathematics

Research Fellow: Chris Cherniakov 2024 (Computer Science)
Faculty Mentor: Will Cipolli (Mathematics)
Title of Project: *The Data Science Collaboratory at Colgate University*
Funding Source: NASC Division

Research Fellow: Thanh Dang 2025
Faculty Mentor: Ahmet Ay (Biology; Mathematics)
Title of Project: *Risk for Seasonal Affective Disorder (SAD) and Depression Linked to Clock Gene Variants*
Funding Source: Michael J. Wolk ‘60 Heart Foundation

Research Fellow: Kartik Devpura 2023 (Economics; Applied Math)
Faculty Mentor: Rob Davis (Mathematics)
Title of Project: *Estimating the Normalized Volumes of Certain Polytopes using Enumerative Graph Theory Methods*
Funding Source: National Science Foundation

Research Fellow: Samay Gupta 2024 (Mathematics)
Faculty Mentor: Will Cipolli (Mathematics)
Title of Project: *The Data Science Collaboratory at Colgate University*
Funding Source: NASC Division

Research Fellow: Wael Mohamed 2024 (Computer Science)
Faculty Mentor: Ahmet Ay (Biology; Mathematics)
Title of Project: *Machine learning analyses to identify circadian-related genotypes predictive of anxiety*
Funding Source: Michael J. Wolk ‘60 Heart Foundation

Research Fellow: Jim Perry 2024 (Computer Science; Russian & Eurasian Studies)
Faculty Mentor: Ahmet Ay (Biology; Mathematics)
Title of Project: *Undernutrition Outcomes in Ethiopian Schoolchildren: A machine learning based risk factor analysis utilizing epidemiological survey data*
Funding Source: Michael J. Wolk ‘60 Heart Foundation

Research Fellow: Will Russel 2024 (Molecular Biology)
Faculty Mentor: Ahmet Ay (Biology; Mathematics)
Title of Project: *Predicting Schizophrenia from Human Gut Microbiome*
Funding Source: Michael J. Wolk ‘60 Heart Foundation

Research Fellow: Will Russell 2024 (Molecular Biology)
Faculty Mentor: Ahmet Ay (Biology; Mathematics)
Title of Project: *Risk for Seasonal Affective Disorder (SAD) and Depression Linked to Clock Gene Variants*
Funding Source: Michael J. Wolk ‘60 Heart Foundation

Research Fellow: Will Russel 2024 (Molecular Biology)
Faculty Mentor: Ahmet Ay (Biology; Mathematics)
Title of Project: *Undernutrition Outcomes in Ethiopian Schoolchildren: A machine learning based risk factor analysis utilizing epidemiological survey data*
Funding Source: Michael J. Wolk ‘60 Heart Foundation

Research Fellow: Gunes Tiryaki 2023 (History; Mathematics)
Faculty Mentor: Rob Davis (Mathematics)
Title of Project: *Estimating the Normalized Volumes of Certain Polytopes using Enumerative Graph Theory Methods*
Funding Source: National Science Foundation

Research Fellow: Cole Ventresca 2023 (Computer Science)
Faculty Mentor: Ahmet Ay (Biology; Mathematics)
Title of Project: *Machine learning analyses to identify circadian-related genotypes predictive of anxiety*
Funding Source: Michael J. Wolk ‘60 Heart Foundation

Research Fellow: Dong Wang 2023 (Computer Science; Applied Math)
Faculty Mentor: Ahmet Ay (Biology; Mathematics)
Title of Project: *Predicting Schizophrenia from Human Gut Microbiome*
Funding Source: Michael J. Wolk ‘60 Heart Foundation

Neuroscience Program

Research Fellow: Leslie Sanchez-Gonzalez 2025 (Undeclared)
Faculty Mentor: Jason Meyers (Biology; Neuroscience)
Title of Project: *Zebrafish Neuromasts Regeneration post full Ablation?*
Funding Source: Michael J. Wolk ‘60 Heart Foundation; NASC Division

Research Fellow: Leslie Sanchez-Gonzalez 2025 (Undeclared)
Faculty Mentor: Jason Meyers (Biology; Neuroscience)
Title of Project: *Early Development of Cavefish and Surface Fish Lateral Lines*
Funding Source: Michael J. Wolk ‘60 Heart Foundation; NASC Division

Research Fellow: Eva Wiener 2023 (Neuroscience)
Faculty Mentor: Jason Meyers (Biology; Neuroscience)
Title of Project: *Early Development of Cavefish and Surface Fish Lateral Lines*
Funding Source: Michael J. Wolk ‘60 Heart Foundation; NASC Division

Department of Physics and Astronomy

Research Fellow: Sam Adler 2023 (Physics)
Faculty Mentor: Rebecca Metzler (Physics and Astronomy)
Title of Project: *Computational Modeling of Calcite-Organic Composites*
Funding Source: National Science Foundation

Research Fellow: Daniel Bernstein 2023 (Physics)
Faculty Mentor: Ken Segall (Physics and Astronomy)
Title of Project: *Macroscopic Quantum Tunneling and Emergence in Josephson Junction Arrays*
Funding Source: Volgenau-Wiley Endowed Research Fellowship

Research Fellow: Nikoloz Bujiashvili 2024 (Physics)
Faculty Mentors: Enrique Galvez (Physics and Astronomy)
Title of Project: *Generating the polarization-entangled photon state with the highest fidelity*
Funding Source: NASC Division

Research Fellow: Denzel Bullen 2023 (Physics; Peace and Conflict Studies)
Faculty Mentor: Ken Segall (Physics and Astronomy)
Title of Project: *Artificial Neurons using Superconductors*
Funding Source: NASC Division

Research Fellow: Jane Carskaddan 2024 (Geology)
Faculty Mentors: Paul Harnik (Geology)
Rebecca Metzler (Physics and Astronomy)
Title of Project: *Comparing Microstructures of Bivalve Shells from the Northern Gulf of Mexico across Spatial and Temporal Regions*
Funding Source: Justus ‘43 and Jayne Schlichting Student Research Fund

Research Fellow: Lance Chen 2025 (Undeclared)
Faculty Mentor: Beth Parks (Physics and Astronomy)
Title of Project: *Measuring building insulation*
Funding Source: NASC Division

Research Fellow: Tarik Cigeroglu 2023 (Physics; Mathematics)
Faculty Mentor: Kiko Galvez (Physics and Astronomy)
Title of Project: *Novel Communications Encoding with Twisting Optical Beams*
Funding Source: Volgenau-Wiley Endowed Research Fellowship

Research Fellow: Edlin Davis 2023 (Psychological Science)
Faculty Mentor: Rebecca Metzler (Physics and Astronomy)
Title of Project: *How Climate Change Affects Balanus amphitrite Exoskeleton Formation*
Funding Source: National Science Foundation

Research Fellow: Jared Diks 2025 (Undeclared)
Faculty Mentor: Cosmin Ilie (Physics and Astronomy)
Title of Project: *Dark Matter Evaporation From Compact Celestial Bodies*
Funding Source: Justus ‘43 and Jayne Schlichting Student Research Fund

Research Fellow: Anna Donovan 2024 (Environmental Studies)
Faculty Mentor: Linda Tseng (Environmental Studies; Physics and Astronomy)
Title of Project: *Microplastics Adsorption of the Antibiotic Ampicillin*
Funding Source: UNST Division

Research Fellow: Norah Du 2024 (Philosophy; Physics)
Faculty Mentor: Thomas Balonek (Physics and Astronomy)
Title of Project: *Optical Variability of Quasars and Stars at the Colgate Observatory*
Funding Source: NASC Division

Research Fellow: Gavin Fowler 2024 (Astrogeophysics)
Faculty Mentor: Jonathan Levine (Physics and Astronomy)
Title of Project: *Dating Boulder Creek Granite with a Prototype Spaceflight Mass Spectrometer*
Funding Source: NASC Division; NASA New York Space Grant

Research Fellow: Noah Hann-Deschaine 2024 (Physics)
Faculty Mentor: Ramesh Adhikari (Physics and Astronomy)
Title of Project: *Bio-derived materials for energy harvesting and hydrophobic surfaces*
Funding Source: NASC Division

Research Fellow: Jeisanelly Hernandez 2024 (Astronomy/Physics)
Faculty Mentor: Ramesh Adhikari (Physics and Astronomy)
Title of Project: *Electronic Leaves*
Funding Source: NASC Division

Research Fellow: Kiyan Hocek 2023 (Physics)
Faculty Mentor: Kiko Galvez (Physics and Astronomy)
Title of Project: *Investigating Gravitational Lensing with Singular Light Beams*
Funding Source: National Science Foundation

Research Fellow: Jackson Kustell 2025 (Undeclared)
Faculty Mentor: Beth Parks (Physics And Astronomy)
Title of Project: *The Heat Seeker - Modeling Heat Flow Through Walls*
Funding Source: Volgenau-Wiley Endowed Research Fellowship

Research Fellow: Ege Kutlubas 2024 (Physics)
Faculty Mentor: Ramesh Adhikari (Physics and Astronomy)
Title of Project: *Role of Aromatic Amino Acids on Conductivity of PEDOT:PSS*
Funding Source: NASC Division

Research Fellow: Sarah Miller 2024 (Physics)
Faculty Mentor: Ken Segall (Physics and Astronomy)
Title of Project: *Kuramoto Model Frequency Synchronization in Coupled Josephson Junction Array*
Funding Source: NASC Division

Research Fellow: Leon Nichols 2023 (Physics)
Faculty Mentor: Ken Segall (Physics and Astronomy)
Title of Project: *Neuromorphic Computing with Josephson Junction Neurons*
Funding Source: NASC Division

Research Fellow: Hadley Pade 2024 (Physics)
Faculty Mentors: Isak Isakovic (Physics and Astronomy)
Ramesh Adhikari (Physics and Astronomy)
Title of Project: *Reduced Graphene Oxide and L-Phenylalanine-PEDOT: PSS Capacitors*
Funding Source: NASC Division

Research Fellow: Jillian Paulin 2023 (Astronomy; Physics)
Faculty Mentor: Cosmin Ilie (Physics and Astronomy)
Title of Project: *Developing a General Expression for the Capture Rate of Dark Matter in Celestial Bodies*
Funding Source: Justus '43 and Jayne Schlichting Student Research Fund

Research Fellow: Gabe Pickard 2025 (Undeclared)
Faculty Mentors: Enrique Galvez (Physics and Astronomy)
Rebecca Metzler (Physics and Astronomy)
Title of Project: *Exploring the structure and composition of the Atlantic Salmon Fish Scale*
Funding Source: Volgenau-Wiley Endowed Research Fellowship

Research Fellow: Ryan Ruan 2024 (Physics)
Faculty Mentor: Cosmin Ilie (Physics and Astronomy)
Title of Project: *Modification of Dark Matter Single Collision Capturing Rate based on hypothetical Pop III star*
Funding Source: Justus '43 and Jayne Schlichting Student Research Fund

Research Fellow: Luke Stayton 2024 (Physics)
Faculty Mentor: Jonathan Levine (Physics and Astronomy)
Title of Project: *Initial Deployment of SDR to Investigate the VHF Radio Band*
Funding Source: Justus '43 and Jayne Schlichting Student Research Fund

Research Fellow: Krelyn Zacarias 2025 (Undeclared)
Faculty Mentor: Beth Parks (Physics and Astronomy)
Title of Project: *Measuring Insulation within Buildings*
Funding Source: NASC Division

Research Fellow: Miriya Pinkerman 2023 (Physics)
Faculty Mentor: Ken Segall (Physics and Astronomy)
Title of Project: *Time Delay in Neural Synapse Learning Circuit with Josephson Junctions*
Funding Source: NASC Division

Research Fellow: Facundo Pérez 2024 (Astronomy/Physics)
Faculty Mentor: Jeff Bary (Physics and Astronomy)
Title of Project: Correlating Changs in Spot Filling Factors with Stellar Rotation
Funding Source: Justus '43 and Jayne Schlichting Student Research Fund

Research Fellow: Sarah Traenkle 2023 (Biochemistry)
Faculty Mentor: Rebecca Metzler (Physics and Astronomy)
Title of Project: *How Climate Change Affects Balanus amphitrite Exoskeleton Formation*
Funding Source: National Science Foundation

Research Fellow: Wayne Wang 2023 (Physics; Mathematics)
Faculty Mentors: Enrique Galvez (Physics and Astronomy)
Title of Project: *Generating the polarization-entangled photon state with the highest fidelity*
Funding Source: NASC Division

Research Fellow: Keiona Williams 2024 (Geology)
Faculty Mentor: Linda Tseng (Environmental Studies; Physics and Astronomy)
Title of Project: *Microplastics Adsorption of the Antibiotic Ampicillin*
Funding Source: UNST Division

DIVISION OF SOCIAL SCIENCES (SOSC)

Department of Economics

Research Fellow: Max Edelstein 2023 (International Relations; Economics)
Faculty Mentor: Pierce Donovan (Economics)
Title of Project: *Finding front doors: Program evaluation with observational data from El Salvador*
Funding Source: Lampert Institute for Civic and Global Affairs

Department of Educational Studies

Research Fellow: Joel Alfaro MAT (Social Studies)
Faculty Mentor: Meg Gardner (Educational Studies)
Title of Project: *US Military Intervention in El Salvador: A Reflection of American Ideals*
Funding Source: Center for Freedom and Western Civilization

Research Fellow: Jenna Mapley 2024 (Mathematics)
Faculty Mentor: Meg Gardner (Educational Studies)
Title of Project: *Virtual Galápagos Curriculum*
Funding Source: SOSC Division

Research Fellow: Eli Watson 2024 (History)
Faculty Mentor: Susan Woolley (Educational Studies; LGBTQ Studies)
Title of Project: *Artifacts of Safe Space in Schools*
Funding Source: SOSC Division

Research Fellow: Angela Zheng 2023 (Educational Studies; Religion)
Faculty Mentor: Sally Bonet (Educational Studies)
Title of Project: *Global Citizenship Development in Secondary Schools: A Case Study of The United States*
Funding Source: SOSC Division

Department of Geography

Research Fellow: Aryaman Chobey 2025 (Undeclared)
Faculty Mentor: Mike Loranty (Geography)
Title of Project: *Using machine learning on UAV and high-resolution satellite data to resolve post-fire patterns of permafrost thaw and vegetation in Siberian larch forests*
Funding Source: SOSC Division

Research Fellow: Tingkuan Hsieh 2024 (Environmental Geography)
Faculty Mentor: Peter Scull (Geography)
Title of Project: *Inventorying Colgate Landholdings with GIS*
Funding Source: Byron R. Hanke ‘33 Endowed Fund-Environmental Studies

Research Fellow: Phoebe Metzger-Levitt 2023 (Peace & Conflict Studies; Russian & Eurasian Studies)
Faculty Mentor: Daniel Monk (Geography; Peace and Conflict Studies)
Title of Project: *The History of Ukrainian Refugees and the Implications of their National Recognition*
Funding Source: Lampert Institute for Civic and Global Affairs

Research Fellow: Sophie Schadler 2023 (Environmental Geography)
Faculty Mentor: Peter Scull (Geography)
Title of Project: *Inventorying Colgate Landholdings with GIS*
Funding Source: Byron R. Hanke ‘33 Endowed Fund-Environmental Studies

Department of History

Research Fellow: Emma Dexter 2023 (Anthropology; Environmental Studies)
Faculty Mentor: Heather Roller (History)
Title of Project: *A Social and Environmental History of Agrichemicals*
Funding Source: Alexander V. Wasson Fund to Support American History/ SOSC Division

Research Fellow: Kayla Gutheil 2024 (Environmental Studies)
Faculty Mentor: Heather Roller (History)
Title of Project: *A Social and Environmental History of Agrichemicals*
Funding Source: Endowed Fund for Peace Research

Research Fellow: Will Lam 2023 (History)
Faculty Mentor: Graham Hodges (History; Africana and Latin American Studies)
Title of Project: *Runaway Advertisements and Enslaved Database*
Funding Source: SOSC Division

Research Fellow: Anya Sokolowski 2025 (Undeclared)
Faculty Mentor: Graham Hodges (History; Africana and Latin American Studies)
Title of Project: *Survivors of the Underground Railroad*
Funding Source: SOSC Division

Research Fellow: Ilyas Talwar 2024 (History)
Faculty Mentor: David Robinson (Asian Studies; History)
Title of Project: *In the Shadow of the Fall: Reanalyzing the Role of the Visigoths in the Last Century of the Western Roman Empire, 395-451 CE*
Funding Source: Center for Freedom and Western Civilization

Research Fellow: Allison Yetter 2023 (History)
Faculty Mentor: Graham Hodges (History; Africana and Latin American Studies)
Title of Project: *Survivors of the Underground Railroad*
Funding Source: SOSC Division

Department of Political Science

Research Fellow: Anna Bamber 2024 (Political Science)
Faculty Mentor: Barry Shain (Political Science)
Title of Project: *Researching "Revolutionary-era American Pamphlet Literature in Context: a Documentary History, 1764-1776," and "Recent Scholarship Exploring The Federalist, 1787-1788."*
Funding Source: SOSC Division

Research Fellow: Changwen Fang 2025 (Political Science)
Faculty Mentor: Robert Kraynak (Political Science)
Title of Project: *Eros and Philosophy: A Comparison of Plato, Freud, & Marcuse*
Funding Source: Center for Freedom and Western Civilization

Research Fellow: Eli Gould 2023 (Political Science)
Faculty Mentor: Matt Luttig (Political Science)
Title of Project: *Polarization In America: Origin and Impact*
Funding Source: Center for Freedom and Western Civilization

Research Fellow: Emma Hubbard 2023 (International Relations)
Faculty Mentor: Edward Fogarty (Political Science)
Title of Project: *Tackling Human Trafficking: Examining Cross-National Variation in Compliance with the Global Compact for Migration*
Funding Source: Lampert Institute for Civic and Global Affairs

Research Fellow: Ridley Lindstrom 2024 (Political Science)
Faculty Mentor: Dominika Koter (Political Science)
Title of Project: *Democracy Building in Nigeria: Political History and Challenges of Achieving Democratic Consolidation*
Funding Source: Center for Freedom and Western Civilization

Research Fellow: Jordy Medina 2023 (Political Science)
Faculty Mentor: Juan Fernando Ibarra Del Cueto (Political Science)
Title of Project: *State-Building, Violence, and Indigeneity*
Funding Source: Walter Broughton '63 Research Fund

Research Fellow: Robert Pfeifer 2025 (Undeclared)
Faculty Mentor: Barry Shain (Political Science)
Title of Project: *Researching "Revolutionary-era American Pamphlet Literature in Context: a Documentary History, 1764-1776," and "Recent Scholarship Exploring The Federalist, 1787-1788,"*
Funding Source: SOSC Division

Research Fellow: Rachel Pittman 2024 (Political Science)
Faculty Mentor: Barry Shain (Political Science)
Title of Project: *Researching "Revolutionary-era American Pamphlet Literature in Context: a Documentary History, 1764-1776," and "Recent Scholarship Exploring The Federalist, 1787-1788."*
Funding Source: SOSC Division

Research Fellow: Seth Rock 2023 (International Relations; Economics)
Faculty Mentor: Fred Chernoff (Political Science)
Title of Project: *Businessmen and the Abraham Accords: A Look at How the Work of the Private Sector Supports Burgeoning Israel-GCC Ties*
Funding Source: Lampert Institute for Civic and Global Affairs

Department of Sociology and Anthropology

Research Fellow: Leah Boykin 2023 (Psychological Science)
Faculty Mentor: Chandra Russo (Sociology & Anthropology)
Title of Project: *Whites Against Supremacy: Cross-racial Alliance in the U.S. Movement for Black Lives*
Funding Source: Endowed Fund for Peace Research

Research Fellow: Yinuo Ding 2023 (Sociology; Asian Studies)
Faculty Mentor: Janel Benson (Sociology & Anthropology)
Title of Project: *Integration of Asian International Students: Engagement with Professors and Other Authority Figures*
Funding Source: SOSC Division

Research Fellow: Eliza Ge 2023 (Anthropology)
Faculty Mentor: Nancy Ries (Sociology & Anthropology; Peace and Conflict Studies)
Title of Project: *"Rareness" as a Political Issue: A Discussion of the Definition of Rare Disease in China's National Healthcare Policies*
Funding Source: SOSC Division

Research Fellow: Yiduo He 2024 (Anthropology; International Relations)
Faculty Mentor: Santiago Juarez (Sociology & Anthropology)
Title of Project: *Noh K'uh Archaeological Project 2022*
Funding Source: SOSC Division

Research Fellow: Joseph LaMuraglia 2024 (Anthropology)
Faculty Mentor: Santiago Juarez (Sociology & Anthropology)
Title of Project: *Noh K'uh Archaeological Project 2022*
Funding Source: SOSC Division

Research Fellow: Jordan Nichols 2023 (Anthropology)
Faculty Mentor: Santiago Juarez (Sociology & Anthropology)
Title of Project: *Noh K'uh Archaeological Project 2022*
Funding Source: SOSC Division

DIVISION OF UNIVERSITY STUDIES (UNST)

Research Fellow: Claire Chen 2024 (Film & Media Studies)
Faculty Mentor: Jordan Lord (University Studies)
Title of Project: The Living Situation of LGBTQ+ Asians (mostly Chinese) in the American Entertainment Industry
Funding Source: Endowed Fund for Peace Research

Africana and Latin American Studies Program

Research Fellow: Will Lam 2023 (History)
Faculty Mentor: Graham Hodges (History; Africana and Latin American Studies)
Title of Project: *Runaway Advertisements and Enslaved Database*
Funding Source: SOSC Division

Research Fellow: Anya Sokolowski 2025 (Undeclared)
Faculty Mentor: Graham Hodges (History; Africana and Latin American Studies)
Title of Project: *Survivors of the Underground Railroad*
Funding Source: SOSC Division

Research Fellow: Allison Yetter 2023 (History)
Faculty Mentor: Graham Hodges (History; Africana and Latin American Studies)
Title of Project: *Survivors of the Underground Railroad*
Funding Source: SOSC Division

Asian Studies Program

Research Fellow: Ilyas Talwar 2024 (History)
Faculty Mentor: David Robinson (Asian Studies; History)
Title of Project: *In the Shadow of the Fall: Reanalyzing the Role of the Visigoths in the Last Century of the Western Roman Empire, 395-451 CE*
Funding Source: Center for Freedom and Western Civilization

Environmental Studies Program

Research Fellow: Anna Donovan 2024 (Environmental Studies)
Faculty Mentor: Linda Tseng (Environmental Studies; Physics and Astronomy)
Title of Project: *Microplastics Adsorption of the Antibiotic Ampicillin*
Funding Source: UNST Division

Research Fellow: Kyleigh Frank 2024 (Biology)
Faculty Mentor: Tim McCay (Biology; Environmental Studies)
Title of Project: *Jumping Worm Invasion and Impact in the Northern Forest*
Funding Source: Oberheim Memorial Fund

Research Fellow: Catie Lang 2024 (Biology)
Faculty Mentor: Tim McCay (Biology; Environmental Studies)
Title of Project: *Sparganophilus Distribution in the Watersheds of the Northeast*
Funding Source: NASC Division

Research Fellow: Jack McGrath 2023 (Biology)
Faculty Mentor: Tim McCay (Biology; Environmental Studies)
Title of Project: *Effects of Invasive Earthworms on Water Infiltration and Nutrient Cycling*
Funding Source: NASC Division

Research Fellow: Sophie Pedzich 2024 (Environmental Biology)
Faculty Mentor: Tim McCay (Biology; Environmental Studies)
Title of Project: *Effect of Invasive Pheretimoid Earthworms on Litter Macroinvertebrates in Upstate New York*
Funding Source: NASC Division

Research Fellow: Keiona Williams 2024 (Geology)
Faculty Mentor: Linda Tseng (Environmental Studies; Physics and Astronomy)
Title of Project: *Microplastics Adsorption of the Antibiotic Ampicillin*
Funding Source: UNST Division

LGBTQ Studies Program

Research Fellow: Eli Watson 2024 (History)
Faculty Mentor: Susan Woolley (Educational Studies; LGBTQ Studies)
Title of Project: *Artifacts of Safe Space in Schools*
Funding Source: SOSC Division

Peace and Conflict Studies Program

Research Fellow: Eliza Ge 2023 (Anthropology)
Faculty Mentor: Nancy Ries (Sociology & Anthropology; Peace and Conflict Studies)
Title of Project: *"Rareness" as a Political Issue: A Discussion of the Definition of Rare Disease in China's National Healthcare Policies*
Funding Source: SOSC Division

Research Fellow: Phoebe Metzger-Levitt 2023 (Peace & Conflict Studies; Russian & Eurasian Studies)
Faculty Mentor: Daniel Monk (Geography; Peace and Conflict Studies)
Title of Project: *The History of Ukrainian Refugees and the Implications of their National Recognition*
Funding Source: Lampert Institute for Civic and Global Affairs

CENTER FOR FREEDOM AND WESTERN CIVILIZATION

Research Fellow: Joel Alfaro MAT (Social Studies)
Faculty Mentor: Meg Gardner (Educational Studies)
Title of Project: *US Military Intervention in El Salvador: A Reflection of American Ideals*
Funding Source: Center for Freedom and Western Civilization

Research Fellow: Changwen Fang 2025 (Political Science)
Faculty Mentor: Robert Kraynak (Political Science)
Title of Project: *Eros and Philosophy: A Comparison of Plato, Freud, & Marcuse*
Funding Source: Center for Freedom and Western Civilization

Research Fellow: Eli Gould 2023 (Political Science)
Faculty Mentor: Matt Luttig (Political Science)
Title of Project: *Polarization In America: Origin and Impact*
Funding Source: Center for Freedom and Western Civilization

Research Fellow: Jordan Hurt 2024 (Art and Art History)
Faculty Mentor: Carolyn Guile (Art and Art History)
Title of Project: *Analyzing Cultural Heritage Policy through the Example of Ukraine*
Funding Source: Center for Freedom and Western Civilization

Research Fellow: Dean Kardas 2024 (Mathematics; Philosophy)
Faculty Mentor: David Dudrick (Philosophy)
Title of Project: *Resurrection and Rationality: A Study of Opposing Epistemic Attitudes*
Funding Source: Center for Freedom and Western Civilization

Research Fellow: Ridley Lindstrom 2024 (Political Science)
Faculty Mentor: Dominika Koter (Political Science)
Title of Project: *Democracy Building in Nigeria: Political History and Challenges of Achieving Democratic Consolidation*
Funding Source: Center for Freedom and Western Civilization

Research Fellow: Ilyas Talwar 2024 (History)
Faculty Mentor: David Robinson (Asian Studies; History)
Title of Project: *In the Shadow of the Fall: Reanalyzing the Role of the Visigoths in the Last Century of the Western Roman Empire, 395-451 CE*
Funding Source: Center for Freedom and Western Civilization

Research Fellow: Tate Wright 2023 (Classics)
Faculty Mentor: Naomi Rood (Classics)
Title of Project: *Bucolic Notions of Unrequited Love*
Funding Source: Center for Freedom and Western Civilization

LAMPERT INSTITUTE FOR CIVIC AND GLOBAL AFFAIRS

Research Fellow: Max Edelstein 2023 (International Relations; Economics)
Faculty Mentor: Pierce Donovan (Economics)
Title of Project: *Finding front doors: Program evaluation with observational data from El Salvador*
Funding Source: Lampert Institute for Civic and Global Affairs

Research Fellow: Emma Hubbard 2023 (International Relations)
Faculty Mentor: Edward Fogarty (Political Science)
Title of Project: *Tackling Human Trafficking: Examining Cross-National Variation in Compliance with the Global Compact for Migration*
Funding Source: Lampert Institute for Civic and Global Affairs

Research Fellow: Brynna Luedde 2023 (Political Science)
Faculty Mentor:
Title of Project: Lampert Fellow
Funding Source: Lampert Institute for Civic and Global Affairs

Research Fellow: Phoebe Metzger-Levitt 2023 (Peace & Conflict Studies; Russian & Eurasian Studies)
Faculty Mentor: Daniel Monk (Geography; Peace and Conflict Studies)
Title of Project: *The History of Ukrainian Refugees and the Implications of their National Recognition*
Funding Source: Lampert Institute for Civic and Global Affairs

Research Fellow: Seth Rock 2023 (International Relations; Economics)
Faculty Mentor: Fred Chernoff (Political Science)
Title of Project: *Businessmen and the Abraham Accords: A Look at How the Work of the Private Sector Supports Burgeoning Israel-GCC Ties*
Funding Source: Lampert Institute for Civic and Global Affairs

UPSTATE INSTITUTE

Research Fellow: Jaanhvi Agarwal 2025 (Computer Science)
Faculty Mentor: Julie Dudrick (Upstate Institute)
Title of Project: *Madison County Youth Bureau*
Funding Source: Upstate Institute

Research Fellow: Ekaterina Balsan 2025 (Undecided)
Faculty Mentor: Julie Dudrick (Upstate Institute)
Title of Project: *An Insight into Primary Care Medicine in Rural Health Settings: Understanding the Importance of Primary Care Medicine and the Elements to Increase Patient Access In Order to Address Medical Needs in Rural Communities*
Funding Source: Upstate Institute

Research Fellow: Eric Barber 2024 (Sociology)
Faculty Mentor: Julie Dudrick (Upstate Institute)
Title of Project: *Getting Local Food to Local People*
Funding Source: Upstate Institute

Research Fellow: Yumeng Chen 2025 (Undeclared)
Faculty Mentor: Julie Dudrick (Upstate Institute)
Title of Project: *The need, the barrier, and the future of perinatal care and prenatal education for refugees in the city of Utica*
Funding Source: Upstate Institute

Research Fellow: Vanessa Dawley 2023 (Peace and Conflict Studies)
Faculty Mentor: Julie Dudrick (Upstate Institute)
Title of Project: *Increasing Biodiversity Through Pollinator Gardens in the Adirondacks*
Funding Source: Upstate Institute

Research Fellow: Joan Jatto 2025 (Undeclared)
Faculty Mentor: Julie Dudrick (Upstate Institute)
Title of Project: *Raising Suicide Prevention Awareness in Madison County, New York*
Funding Source: Upstate Institute

Research Fellow: Sowon Kim 2022 (Arts and Humanities)
Faculty Mentor: Julie Dudrick (Upstate Institute)
Title of Project: *Supporting and Integrating Refugee and Immigrant Communities in Utica, NY: Working at the Midtown Utica Community Center*
Funding Source: Upstate Institute

Research Fellow: Rebecca Landry 2024 (Molecular Biology)
Faculty Mentor: Julie Dudrick (Upstate Institute)
Title of Project: *Raccoon Rehabilitation*
Funding Source: Upstate Institute

Research Fellow: Yinuo Lin 2023 (Art and Art History; Geography)
Faculty Mentor: Julie Dudrick (Upstate Institute)
Title of Project: *Value Proposition Project with New York State Association for Rural Health*
Funding Source: Upstate Institute

Research Fellow: Ruby Macfarlane 2025 (Undeclared)
Faculty Mentor: Julie Dudrick (Upstate Institute)
Title of Project: *Sexually Transmitted Infections in Madison County*
Funding Source: Upstate Institute

Research Fellow: Morgan McMahon 2025 (Undeclared)
Faculty Mentor: Julie Dudrick (Upstate Institute)
Title of Project: *Village of Hamilton Government Operations*
Funding Source: Upstate Institute

Research Fellow: Tiasia McMillan 2024 (Sociology)
Faculty Mentor: Julie Dudrick (Upstate Institute)
Title of Project: *LIRS and Community Sponsorship*
Funding Source: Upstate Institute

Research Fellow: Marisa Modugno 2022 (Peace and Conflict Studies)
Faculty Mentor: Julie Dudrick (Upstate Institute)
Title of Project: *Chenango County Historical Society & Museum: Creating an Oral History Project*
Funding Source: Upstate Institute

Research Fellow: Tessa Mountain 2023 (Environmental Biology)
Faculty Mentor: Julie Dudrick (Upstate Institute)
Title of Project: *Common Loon Monitoring in the Adirondacks: A Stepping Stone for Nest Rafts*
Funding Source: Upstate Institute

Research Fellow: Jason Qian 2024 (Environmental Geography)
Faculty Mentor: Julie Dudrick (Upstate Institute)
Title of Project: *Town of Hamilton and People's Access to Information about the Town*
Funding Source: Upstate Institute

Research Fellow: Riley Rice 2024 (Political Science)
Faculty Mentor: Julie Dudrick (Upstate Institute)
Title of Project: *Centennial Farms - Cornell Cooperative Extension Madison County*
Funding Source: Upstate Institute

Research Fellow: Natalie Ringel 2023 (English)
Faculty Mentor: Julie Dudrick (Upstate Institute)
Title of Project: *(Dis)ability in the Outdoors: Increasing Accessibility to the Adirondacks*
Funding Source: Upstate Institute

Research Fellow: Lily Schaeffer 2023 (Biology)
Faculty Mentor: Julie Dudrick (Upstate Institute)
Title of Project: *Community Perceptions of Substance Use in Chenango County through the Lens of Qualitative Data*
Funding Source: Upstate Institute

Research Fellow: Sarah Shelton 2023 (Educational Studies)
Faculty Mentor: Julie Dudrick (Upstate Institute)
Title of Project: *Creating an I/DD Accessible Survey*
Funding Source: Upstate Institute

Research Fellow: Stuart Sopko 2024 (Geography)
Faculty Mentor: Julie Dudrick (Upstate Institute)
Title of Project: *Telling the Story of Oneida: From Free Love to Fine Silver*
Funding Source: Upstate Institute

Research Fellow: Rebecca Sweigart 2023 (Art and Art History; Film and Media Studies)
Faculty Mentor: Julie Dudrick (Upstate Institute)
Title of Project: *Chenango Canal Association: The Project on the Summit*
Funding Source: Upstate Institute

Research Fellow: Catherine Wang 2023 (Environmental Studies)
Faculty Mentor: Julie Dudrick (Upstate Institute)
Title of Project: *Working as an Upstate Institute Summer School Fellow with the Ausable River Association*
Funding Source: Upstate Institute

Research Fellow: Haobo Wang 2022 (Geography; Geology)
Faculty Mentor: Julie Dudrick (Upstate Institute)
Title of Project: *Parking Area Utility Study In Downtown Oneida City*
Funding Source: Upstate Institute

Research Fellow: David Xiu 2024 (English; Philosophy)
Faculty Mentor: Julie Dudrick (Upstate Institute)
Title of Project: *Modern United Way: The Response to Our Changing World*
Funding Source: Upstate Institute

Research Fellow: Israel Zarate 2024 (Women's Studies)
Faculty Mentor: Julie Dudrick (Upstate Institute)
Title of Project: *National Abolition Hall of Fame*
Funding Source: Upstate Institute

Research Fellow: Ruilin Zhang 2024 (History)
Faculty Mentor: Julie Dudrick (Upstate Institute)
Title of Project: *Rejuvenating Local History*
Funding Source: Upstate Institute

Research Summaries

Research Fellow: Sam Adler (2023) **Concentration:** Physics
Faculty Mentor: Rebecca Metzler **Department:** Physics and Astronomy
Title of Project: Computational Modeling of Calcite-Organic Composites
Funding Source: National Science Foundation
Project Summary:

For this research project, I attempted to model the complex structure of the cowry shell. Improving the scientific community's understanding of the behavior of the cowry shell under stress will provide important information about the mechanical properties of all calcite shells. This information will allow for more accurate predictions of the effects that environmental changes, such as ocean acidification caused by climate change, will have on shells and aquatic ecosystems.

The cowry shell was chosen due to its complex structure which makes it difficult to calculate the way it reacts to stresses. Cowry is about 97% calcite with the other 3% being organic material. This organic material is layered throughout the shell in an almost random way. Seeing as randomness is much easier to code into a model than to work with analytically, this project attempted to model this structure with computational methods. This research heavily relied on the use of ABAQUS standard (student edition).

Using ABAQUS, a layered shell-like structure with random thin layers (accounting for about 3% of the total volume) scattering in-between with small cracks placed on the boundaries was able to be modeled. These models produced results showing how crack propagation evolves under loads and where stresses are forming in other regions of the material. While some of the results were as expected, others were not as easily understandable. Specifically, the formation of high stress in layers of the modeled shell that were not near a crack was difficult to justify.

Due to the time constraints of this research and the little availability of data on these materials, it was difficult to find accurate material and interaction constants for the model. Also, due to the limited nodes that the ABAQUS student edition allows for its FEM (limits to only 1,000 nodes), the models had to be small with coarse meshes. The student edition of ABAQUS also does not create .jnl files along with the model meaning that any python script file must be created by recording macros. This causes issues when edits are made to the model such as adding a partition.

Future research on this subject should focus on these main difficulties. Finding better constants for our model will be a matter of digging through research papers related to these materials and calculating certain values from related data. Some of these values may need to be estimated seeing as the experiments needed for learning these values are often very time-consuming and expensive. To see the effects of loads more accurately on our model, the full version of ABAQUS should be utilized and .jnl files should be used and edited to add randomness to our model.

Research Fellows: Sara Alam (2023) — **Concentration:** Computer Science
Jyotirmay Chauhan (2023) — **Concentrations:** Computer Science; Mathematical Economics
Zhaoyang Liu (2023) — **Concentration:** Computer Science

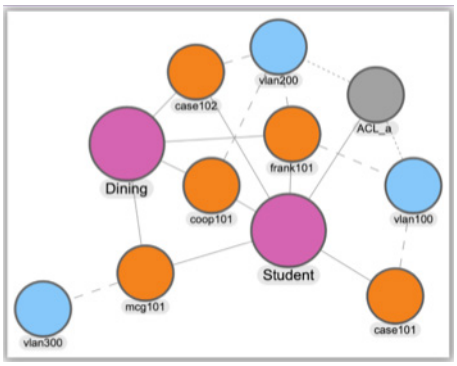
Faculty Mentor: Aaron Gember-Jacobson — **Department:** Computer Science

Title of Project: Learning from Network History

Funding Source: National Science Foundation; Holden Endowment Fund

Project Summary:

Configurations are the set of instructions provided to network devices like routers that affect the operation of the network. They are notoriously complex and are unique to each network. Since these configurations are written manually, they may contain errors that can compromise the network's reliability and security. The conventional methods of detecting configuration errors require a detailed description of a network's expected behavior as a reference. However, such approaches lack generality. We explore three approaches to infer network-specific patterns from static configurations which can be used to flag potential errors, without prior specification of network policies.



Model: We parse configuration files from all devices in the network and represent the configurations as a graph G. The nodes of G are the key components that exist in configurations, and the edges of G represent relationships between these components. The figure shows a simplified version of typical graphs obtained from Colgate's network.

Cycle Finding: Multi-component relationships can be viewed as a series of edges in G that ties a set of nodes together. In other words, common ways that components are grouped together in a given network can be characterized as cycles in G. Cycles that appear most often are identified as network specific patterns and instances of these patterns, where the cycle-completing edge is missing, are flagged as possible misconfigurations. Network engineers for Colgate's network have confirmed that some of the anomalies found are either actual misconfigurations or exceptions that are beneficial to track.

Contrast Set Learning (CSL): A form of association rule mining that attempts to group network attributes based on common attributes. The STUCCO implementation of CSL generates rules based on their ability to identify a particular group from other similar groups. This grouping method helps identify suspicious configuration patterns.

Temporal Analysis: Network configurations experience changes frequently. Multiple, related components often are changed together. The temporal analysis compares and analyzes these changes in configuration over time and records the types of components that are added, deleted, or modified in the same period. Afterward, we run CSL to find component types with correlated changes. If changes to components are correlated, but only one component is changed, we flag the change as a possible error.

Research Fellow: Joel Alfaro (MAT) **Concentration: Social Studies (MAT)**

Faculty Mentor: Meg Gardner **Department: Educational Studies**

Title of Project: US Military Intervention in El Salvador: A Reflection of American Ideals

Funding Source: Center for Freedom and Western Civilization

Project Summary:

This research aimed to understand how the United States intervened in El Salvador's Civil War, which began in 1979 and concluded in 1992. This project also sought to determine whether US involvement reflected and aligned with democratic ideals and human rights. The research considers the response of three presidential administrations, Jimmy Carter, Ronald Reagan, and George H.W. Bush.

The paper informs readers about the long history of economic inequality and military coups d'état that contributed to the war outbreak that left over 75,000 dead, countless missing, and over a million fleeing the country of El Salvador.

The first president to respond to the crisis was Jimmy Carter. At the beginning of his term, he ensured the nation that his foreign policy would take a more robust moral stance by centering on human rights and not supporting authoritative governments to fight communism. The administration changed its perspective when it provided military and economic aid to a military-civilian junta government that had come to power through a coup d'état. The killing of four catholic American women by government forces did temporarily stop assistance to the government. Still, once there were fears that a well-organized and collective left-wing guerrilla group would topple the government, the administration provided economic and military aid.

President Reagan continued the economic and military support to the Salvadoran government as the Carter administration did. But Congress, through adding certification processes to aid bills, ensured that the White House and El Salvador's government only received aid if the country was working toward the military respecting the human rights of all citizens and it was democratizing through elections. And the country did hold elections with a high number of voters, but not all parties, the left-wing for instance, are on the election ballot.

The H.W. Bush presidency is the last administration to respond to the war because of pressure from Congress for a peace agreement between both sides. There was a stalemate between both government and guerilla forces. Even with U.S. training, weapons, and increased soldiers, the government failed to squash the insurgency fully. The threats of aid cuts from Congress stem from the killing of six Jesuit priests by a government battalion in 1989. It demonstrated that the military was still incapable of respecting the human rights of civilians.

The lessons learned from the conflict include:

1. Justice is a continuing process from the conflict. Many high-profile victims of the conflict are currently hearing their cases heard in court. For example, in the Jesuit massacre, former president Alfredo Cristiani (1989-1994, ARENA party) and other military officers were charged in February of 2022.

2. The U.S. intervention in El Salvador successfully transformed the country into a civilian-led government that holds elections, is open to all factions of society, and the people decide who is in power. Military restructuring transformated the forces away from acting with impunity into a force that tries to respect the human rights of citizens and no longer commit large massacres. While not perfect, U.S. actions in El Salvador helped the country create a more stable and strong political system.

3. U.S. foreign affairs continue to challenge presidents who want to center human rights, but when crises arrive, they pivot to work with authoritative governments to support U.S. interests and priorities.

Research Fellow: Emily Amano (2022) **Concentrations:** Computer Science; Chemistry
Faculty Mentor: Jason Keith **Department:** Chemistry
Title of Project: Ligand K-edge XAS of Metal Borohydride Complexes
Funding Source: Warren Anderson Fund

Project Summary:

In this project, we aimed to quantify variations in covalent M-H-B bonding and electronic structure in transition metal, lanthanide and actinide borohydride complexes. Computational chemistry methods were used in Gaussian to model, create spectra and find the orbital population of metal borohydride complexes. Collaborator, Professor Scott Daly, has been synthesizing the metal borohydride complexes in his lab to be taken to the Canadian Light Source to collect experimental Boron K-edge X-ray absorption spectroscopy data.

As a first approach we can assume a simple covalent model for the boron-metal interaction where the bonding orbital is αM + βB and the antibonding orbital is βM - αB. α and β represent the amount of metal and boron character in the orbital. With no covalent bonding, the bonding α value would be 100%. On the other hand, a perfectly non-polar system would have both α and β values equal to 50%. In reality the answer will be somewhere in the middle and that's what we are trying to determine through a combination of our calculations and Prof. Daly's experiments.

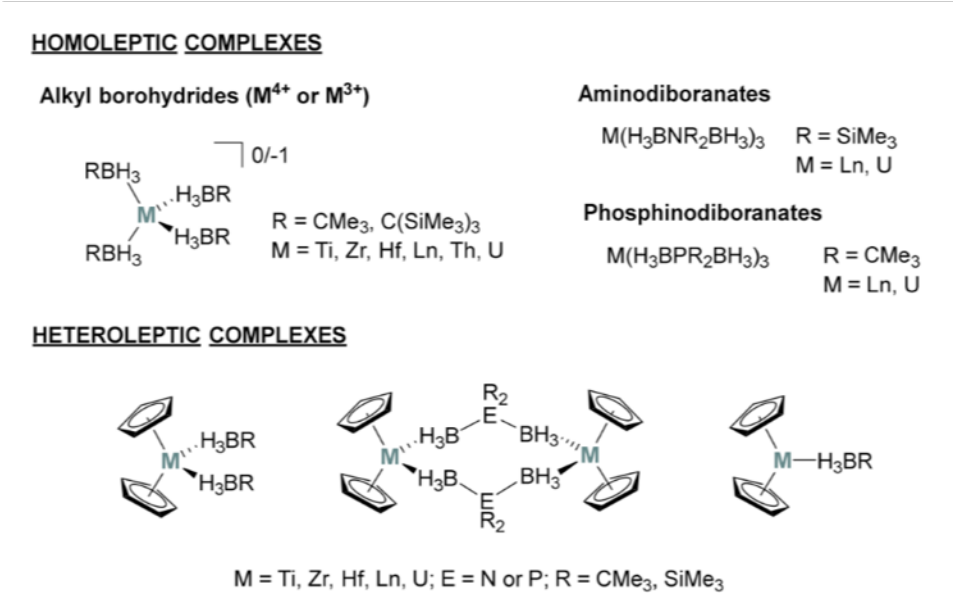


Figure 1: Collection of Proposed Metal Borohydride Complexes

Research Fellow: Ian Andrews (2025) **Concentration:** Undeclared

Faculty Mentor: Alison Koleszar **Department:** Geology

Title of Project: Characterizing Modern Ash-Soil Layers at Augustine Volcano through Grain Size & SEM analysis

Funding Source: Norma Vergo Prize

Project Summary:

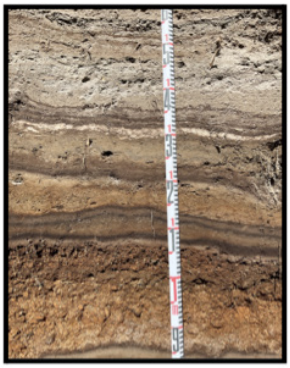


Fig.1: Field site 22AUAMK005 on the NE coast of Augustine; the couplet layer is visible between ~113-120 cm.

Marker beds hold great importance when observing an outcrop as a tephra stratigrapher. These clearly-recognizable layers of tephra and/or soil assist in identifying and characterizing surrounding depositional layers, and also illustrate the chronology (relative ages of the layers) within an outcrop. Augustine Volcano is one of the many intermediate arc volcanoes along the Alaskan Aleutian Arc, and marker beds have been essential for characterizing its past eruptions (Waitt, R. B., & Beget, J. E., 2009). The most recent of Augustine's explosive eruptions occurred about 400 years ago, depositing the layer known as Tephra B. The main marker bed present between the present and Tephra B is a pale cream colored layer of ash fall produced by Katmai Volcano in 1912. During summer 2022 fieldwork on Augustine, we observed a distinct ash-soil layer in multiple locations across the east and southern portion of the island. The layer contains light to medium gray ash overlying tan/orange soil. This ash-soil layer, dubbed "the couplet," is consistently located between the Katmai 1912 layer and tephra B layer, though it varies in terms of stratigraphic distance from Katmai 1912 and Tephra B due to different intermediate ash and soil layers. My ongoing work is to characterize the couplet layer at each field site to determine if the same couplet is seen across the island. If the couplet is the same across outcrops, then it would be valuable as a new possible marker bed for the identification of Tephra B and other unnamed tephra and soil layers on Augustine.

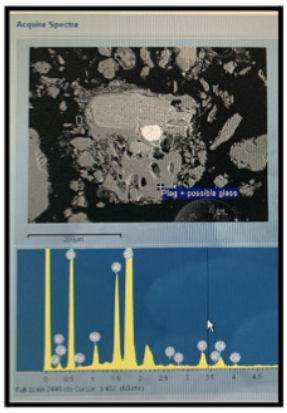


Fig. 2: SEM image (top) of a couplet ash grain with chemical spectra (below) consistent with plagioclase and glass (high O, Si, and Al).

I am characterizing the couplet physically and geochemically. Physical characteristics include the thickness of the couplet layer at each site and detailed grain size distribution within each sample. I am sieving samples to 1 mm, 0.5 mm, 0.25 mm, and 0.125 mm and will mount this material for semi-quantitative geochemical analysis by SEM to compare glass compositions across the size fractions and field sites. I will also use the SEM to analyze the morphology of specific ash samples to understand the formation process of ash in the couplet (Vonlanthen et al., 2015). To further my understanding of the couplet, I will also do SEM analysis on other recent ash layers, such as Augustine's 1883 eruption, to observe how the couplet compares (Kamata et al., 1991). If the couplet is geochemically consistent between the various outcrops, then I will use carbon-14 dating of the soil layers that surround the couplet to determine when the couplet was formed. With both the chemical compositions and an age for the couplet, the layer could be established as a marker bed, and would provide valuable information for future endeavors to identify and characterize the historic eruptions of Augustine.

Research Fellows: **Jose Arriaza (2025)** **Concentration: Undeclared**
Carissa Edwards-Mendez (2023) **Concentration: Biology**
Katie Victor (2025) **Concentration: Undeclared**

Faculty Mentor: **Karen Harpp** **Departments: Geology; Peace and Conflict Studies**

Title of Project: **Virtual Galapagos: Design and Development of an Interactive Online Educational Resource for Children to Learn Science**

Funding Source: **NASC Division; Bob Linsley/James McLelland Fund**

Project Summary:

Virtual Galápagos is a virtual field trip designed to teach third-to-fifth grade students about science through the lens of the Galápagos Islands. Students are tasked with solving a scientific mystery by collecting observations about the volcanic islands, flora, and fauna. Guided by animal characters, students explore the Galápagos using 360o panoramas, educational videos, interactive activities, and games. The virtual field trip teaches many different aspects of math and science, grounded in scientific questions about the islands; our goal is to convey that science applies to the real world, to motivate them to pursue their interests in science.

The scientific mystery we used is centered on the evolution of land and marine iguanas in this volcanic landscape. We began by comparing two different virtual field trip platforms, TourIt and 3DVista, to determine which encourages the most engagement and retention of material by students, while being efficient and accessible for those programming the content. We concluded that 3DVista was the best platform for our purposes and spent the rest of the summer programming pre-existing and new material for the scientific mystery into the platform. We constructed the site to have an easy-to-use and enjoyable interface, encouraging the user to explore and make independent observations about the Galápagos as much as possible.

We designed additional interactive activities, games, and educational animated whiteboard videos to engage the students on their virtual journey to the Galápagos, as well as hands-on activities to perform at home or in the classroom. The newly created games, activities, and worksheets take the students away from their computer screens to apply their newfound knowledge, solving problems and apply what they have learned from the website.

One overarching objective of the 2022 Virtual Galápagos is to create a STEM-oriented educational program that centers on inclusivity and makes STEM education accessible for all. To accomplish our goal, we created a series of modules rooted in various pedagogical frameworks, especially Universal Design for Learning (UDL). We focused on how to implement the main principles of UDL into our project to address systemic barriers that actively prohibit young students across the globe from pursuing STEM education. The 2022 Virtual Galápagos team not only became familiar with ongoing discourses about implementing UDL to create accessible programs for students of disadvantaged backgrounds, but actively immersed themselves in a world that believes in a more inclusive, accessible STEM education for all. In our Virtual Galápagos modules, we implemented UDL by incorporating text-to-speech, providing various methods for teaching students, designing ways to interact with the material online and in person, and supplying background knowledge. Our primary means of implementing UDL is through our Guided Field Books, a series of worksheets that scaffold otherwise complex and advanced scientific concepts.

We carried out several test trials throughout the summer to identify ways to create a program that comply with the UDL framework. This coming fall and spring, we will be testing this new curricular resource in classrooms and implementing the feedback we receive. This pilot version of the project will be used as a model for next summer's training program for pre-service STEM teachers, focused on designing interactive science curricular materials.

Research Fellows: **Katerina Atallah-Yunes (2023)** — **Concentration: Biochemistry**
Olivia Borden (2023) — **Concentration: Biochemistry**
Ben Joseph (2023) — **Concentration: Biochemistry**
Mina Head (2023) — **Concentrations: Philosophy; Chemistry**

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

Title of Project: **Understanding How Ruthenium Catalyzed Reactions Work**

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

Project Summary:

The Chianese group explores the use of pincer-ruthenium catalysts to promote the hydrogenation of various organic functional groups, including esters and epoxides. Our lab employs a variety of experimental techniques to identify and optimize these ruthenium-based catalysts for various reactions, while also probing the mechanisms of these reactions.

This summer, one area of focus was the reaction of dehydroalkylative catalyst activation. Previous literature has proven that a dehydroalkylation occurs transforming Milstein's catalyst, $RuPNN^{dearom}$, to $RuPNN^{imine}$. However, there is not a confirmed mechanistic study for this reaction. We conducted both kinetic and computational investigations using UV-Visible spectroscopy and Density Functional Theory (DFT) to reveal more information about the reaction. Kinetic studies involved varying concentrations of reactants and reaction temperatures, in addition to a detailed study on varying $RuPNN^{dearom}$ concentrations. Since both $RuPNN^{dearom}$ and $RuPNN^{imine}$ are different in color, monitoring the change in UV absorption (using a spectrophotometer) allowed for determination of formation of product. Using mathematical manipulation, and a detailed python script, the quantity of product was also determined. Computational studies involved using DFT to predict possible mechanisms and determine if they were energetically favorable. The DFT studies were defended by the kinetic studies, and vice versa.

Another area of focus was the extension of more recent work on epoxide hydrogenolysis. We previously identified optimal conditions for branched-selective epoxide hydrogenolysis using $RuPNN^{HEt}$, the active catalytic intermediate derived from Milstein's catalyst. This summer, we sought a Ru catalyst that could be used to hydrogenate chiral epoxides selectively to one enantiomer of the alcohol product. The optimization study involved the manipulation of reaction conditions such as temperature, pressure, type and amount of reactant and catalyst, solvent, and additives such as acids and bases.

Once these optimized conditions were identified, we dedicated much time assembling a substrate table. This required us to procure racemic substrates and resolve them into individual enantiomeric solutions. We also dedicated time to refining analytical methods, through gas chromatography method development, response factor determination, and HNMR acquisition.

We also embarked on preliminary mechanistic studies of this reaction, by probing the kinetics of these reactions. Determination of a rate law is very informative of the rate-limiting steps of a reaction, and to a greater extent, the overall reaction mechanism.

This summer's research was beneficial to the continuation of key projects while also beginning some new ones, which we will continue working on into the next academic year.

Research Fellow: **Ekaterina Balsan (2025)** **Concentration: Undecided**

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

Title of Project: **An Insight into Primary Care Medicine in Rural Health Settings: Understanding the Importance of Primary Care Medicine and the Elements to Increase Patient Access In Order to Address Medical Needs in Rural Communities**

Funding Source: **Upstate Institute**

Project Summary:

The goal of this project was to pursue community-based research as a part of Colgate University's Upstate Institute Summer Field School. My project with Community Memorial Hospital (CMH) specifically focused on their Family Health Centers (FHCs) which offer primary care services. These offices and providers are geared to address the medical needs of their local communities. CMH has FHCs in both Madison and Oneida counties located in Hamilton, Morrisville, Waterville, Cazenovia, and Munnsville. There are primary care providers at these locations, as well as medical specialties such as Cardiology, Urology, Pulmonology, and General Surgery at the Hamilton office. Additionally, CMH offers Urgent Care hours out of their Hamilton office as a resource for the community and individuals who seek immediate medical care.

My work with CMH and the FHC administration team was to identify methods for streamlining communication and bolstering efficiency as part of the organization's goal to increase patient access. This primarily involved three key aspects. First, I carried out data analysis for the FHCs' call center. This involved assessing the number of calls and analyzing data over time. Second, I shadowed four of the FHCs to learn more about their process flows. This was especially interesting as it taught me how important teamwork is in the medical field as well as the multifaceted topics in the healthcare industry. Third, I created feedback questionnaires for FHC departments. These three pieces of my work allowed me to learn much about rural health and primary care medicine, as well as the multiple roles involved in providing care and supporting the communities of upstate New York.

With an interest in health sciences, this project allowed me to learn more about medical care in rural areas and the many nuances involved in healthcare, especially the impact of COVID-19. Having just finished my first year at Colgate, I wanted to participate in the Upstate Institute's Field School Fellowship program in order to contribute to a local organization and learn more about Hamilton and its surrounding communities. In doing so, I received real-world experience in the healthcare field while working with my community partner. Moreover, I was exposed to the importance of teamwork and collaboration all geared toward helping patients. CMH is an organization that deeply cares about its community, and I am thankful for the opportunity to have worked with and learned from them.

Research Fellows: **Anna Bamber (2024)** **Concentration:** **Political Science**

Rachel Pittman (2024) **Concentration:** **Political Science**

Faculty Mentor: **Barry Shain** **Department:** **Political Science**

Title of Project: **Researching "Revolutionary-era American Pamphlet Literature in Context: a Documentary History, 1764-1776," and "Recent Scholarship Exploring The Federalist, 1787-1788."**

Funding Source: **SOSC Division**

Project Summary:

For 8 weeks this summer, we have worked alongside Professor Barry Shain in order to research the North American British Continental Colonies' revolutionary-era pamphlet literature. The pamphlet literature during this time was extensive, though only few pamphlets are well-known today. The arguments presented in these pamphlets are crucial to be dissected as they provide insight to the troubled imperial relationship between Britain and the Colonies that set the stage for the American founding and these varied arguments might have otherwise been overlooked in the historiography of the American War for Independence.

The purpose of our research was to gather information to introduce 80 or so pamphlets, and we were required to research biographical, historical, and contextual information to include in headnotes to the pamphlets written in this period. Most of our writing was focused on each pamphlet's author's life, the widespread reactions to their writings, and the pamphlet's publishing information. We consulted many books and texts to aid us in our research and with finding the publishing information of each pamphlet. Many times we found it difficult to discover information that had previously been difficult to attain; however, we felt our research skills were pushed and we learned a lot about consulting the Colgate library services to help us find resources we may have not otherwise.The headnotes had been previously worked on in past summers and so our research was designed to complete headnotes lacking information and editing them extensively. The task of editing included lots of updating the formatting of the bibliography and the footnotes, which proved useful in developing our citation skills which can hopefully be useful to us in future endeavors.

Research Fellow: **Eric Barber (2024)** **Concentration:** **Sociology**

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

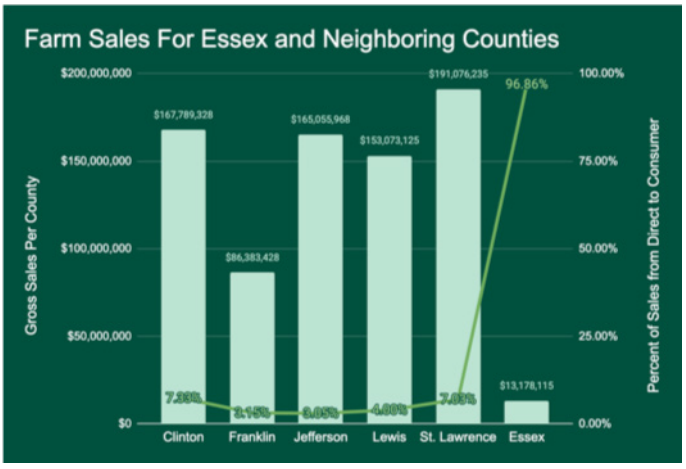
Title of Project: **Getting Local Food to Local People**

Funding Source: **Upstate Institute**

Project Summary:

My work this summer involved doing research for the food systems department of the Adirondack North Country Association. Their goal is to help create networks between food producers and consumers that facilitate local and sustainable economic growth, along with food security and a sense of community. My specific research had to do with looking at the success of Essex county in the Adirondack region, where I was living this summer as an Upstate Institute Summer Field School Fellow, and comparing it to other counties nearby. As demonstrated in the graph below, Essex county is an outlier compared to many other counties in the North Country region. Percentage of sales direct to consumer is a data-point that tells us what percentage of total sales from farms are made directly to those who consume those goods. For example, a purchase at a farmers market would count as direct to the consumer, but buying cheese from Cabot co-op, which works as an intermediary that buys dairy products from farms, many of which are in the North Country region, would not. While the vast majority of counties in the region have about 3-8% of their sales come from direct to consumer sales, Essex county gets about 97% of its total sales from direct-to-consumer. My research question was focused on what systems were put in place in Essex county and in other counties which have achieved similar success to create this specific market for direct-to-consumer sales, and the impact it has had on the food community in the area.

I found five factors that contributed to the strength of the local food economy in Essex county. The first was the creation and maintenance of local food hubs. These hubs work as a marketplace as well as distribution centers for local food growers. While most small farms couldn't afford to sustain a hub on their own, the fact that they are used by numerous local farms distributes the cost, while helping each farmer reach new markets. The second factor involves a push for farmers markets to accept SNAP benefits. This widens the market to many who wouldn't assume they could afford farmers markets, and again gives these growers new customers. The third factor was campaigns at grocery stores to label and prioritize local foods. Consumers tend to want to buy locally, so when vendors make an effort to label those products which are grown locally, people buy them. The fourth factor is the work of nonprofit organizations to connect local growers to institutions that need consistent supplies of food like schools and hospitals. This is especially important for farmers as it gives them consistent sources of income and consistent demand for their products. Lastly is the work of financial organizations to fund innovations at the farm level. It is often difficult for farmers to afford technological advancements, or to even know what sort of changes they should be making, so institutions that advise and support them are incredibly helpful.



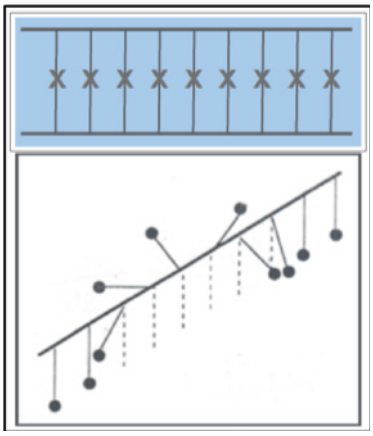
Research Fellow: **Daniel Bernstein (2023)** **Concentration:** **Physics**

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

Title of Project: **Macroscopic Quantum Tunneling and Emergence in Josephson Junction Arrays**

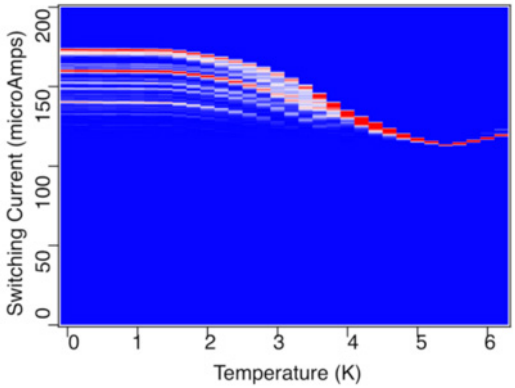
Funding Source: **Volgenau-Wiley Endowed Research Fellowship**

Project Summary:



Josephson Junctions are superconducting circuit elements whose behavior is described by a second-order, non-linear differential equation, that is dependent on the phase difference between the wavefunctions of Cooper pairs in two superconducting materials separated by an insulator. This non-linear equation is very similar to the equations that describe a pendulum with driving and damping forces, and as a result of which, Josephson Junctions can be directly compared and modeled as a pendulum. Josephson Junctions can be connected in parallel with one another, much like other circuit elements. This is physically analogous to a system of coupled pendulums as seen in the image, with neighboring junctions acting like neighboring pendulums. These parallel arrays are often connected in circular rings of junctions to make a continuous loop, with our arrays typically consisting of nine or fifteen junctions.

When cooled down below a given temperature current loops in the array can cause quantized bits of magnetic flux - called fluxons - to become trapped between two junctions in the array. At a certain current, Isw, or thermal energy level, a fluxon will begin to move around the array and a voltage is detectable. Isw, however, can vary significantly. It is strongly suspected that this variation is caused by production uncertainty in the size of the junctions, akin to a particle moving over a hill. The goal of the project is to confidently observe Macroscopic Quantum Tunneling (MQT), which would describe the behavior of the flux in the arrays. It is thought that MQT occurs when the fluxon tunnels from one side of a junction to the other without sufficient energy from an applied current or from heat energy. By sweeping a range of temperatures, ranging from 270 mK to 4 K, or around -450°F, the uncertainty in the size of the junctions can begin to be ascertained. As seen in the data below, as the temperature in the system begins to decrease, distinct switching currents can begin to separate, which likely correspond to slight variations in the size of junctions as a result of manufacturing processes.



Research Fellows: **Joe Berberich (2024)** — **Concentrations:** **Geography; Chemistry**
Steph Jacoby (2023) — **Concentration:** **Chemistry**
Morgan Usselman (2024) — **Concentration:** **Chemistry**

Faculty Mentor: **Anne Perring** — **Department:** **Chemistry**
Title of Project: **Measurements of Ambient Aerosol**
Funding Source: **NASC Division; Miller-Cochran Fund**
Project Summary:

Aerosols have important radiative effects and significant climate implications. Our group focuses on two specific kinds of aerosol: primary biological aerosol (PBA) and black carbon (BC). PBA includes bacteria, fungal spores and pollen which are interesting because some of them can nucleate ice at warm temperatures, affecting cloud properties and lifetime. BC is produced from incomplete combustion and has a net positive radiative forcing effect through its absorption of sunlight.

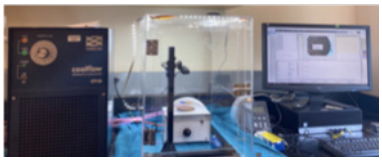


Figure 1: Drop Freeze Apparatus

This summer, in our work on PBA, we began collecting ambient samples as part of a year-long data set at the Bewkes Center using a Micro Orifice Uniform Deposition Impactor (MOUDI). We have developed systematic and repeatable methodologies for measuring ice nuclei (IN) and amino acids (AAs) in ambient samples. To measure IN, 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 ul drops are deposited with an acid-washed autopipette on a copper disk which is covered with a thin layer of vaseline. The plate is gradually cooled and pictures are taken every four seconds to capture when the drops freeze. Drops frozen at each temperature are converted to concentration of IN to quantify ambient warm temperature IN.. Preliminary findings from ambient samples suggest that the most active IN correlate with the size range associated with fungal spores, and increased warm temperature activity is observed after precipitation.

AAs can be measured as biomarkers for biological aerosol in the atmosphere to help further quantify PBA. AAs are derivatized using o-phthaldialdehyde mercaptopropionic acid (OPA-MPA) to produce fluorescence. AAs are quantified by reverse-phase high-performance liquid chromatography (HPLC). A calibration curve for AAs was created from a standard sample with retention times obtained from single AAs samples. MATLAB code was used to identify and quantify AAs for each stage sample. Acid hydrolysis was performed to digest combined AAs into free AAs for HPLC detection as the OPA-MPA would not react with combined AAs. Measurement of ambient aerosol amino acids will further allow us to investigate the link between PBA and warm temperature IN.

For our work on BC, we participated in the Asian Summer Monsoon Chemical & Climate Impact Project (ACCLIP) which aimed to investigate the convective transport of pollution via the Asian Summer Monsoon. using the NOAA Single Particle Soot Photometer (SP2). To prepare for this project, we analyzed data from the previous NASA campaign: Deep Convective Clouds & Chemistry (DC3), comparing concentrations of BC in convectively transported air to background levels. During ACCLIP, we worked as part of the NOAA SP2 team maintaining instruments installed on the NSF GV and the NASA WB-57 and analyzing data. Preliminary analysis focused on concentrations and size distributions of BC at various altitudes in Southeast Asia. In the future we will investigate the microphysical evolution of BC aerosols following transport and the convective transport efficiency of BC.

Research Fellow: **Leah Boykin (2023)** **Concentration:** **Psychological Science**

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

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

Funding Source: **Endowed Fund for Peace Research**

Project Summary:

The Movement 4 Black Lives (M4BL) signals the potential for a shift in racial politics in America. At the very least, this movement marks a newly unified and visible moment in a centuries old Black Liberation struggle. Since the resurgence of the fight for freedom from white supremacy, many white people have wondered what their role in this struggle might be. This research seeks to analyze white antiracists' answer to this query and study the contributions from those who consider themselves as such.

The data for this project includes interviews, participant observation, and archival investigation with a national network of predominantly white people, Showing Up for Racial Justice (SURJ), to ask how these activists approach their role in contemporary racial justice organizing. As a research assistant on this project, the majority of my time was spent listening to and cleaning interview transcripts from almost thirty leaders and organizers in SURJ, as well as from Black and Brown leaders who identify as solidarity partners with local SURJ chapters. I also attended meetings, Courtwatch, various political education sessions, compiled and coded months of emails disseminated by SURJ, and held regular conversations with Professor Russo, the PI, about emergent themes, arguments, and complexities within the data.

The idea of white anti-racist organizing is not a new phenomenon. During the Civil Rights Movement, Black leaders (most notably, those in the Student Nonviolent Coordinating Committee, or SNCC) asked white people to organize in their own communities. Several white antiracist groups today have heeded that call and have implemented strategies to help organize white people. As a national network, SURJ also prioritizes recruitment of those they believe to be most impacted by white supremacy among white communities: poor and working-class white people. Though data collection and analysis is ongoing, initial findings have indicated a shift from white people who consider themselves "allies" to the movement, thinking they are without any real investment in the eradication of white supremacy, to understanding that they too have a stake in ending white supremacy. White people, especially those from poor and working-class backgrounds, are being invited into racial justice organizing based on what they have to gain from a new antiracist social order.

Research Fellows: **Nikoloz Bujiashvili (2024)** **Concentration: Physics**
Wayne Wang (2023) **Concentrations: Physics; Mathematics**

Faculty Mentors: **Enrique Galvez** **Department: Physics and Astronomy**
Valeria Rodriguez Fajardo **Department: Physics and Astronomy**

Title of Project: **Generating the polarization-entangled photon state with the highest fidelity**

Funding Source: **NASC Division**

Project Summary:

Quantum mechanical principles and phenomena offer new possibilities for medical technology advancements. Our work this summer served as a preparation for the experimental detection of Alzheimer's disease in brain tissues using entangled photons. The potential advantage of this method stems from the high sensitivity of quantum states, the low intensity of single photon source, and the nonlocality of quantum entanglement.

Due to the fragility and sensitivity of quantum states, we need to be precise with our setup. The main goal of our research was to maximize the detection rate of non-classical/quantum light. We adopted ID900, a high-frequency time-tagging equipment, as a new and more rigorous way of detecting entangled photon pairs. Combined with automated components, we prepared the photons in an entangled state of high fidelity. The new setup provided more precise and efficient measurements, consistently producing states with tomography results and Bell numbers close to the theoretical values. These results assured us that the setup possessed the necessary precision and consistency for future scientific research.

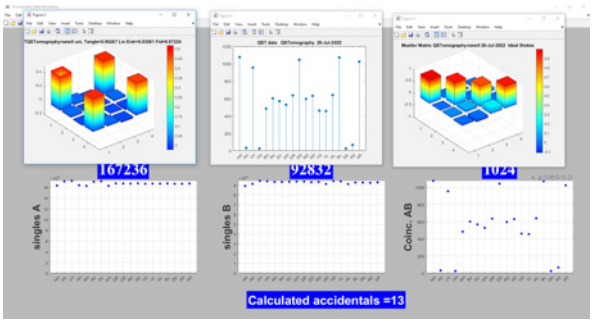


Figure 1: Output of Tomography Results. The background figure shows the counts of each detector and their entangled photons. The top subfigures (from left to right) give tomography output, a number of entangled photons for each entangled state, and the Mueller Matrix.

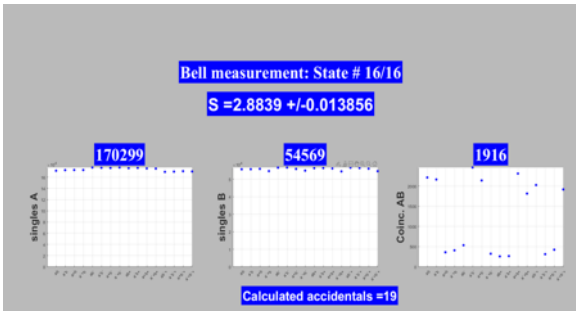


Figure 2: Output of one of the Bell tests we performed. The figure shows the counts of photons by each detector and their entanglement. The S value is the Bell number.

Research Fellow: Denzel Bullen (2023) **Concentrations:** Physics; Peace and Conflict Studies
Faculty Mentor: Ken Segall **Department:** Physics and Astronomy
Title of Project: Artificial Neurons using Superconductors
Funding Source: NASC Division
Project Summary:

The project, Artificial Neurons using Superconductors, highlights the capabilities of superconducting circuits, but more specifically, the Josephson Junction (JJ). JJ's are devices that use two superconducting materials, Niobium (Nb), which possess little to no electrical resistance, and one non superconducting material, Aluminum Oxide. Electrical current moves through these junctions similar to a capacitor. However, when multiple JJ's are linked together the possibility to create artificial neuron firing is more likely. but there are varying effects, which make them especially useful for simulating neuron spiking. Another unique aspect of JJ's and superconducting circuits in general, is that they exhibit hysteresis, which is the process of systems being dependent on its previous state. A very common example of hysteresis is the behavior of thermostats. If your house is at 65°, and you set the thermostat to 70°, it will continuously raise the temperature. Once the temperature raises a little above 70°, the thermostat will then lower the temperature, and in a similar fashion it will raise the temperature once it dips below 70°. This example of hysteresis clearly demonstrates a system that depends on its previous state. Much like the thermostat, JJ's behavior depends on the previous state of current applied.

The problem with understanding the way current is found JJ's is that they are incredibly small. To combat this problem, a parallel model was needed to illustrate. Fortunately, the equation of motion for a pendulum is similar in terms and magnitude. This allows us to use the pendulum to replicate how current goes through the JJ's by finding torque applied to the pendulum. Based on prior research, the best pendulum to use was a magnetic flywheel that uses a stepper motor and function generator to change the frequency at which the motor spins. There is a magnet attached to the motor that generates a field causing a magnetic flywheel to spin. Much like JJ's, the pendulum has different states it reaches once a certain amount of torque is applied. The states are called "whirling/dynamic" and "static". When switching bifurcation (a certain applied torque limit) is surpassed, the pendulum goes from static to whirling. When the applied torque is decreased, a return the static state expected, and a retrapping torque is recorded (Fig 1). In addition there is a magnet that can be applied to the flywheel, and this will apply a damping effect, which changes the switch bifurcations torque value (Fig 2).

In addition to the larger scale model, working on machining parts was an important part of this summer's research because of the low temperatures needed to operate with superconductors. As the experiments are being carried out in the older fridge, there is a new fridge that requires components to be built in order to get it up and running. For example, a voltage readout box has been under construction, and this would help consolidate the amount of wires that run from chip to the data collecting station. There is still work to be done on the components for the new fridge, so many more components will continue to be fashioned.

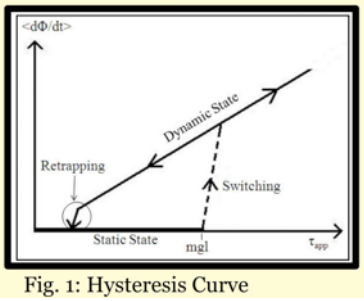


Fig. 1: Hysteresis Curve

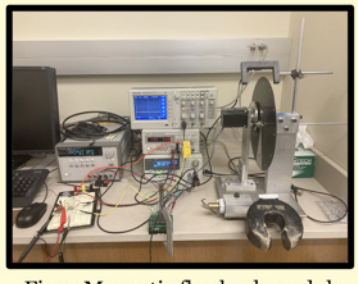


Fig. 2 Magnetic flywheel pendulum

Research Fellow: **Thomas Butler (2024)** **Concentration:** **Environmental Geography**

Faculty Mentor: **William Meyer** **Department:** **Geography**

Title of Project: **How Did People's Perception of Weather, Especially Winter, in Upstate NY Change After the Introduction of Automobiles and Paved Roads if at All?**

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

Project Summary:

Pre-automobile, local transportation in rural upstate New York was typically done on foot, or by horse-drawn vehicles, while railways, after the 1830s, were utilized to travel further. Even in cities, nearly all roads were unpaved, and travel consequently was weather-sensitive, and especially difficult when roads were muddy or dry and rutted. Some have suggested that winter was the best season for travel, the opposite of what we see today. Frozen and snow-covered roads offered a hard and low-friction surface for travel using horse-drawn sleighs. However, as upstate NY residents know, temperatures often plunge below zero during the winter, making outside activities uncomfortable, and in extreme cases, nearly impossible. Thaws and rain during warmer spells may also have complicated travel by worsening road conditions.

This project focuses on how the adoption of the automobile affected people's valuation of weather, particularly during winter, using the Rhoades Family Diaries (housed in Colgate's SCUA) and other historical documents. Past researchers have used diaries mostly in attempts to reconstruct local climate histories using similar diaries, and while this type of research is useful, diaries are only very imperfect substitutes for instrumental records. Much less use has been made of them for a purpose for which they are better suited, to gain an understanding of weather valuation. The Rhoades Family mainly resided on a large farm near Hubbardsville, and from 1843 to 1936, at least one member of the family kept a diary. Both male and female diarists noted the weather nearly every day, and otherwise gave a fairly detailed composite of daily life for the average farming family. Similar diaries exist, including the Eaton diaries, (also in SCUA), and the Diary of Ellen Birdseye Wheaton. A comparison of these diaries to the Rhoades Family diaries may reveal how valuations of the weather changed (or didn't) existed in upstate New York, and how male and female diarists, who are both represented are encompassed in the collection, may have differed in their weather valuations.

A deeper question this project asks is whether people's valuation of weather is constant or changes with historical and technological circumstances. An answer would help inform debates within the geographic community regarding climatic determinism and environmental determinism more broadly, an ideology that was widely shunned by academia for much of the 20th century, but has recently seen a resurgence. Though the results are tentative, and more research remains to be done, a few preliminary conclusions can be drawn from the research. The first is that weather valuation does seem to vary by gender, age, proximate physical geography, as well as other factors. Moreover, a composite valuation seems to have prevailed, as people thought of winter as a festive time with unique activities, like sleighing, but also the most difficult season to experience due to extremely cold bouts.

Research Fellows: **Luke Calderaro (2022)** — **Concentrations: Molecular Biology; Geology**
Charlotte Filipovich (2023) — **Concentration: Geology**
Juan Gómez (2024) — **Concentration: Environmental Geology**
Adam Limoges (2024) — **Concentration: Environmental Geology**
Victor Unnone (2023) — **Concentration: Natural Sciences**

Faculty Mentor: **Paul Harnik** — **Department: Geology**

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

Funding Source: **Doug Rankin '53 Endowment - Geology Research; NASC Division; Hackett-Rathmell 1968 Memorial Fund**

Project Summary:

Recent human activities have increased the delivery of nutrients to coastal ecosystems, leading to enhanced primary productivity and the development of oxygen-limited zones. Changes to environmental conditions have the potential to alter organisms' life histories, physiologies, and the composition of communities. Live-dead analysis is a method used to estimate changes between past and present communities. Surficial shell assemblages from the northern Gulf of Mexico can yield biological data that extend back ~10,000 years before present, which can be used to establish historical baselines for contemporary species. Shifts from these baselines may result from preservational processes but also may reflect biotic responses to recent environmental change.

To assess biotic response to enhanced nutrient delivery, we collected surficial samples at -20m depths from fourteen stations located offshore Alabama, Florida, and Louisiana. Following collection, samples were sieved and subsequently sorted to separate live bivalves from shelly material for subsequent analysis. While processing, we observed geographical variation between sites that will be further investigated through individual projects.

Charlotte Filipovich ('23) is analyzing live-dead samples from Alabama to study the functional diversity of bivalves. Functional diversity measures the variety of traits present in a community (e.g., feeding type, depth, environmental tolerance). Living assemblages in areas like Alabama that are affected by increased primary productivity may be enriched in deposit-feeding, surface dwelling bivalves relative to the frequencies of these communities in the past. Comparing functional traits can document potential shifts in communities reflective of environmental change. Charlie is currently identifying species from Alabama samples and plans to measure body sizes and characterize functional traits.

Victor Unnone ('23) is studying the spatial distribution of sexual versus asexually reproduced cupuladriid bryozoan colonies. Previous studies show that cupuladriids clone themselves in times of increased food availability, but reproduce sexually when food is scarce . One can distinguish differences in reproductive modes by looking for fragments from previous colonies present in the individual, or by features present from the larval stage. We are currently building a catalog of bryozoan photographs in order to consistently classify their clonality.

Juan Gómez ('24) is investigating temporal variation in larval shell size in Nucula proxima using scanning electron microscopy. The larval shell preserved on adult shells is correlated with egg size and is hypothesized to be smaller in nutrient-rich conditions. Juan's research focuses on comparing larval shell size from live and dead assemblages in order to assess life history differences among populations over time in response to environmental change. Their work extends that of a former student in the lab (Celia Meyer '22), who compared assemblages of N. proxima in Alabama and Florida that lived in varying conditions of primary productivity.

Research Fellow: **Jane Carskaddan (2024)** **Concentration:** **Geology**
Faculty Mentors: **Paul Harnik** **Department:** **Geology**
Rebecca Metzler **Department:** **Physics and Astronomy**
Title of Project: **Comparing Microstructures of Bivalve Shells from the Northern Gulf of Mexico across Spatial and Temporal Regions**
Funding Source: **Justus '43 and Jayne Schlichting Student Research Fund**
Project Summary:

How bivalve mollusks grow their biomineralized shells is highly influenced by factors of their environment. Exact relationships between these factors (temperature, pH, oxygen content, etc.) and shell microstructure is largely unknown. However, it is hypothesized that as the environment shifts from the "natural," or "baseline," conditions, the patterns of orientations of the individual crystals that make up a shell become increasingly disorderly. Marine ecosystems are undergoing rapid change due to anthropogenic influences, which could therefore cause this disorderly growth. This is the basis of my project, which seeks to answer the question of how shell microstructures of bivalve species of the northern Gulf of Mexico have changed over time.

We focused on two genera of small clams found throughout regions of the northern Gulf: the species *Nucula proxima* and various individuals from the *Lirophora* genus. Individuals were selected from Paul Harnik's archives. These included shells that were collected live and shells that were collected dead. These dead collected shells may be anywhere from years to centuries old. Live and dead collected *Lirophora* were taken from Florida and Alabama while *N. proxima* were collected from Louisiana and Alabama. We determined via IR spectroscopy that both groups' shells are composed entirely of the carbonate mineral aragonite. To find the crystal orientations of our *Lirophora* shells, we utilized the synchrotron powered X-ray Photoemission Electron Microscope (X-PEEM) at the Berkeley Advanced Light Source. C-axis orientation of aragonite crystals can be determined by changing the polarization of incoming synchrotron light and acquiring a stack of images under many varying polarizations. Polarization-dependent image contrast (PIC) maps were produced for various regions of one live and one dead collected *Lirophora* shells from both Florida and Alabama using the Gilbert Group Macros in Igor (Figure 1). The maps show that crystal orientation patterns vary between live and dead collected individuals as well as between geographic regions. For *N. proxima*, orientation can be found using EBSD. EBSD is not as sophisticated as X-PEEM analysis which can detect the orientation of extremely small crystals. This makes it a poor technique to use for analysis of *Lirophora*, but viable for *N. proxima* which grows larger crystals. Minimal EBSD has been conducted thus far, but it is showing promising results and will be continued in the future. Besides crystal orientation, we are also interested in variations in nacre tablet thickness between temporal and spatial groups. Cross sections of shells were imaged under SEM and stitched together in Adobe Photoshop. Tablet thickness was then measured from these maps using ImageJ and plotted against distance from the interior edge of the shell. We found that all mapped shells had different overall tablet thickness. Additionally, each shell had a different trend of how thickness changed throughout the cross section. This could be because of differences in environmental factors between groups, but mapping of more shells is needed before coming to that conclusion. This is one of our many future goals for this project. More dead collected *N. proxima* shells have been pulled for SEM mapping and EBSD work. Eventually, we hope to take *N. proxima* shells to a synchron for X-PEEM and PIC mapping. We are also currently awaiting results of radiocarbon dating of all our dead collected shells.

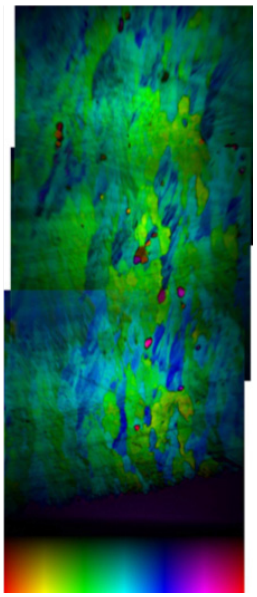


Figure 1: Example of PIC mapping of *Lirophora*. Each color corresponds to an angle of crystal orientation.

Research Fellow: Claire Chen (2024) **Concentration:** Film & Media Studies

Faculty Mentor: Jordan Lord **Department:** University Studies

Title of Project: The Living Situation of LGBTQ+ Asians (mostly Chinese) in the American Entertainment Industry

Funding Source: Endowed Fund for Peace Research

Project Summary:

For decades, stereotyping and discrimination have made it difficult for Asian individuals to attain fair representation in film and media. As a result of these barriers, Asian film workers are often given stereotypical roles and prevented from playing characters that stray from how Asian characters have been portrayed in the past. For my research project, I explore the experiences of LGBTQ+ identified Asians, focusing on Chinese, in the entertainment industry in the U.S.. I approached this topic through two quantitative methods: reviewing existing articles about Asian LGBTQ+ film and interviewing subjects who have worked in the film industry.

According to a recent article about Asians in the American workplace, Asians are often labeled as well-educated and successful "model minorities" and therefore often left out of diversity and inclusion plans. As a result, Asian employees are among those least likely to be promoted to a company's management level. The situation is even harsher for foreign Asian workers, who face tremendous legal difficulties just to live and work in the United States, especially in creative industries.

Since my current research focuses on the living situations of LGBTQ+ identified Asians, I have conducted several personal interviews with individuals about their lived experiences. The information shared with me in these interviews can help me to understand the situation on a deeper level.
The interviewees agreed that gaining the "green card" to almost permanently live and work in the U.S. is a long and strenuous process. The interviewees for my research were actually all extremely lucky in this (meaning that it only took them around five years,) and yet they constantly see their friends struggling with that. They also agree that one of the major reasons for them to have their heart set on staying in the U.S. is the invisible yet suffocating pressure on the LGBTQ+ community, not only in the workplace but also in their social life in China.

Interestingly enough, when talking about their opinions on the living situation of LGBTQ+ Asians/Chinese workers in the American entertainment industry, they formed two almost opposite sides.
The first side, featuring a Chinese line production worker and playwright, David Chen, views Asian representation in American films as both insufficient and stereotypical. He gave the example of the American TV show Once Upon A Time in which Mulan, a Chinese female warrior character, is written as a lesbian, thus reinforcing the stereotype of the "butch" lesbian. This side also believes that the only solution to inaccurate representation is to put the creative rights in the hands of people with relevant experiences. A powerful example of this is Everything Everywhere All at Once in which Asian cultures are authentic and diverse.

The other side finds these arguments unconvincing. "Just think about what percentage Asians are in the U.S. and the percentage of LGBTQ+ people among that. It is statistically an extreme minority so a so-called lack of media representation is not as big a problem as you may think it is." said Robert Wei, a Chinese game producer working for a Singaporean company in the U.S.. This side also believes that with strong professional skills and experiences and adequate research, film workers should be able to master whatever topics. For example, famous Chinese director Ang Lee (the director of Brokeback Mountain,) directed the movie Sense and Sensitivity–a movie taking place in the U.K. in the eighteenth century– in 1995 when he could barely speak English. Yet the movie received seven Oscar nominations.

Research Fellows: **Jian Chen (2023)** **Concentration: Biochemistry**
James Clark (2023) **Concentration: Biochemistry**
Abby Getz (2024) **Concentration: Biochemistry**
Ethan Riggs (2025) **Concentration: Undeclared**

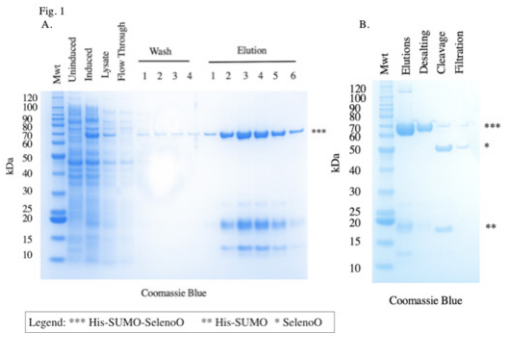
Faculty Mentor: **Jenny Peeler** **Department: Chemistry**

Title of Project: **Study of SelenoproteinO Using Genetic Code Expansion**

Funding Source: **NASC Division**

Project Summary:

Selenocysteine (Sec) is a naturally occurring amino acid that is found in all domains of life. Selenoproteins are characterized by the incorporation of Sec, which has been demonstrated to be involved in redox biochemistry and homeostasis. SelenoproteinO (SelenoO) has recently been characterized as an AMPylating enzyme, but the role of the Sec residue has not yet been determined. Our work focuses on expressing and purifying the cysteine (Cys)-containing E. coli SelenoO homolog as well as performing assays to measure AMPylation activity of E. coli SelenoO. We also wish to study human SelenoO, but the endogenous system of Sec synthesis is complex and energetically costly. To bypass the complicated endogenous incorporation of Sec into a protein, we use genetic code expansion (GCE), which uses engineered tRNA and tRNA synthetase pairs that allow for the incorporation of the noncanonical photocaged amino acid DMNB-Sec. We can transfect cells with a plasmid that contains genetic information for the tRNA synthetase, tRNA pairs, and our protein of interest (POI) in order to express it in HEK293 cells. GFP is a helpful POI as its fluorescence is an indicator of the success of GCE and DMNB-Sec incorporation. We synthesized DMNB-Sec and successfully optimized its incorporation into GFP. To study human SelenoO, we first made a plasmid containing the *SELENOO* gene and the tRNA and tRNA synthetase regions of pAcBac2 by molecular cloning. We then transfected HEK293 cells with the pAcBac2 *SELENOO* plasmid. In the future, we will continue optimizing GCE to express human SelenoO to study SelenoO AMPylation functions and the role of Sec residue in AMPylation. To study SelenoO in E. coli, cells were transformed with *SELENOO* plasmids. Then the protein, SelenoO-SUMO-His, was expressed, purified, desalted, and cleaved. The cleaved SelenoO was isolated from SUMO-His for future assays. Upon optimizing the purification and cleavage of this protein, AMPylation functional assays will be performed using biotinylated ATP as well as mass spectrometry to confirm the 329 Da shift between AMPylated residues.



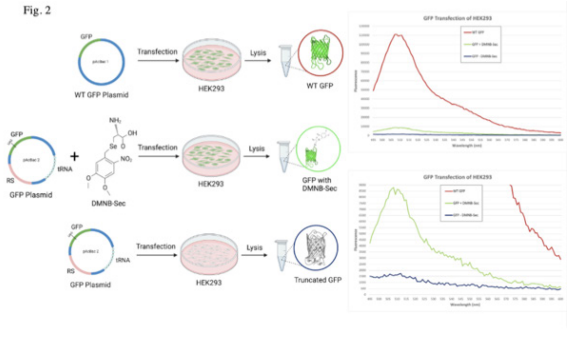


Figure 1: A: The expression of His-SUMO-SelenoO is shown with the band at 70 kDa. This was expressed in the induced lane and purified throughout flowthrough, washes, and elutions. B: The purified protein was desalted then cleaved. The SelenoO is shown with the band at 50 kDa. The His-SUMO is shown at about 18 kDa. In the filtration lane, the SelenoO was isolated from the His-SUMO.

Figure 2: The left diagrams show the transfection of Wild Type GFP, GFP with DMNB-Sec, and GFP without DMNB-Sec into mammalian cells and the synthesized GFP protein. The right graphs show the fluorescence of GFP which peaks at 509 nm.

Research Fellow: **Lance Chen (2025)** **Concentration:** **Undeclared**
Faculty Mentor: **Beth Parks** **Department:** **Physics and Astronomy**
Title of Project: **Measuring building insulation**
Funding Source: **NASC Division**
Project Summary:

Heating and cooling of buildings is one of the biggest usages of energy in the U.S. Our project was aimed to determine the level of insulation of normal house walls using instruments that are affordable and easy to use, so that people can have a better idea of their house wall insulation and make improvements to conserve energy.

Our main method was using a thermal insulation square to measure the R-value of the wall. (R-value is a measure of the thermal resistance of the wall, so a higher R-value means better insulation.) We tape a square onto an exterior wall, as shown in Figure 1. Then, we set up thermocouples to measure the temperature difference across the insulation square and also the temperature difference across the wall. For testing purposes, we also used sensitive thermometers to confirm the thermocouple measurements. When temperature and heat flow across the wall is uniform, the relationship between temperature and R-value is:

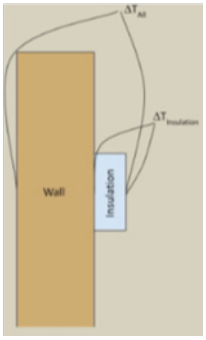


Figure 1: Set up

$$\frac{\Delta T_{Insulation}}{\Delta T_{Total}} = \frac{R_{Insulation}}{R_{Total}}$$

Since we know the R-value of insulation and can measure the two temperature differences, we can calculate the R-value of the total wall.

We started with a Styrofoam House that helped us find any potential deficiency of our method. To be more specific, because the Styrofoam House was built with uniform material and heat transfer should hence be uniform also. In this case, it would be easier to start with this house first for better understanding. Since room temperature was always changing, we took data overnight to make sure data was stable enough. Meanwhile, we also monitored the temperature over places inside the house to have a better idea of the heat structure of the house.

After everything was going well for the Styrofoam house, we turned to a Model House with studs inside the wall, where heat leaked out just like a normal house. To mimic the real life situation more, we moved the House outside overnight. We found things interesting. For example, the insulation square should be inside the house rather than outside. However, we were half-way on this part of the experiment when the project ended. The next students working on this project will work on this more.

Research Fellow: **Yumeng Chen (2025)** **Concentration: Undeclared**

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

Title of Project: **The need, the barrier, and the future of perinatal care and prenatal education for refugees in the city of Utica**

Funding Source: **Upstate Institute**

Project Summary:

I worked with the Center in Utica as a Field School Fellow this summer on research about prenatal care and education. My project aims to generate actionable insights to build up an educational and birth support program in Utica in the future. Many refugee and immigrant women in the United States experience cultural and language barriers when seeking pregnancy-related medical care. Such barriers may delay needed care and adversely impact birth outcomes. By giving better guidance through the program, The Center would help to raise refugee women and their family's awareness and spread maternal health literacy, which is a known predictor of perinatal outcomes. I started by examining research papers and collecting data about how low English proficiency and cultural barriers among refugees could lead to a lack of adequate prenatal care and increase the risk of complications during pregnancy. With an all-depth understanding of the needs and difficulties, I was then able to interview refugee women who had given birth in Utica. These interviews offered me valuable insight into their experiences and difficulties when it comes to prenatal education access and concerns about baby health. Outside of the Center, I have also talked to other nonprofits and refugee resettlement agency coordinators about their childbirth education and prenatal care program.

It is not only about the women here, but more essentially the members of the healthcare team, including hospital staff, healthcare providers, and medical interpreters. Every member of the team would benefit from cultural sensitivity training that includes topics such as patients' cultures, traditions, and values as well as their expectations of delivery. They could therefore better assist the overall experience and enhance communication between the parties. Ensuring that the interpreters are trained in medical competency is fundamental during the diagnostic process: refugee women with low LEP will be able to understand and follow certain medical routines and treatments and exhibit a higher return rate.

The ultimate goal of this research is to help develop multi-language maternal health education focusing on preconception, pregnancy, and postnatal care for women from refugee and migrant backgrounds. Suggested approaches may include lecture series, animated videos, printed materials, and tours of the hospital's birth center. Also, to increase attendance at prenatal visits, providers should consider implementing a system of reminder telephone calls before prenatal appointments and provide necessary transportation to the appointment and child care if possible. More women with immigrant and refugee backgrounds would benefit from this birth support program in the future.

Figure.1 Rahina Kamal demonstrates postures and positions on a birth ball in a Healthy Moms class, to show pregnant women to get comfortable and stretch throughout pregnancy and labor at Friends of Refugees.

Research Fellows: **Chris Cherniakov (2024)** **Concentration: Computer Science**
Samay Gupta (2024) **Concentration: Mathematics**

Faculty Mentor: **Will Cipolli** **Department: Mathematics**

Title of Project: **The Data Science Collaboratory at Colgate University**

Funding Source: **NASC Division**

Project Summary:

The collaboratory is a data analysis collaboration network focused exclusively on smaller colleges and universities in New York State. Leveraging expertise across the New York Six Liberal Arts Consortium (NY6), the collaboratory consists of a cohort of statisticians and data librarians from regional colleges and universities and from within the community.

One of the challenges that many faculty members and student researchers face is the lack of resources for statistical analysis for quantitative work. The current resources — such as R, STATA, or Matlab — require coding proficiency and considerable time investment. This creates artificial barriers for the researchers, preventing them from doing advanced quantitative work.

Our research team's solution for this issue is using the R Shiny framework to build web applications. R Shiny provides robust instruments for building reactive applications that we used to design scalable applications for completing statistical analyses. These applications require zero previous programming experience and have built-in statistical expertise to ensure that the methods are used correctly.
Our research team leveraged the power of the tidyverse package for data manipulation and ggplot2 for plotting the data assessment. We utilized multiple R packages to complete the desired statistical analysis. Critically, our web applications plot and interpret the results of the supported methods so that they can be easily understood, even by those unfamiliar with the statistical specifics.

We use Shiny Meta to ensure that the apps are also helpful for those willing to learn the code. Each model result and plot have a corresponding `R Code' button that reveals the lines of code that created them. This makes the analysis easily reproducible.

One of the major challenges we faced was learning complex coding to create applications capable of performing complex statistical analyses in a generalizable way. Furthermore, we had to ensure that our applications' UI and design were straightforward. Testing is also a significant challenge, as we must ensure that each app works with various datasets and performs equally well on most devices and screen sizes.

The next steps for the collaboratory are to develop more apps geared toward removing barriers from the world of statistics and quantitative research. Furthermore, we aim to provide data analysis services to researchers from other departments at Colgate as part of our mission to create a vibrant community comprising various fields

Research Fellows: **Thanh Dang (2025)** **Concentration: Undeclared**
Will Russell (2024) **Concentration: Molecular Biology**

Faculty Mentor: **Ahmet Ay** **Department: Biology; Math**

Title of Project: **Risk for Seasonal Affective Disorder (SAD) and Depression Linked to Clock Gene Variants**

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

Project Summary:

Background: Depression and related mood disorders, such as anxiety and seasonal affective disorder (SAD), affect nearly one-fifth of the global population and disproportionately affect young adults, particularly females. In addition to exacting personal costs, such disorders have substantial economic costs. Individuals affected by mood disorders are frequently plagued by sleep problems and disruptions in circadian rhythms, daily cycles in physiological processes and behavior, indicating a connection between circadian physiology and mood pathways. In addition, mutations in core regulatory clock genes are associated with sleep-wake patterns and mood disorders, suggesting that molecular mechanisms affecting mood are influenced, in part, by the circadian clock.

Methods: This project employs a combination of machine learning and statistical analyses to predict significant associations of SAD and depression with circadian gene variants, clinical features (depression, anxiety, chronotype, sleep issues) and environmental features (sleep patterns, seasons, socio-economic status).

Key Findings:

a) **b)**

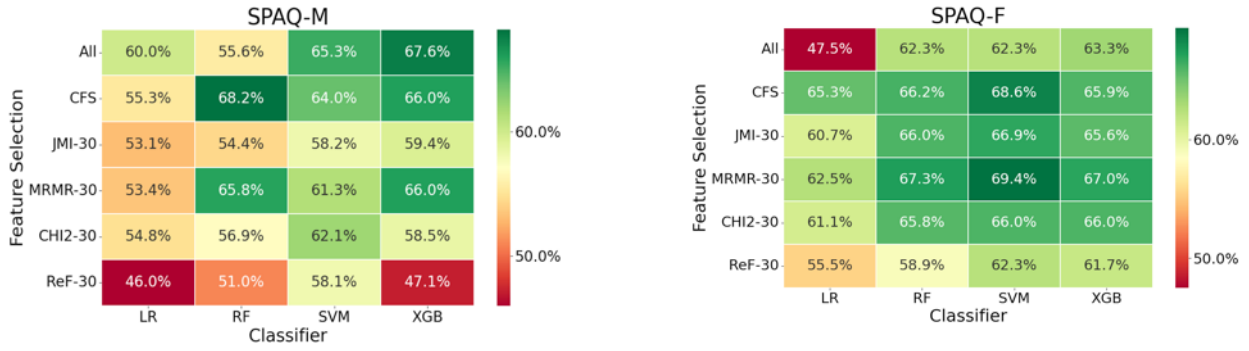


Figure 1: LR, RF, SVM, and XGB classifiers predicted 7-10% higher accuracy over baseline (58% & 42%) on balanced datasets, using all or a subset of features determined by feature selection methods including CFS, JMI, MRMR, and CHI2.

Conclusions:

- Machine learning can be used to predict seasonality/depression with high prediction accuracy. we identified following seasonality risk factors: PER2-GG/PER3B-AG and CLOCK3111-TC/ZBTB20-AB in males, CRY2-AA/PER3C-TG and age in females, and PER3C-TG, PER2-GG eveningness, and sleep disturbance for both sexes. VNTR may be a risk factor when present alongside other genotypes like PER3C-TG and PER2-GG.
- Through our study, we identified different significant factors by sex, supporting sex differences in seasonality. Etiological studies provide further support for these observed differences.

Research Fellows: **Edlin Davis (2023)** **Concentration: Psychological Science**
Sarah Traenkle (2023) **Concentration: Biochemistry**

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

Title of Project: **How Climate Change Affects Balanus amphitrite Exoskeleton Formation**

Funding Source: **National Science Foundation**

Project Summary:

Barnacles, such as *Balanus amphitrite*, are found in most warm or temperate seas, particularly with a lot of water activity (ie. intertidal zones and underwater volcanoes) as barnacles are filter feeders. These organisms attach themselves to any hard surface they encounter, including rocks, buoys, and whale tails. Their exoskeletons are used for protection and structure and are primarily made up of calcite, the most stable calcium carbonate mineral polymorph. The exoskeleton consists of a base plate underneath the barnacle, parietal plates surrounding the organism, and opercular plates that open and close to allow the organism to eat; each plate consists of rhombohedral calcite crystals which vary in size, shape, and orientation. To explore the effects of temperature and pH on barnacle settlement and exoskeletal development, light microscopy, scanning electron microscopy (SEM), and x-ray photoemission electron microscopy (X-PEEM) were used to examine barnacles grown in different conditions. We placed cyprids, which are the barnacles' second stage of life, in incubators at 27ºC, 29ºC, and 31ºC. The 27ºC environment was meant to mimic the current ocean temperature, while the two other temperatures were theorized to be future ocean temperatures caused by climate change. In addition to temperature, we also investigated how ocean acidification would affect the exoskeleton of *Balanus amphitrite*. This time, cyprids were placed in 8.28 pH, 7.96 pH, and 7.66 pH and grown under 27ºC, 29ºC, and 31ºC incubator conditions. From the combined pH and temperature experiments, we were able to analyze the differences in growth of the various temperatures and pHs. However, to examine the elemental composition and crystalline orientation of the exoskeletons several microscopy methods were utilized. The x-ray photoemission electron microscope [XPEEM] (Figure 1) was used to identify the differing calcite orientations of the exoskeleton, while the scanning electron microscope [SEM] (Figure 2) was used to determine the topography and elemental composition of the exoskeleton. Given the various experiments performed, it was concluded that *Balanus amphitrite* flourishes in higher ocean temperatures, while lower ocean acidities decrease the number of settled and metamorphosed barnacles.

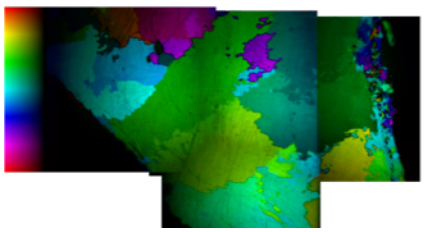


Figure 1. Exhibits a PEEM map of adult barnacles grown at 30ºC/7.8 pH. The different colors in the maps show the varying calcite crystal orientations in each barnacle, which helps us determine how climate change affects barnacle structure and morphology.

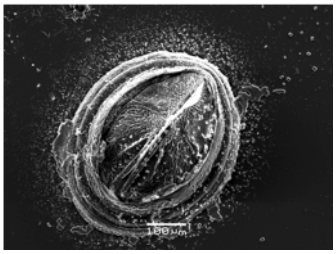


Figure 2. Presents an SEM image of a baby barnacle grown in an extreme condition of 31ºC and 7.66 pH. The parietal plate (the shell providing structure and protection) and operculum (mouth of the barnacle) are displayed at 150x magnification.

Research Fellow: **Vanessa Dawley (2023)** **Concentration:** **Peace and Conflict Studies**
Faculty Mentor: **Julie Dudrick** **Department:** **Upstate Institute**
Title of Project: **Increasing Biodiversity Through Pollinator Gardens in the Adirondacks**
Funding Source: **Upstate Institute**
Project Summary:

The current project aims to facilitate the needs of pollinators and create significant positive change within pollinator populations in the Adirondacks. Adirondack Action is a non-profit organization that manages several different environmental and community-based projects within the region. The primary methods of the pollinator project are building local pollinator gardens as well as community-based science programming. My everyday work schedule to accomplish this goal was going to local Adirondack sites such as public schools, town squares, community gardens, and churches to build gardens or host events. When there was not a garden installation or event programming that day I created educational materials for garden owners to use to facilitate their own events. This was aimed at creating opportunities for individuals within local communities to feel empowered and prepared enough to advocate for pollinators without Adirondack Action.

One of the main themes that the pollinator project intends to promote is that Native plants and pollinators have a symbiotic relationship. Plants provide pollen or nectar to pollinators. Then, the seeds spread and grow far outside gardens and increase biodiversity. Biodiversity creates stabilization that provides a safe world for people and nature. As rates of native species continue to decrease in response to human activity, humans are increasingly responsible for conserving current biodiversity and working to restore damaged ecologies. When thriving, pollinator gardens do both. Pollinator gardens are a space of de-hierarchization, where humans can advocate for the needs of the environment above their own. This reduces the tendency for colonial, humancentric frameworks. Local communities plant gardens to restore balance to the environment by increasing biodiversity. At the same time, the continued existence of pollinator gardens and their caretakers expands knowledge to a larger audience that can then take on advocacy roles. Continued research should focus on collecting empirical data in the future, and will show the success of such gardens on pollinators.

Research Fellows: **Emma Dexter (2023)** **Concentrations: Anthropology; Environmental Studies**
Kayla Gutheil (2024) **Concentration: Environmental Studies**

Faculty Mentor: **Heather Roller** **Department: History**

Title of Project: **A Social and Environmental History of Agrichemicals**

Funding Source: **Alexander V. Wasson Fund to Support American History; SOSC Division; Endowed Fund for Peace Research**

Project Summary:

This summer, we had the privilege of assisting Professor Roller as she began research for her upcoming book project on the history of agrichemical use and peoples' perception of contamination since the 1970s. We began with a literature review to familiarize ourselves with the existing academic literature on topics related to agrichemical use and issues of risk and exposure in agrarian contexts. We also made official public records requests for relevant cases of agrichemical misuse complaints. As we contemplated the role that local voices could play in shaping this project, we consulted articles and discussed best practices regarding the ethics of collecting oral history narratives. These preliminary tasks prepared us to conduct 17 semi-structured interviews with three groups: (1) conventional farmers, (2) organic farmers, and (3) folks living adjacent to conventional farmlands. The audio of these conversations was recorded with participants' consent and processed by Otter.ai transcription software to produce a transcript. We corrected each transcript for accuracy and clarity and added topical keywords as a means of indexing each interview so that Professor Roller may easily return to them later in her writing process. Our final task was to write a personal reflection of our 8-week research experience and consider how the findings of our oral history interviews connect with the sources we examined at the beginning of the summer. The insights we gained from these conversations have greatly influenced the trajectory of the project and our work suggests that an exploration of the complex decision-making process behind pesticide use (or non-use) may provide a richer dialogue rooted in historical practices and public perception. The work our team has achieved this summer has laid the foundation for future interviews and an expanded, multi-sited investigation of agrichemical practices beyond the Central New York region.

Research Fellows: **Kartik Devpura (2023)** **Concentrations: Economics; Applied Math**
Gunes Tiryaki (2023) **Concentrations: History; Mathematics**
Faculty Mentor: **Rob Davis** **Department: Mathematics**

Title of Project: **Estimating the Normalized Volumes of Certain Polytopes using Enumerative Graph Theory Methods**

Funding Source: **National Science Foundation**

Project Summary:

A *polytope* $P \subset R^N$ where *N* is a positive integer is the convex hull of finitely many points $v_1,\ldots,v_d \in R^N$, that is,

$$P = \{\sum_{i=1}^{d} \lambda_i v_i | \lambda_1, \ \ldots, \lambda_d \geq 0, \ \sum_{i=1}^{d} \lambda_i = 1\}$$

This is a technical definition for shapes in any number of dimensions without any curves or holes. An example of a polytope in 3 dimensions is a cube. Similarly, the tesseract is an example of a polytope in 4 dimensions.

The *associated type-PQ adjacency polytope* for a simple undirected graph G on {1, …,*N*} is,

$$\nabla_G^{PQ} = \text{conv}\{(e_i, e_j) \in R\text{^}2N \mid i=j \text{ or } ij \in E(G)\}$$

where e_i is the standard basis vector and *E(G)* is the set of edges of *G*. The *normalized volume* of a type-PQ adjacency polytope is[1],

$$NVol(\nabla\_G\text{^}PQ) = dim\ dim\ (\nabla_G^{PQ})\ !\text{vol}(\nabla_G^{PQ})$$

The first factor in the equation is the dimension of the polytope and the second factor is the Euclidean volume of the polytope. The normalized volume of such a polytope is always a positive integer when *P* is the convex hull of points in Z^N, a way to compute the normalized volume is to find a set *S* for which $NVol(\nabla_G^{PQ}) = |S|$.

This project focuses on using graph theoretic methods to find such a set *S*.

Methods

1. Draconian Sequence Method:

We count the number of *draconian sequences* created by a graph *G* using the method given by Postnikov[2]. It has been proven that the number of draconian sequences of *G* is equal to the normalized volume of the type-PQ adjacency polytope generated from *G*[3]. We further extend this notion to create *b-draconian sequences* and *maximal complete bipartite subgraphs* to calculate the draconian sequences in a graph.

2. Spanning Tree Method:

It has been proven that the normalized volume of a type-PQ adjacency polytope is equal to the size of the maximal set of spanning trees of the bipartite transformation of *G* which pairwise fail the left-right directed cycle condition[4]. Through our work, we proved that there is no function that takes the draconian sequences of graph *G* as an input and produces an image set that gives us a maximal set as specified above.

1 Beck, M., & Robins, S. (2015). Computing the continuous discretely: Integer-point enumeration in polyhedra (2nd ed.). Springer;
2 Postnikov, A. (2009). Permutohedra, associahedra, and beyond. International Mathematics Research Notices, 2009(6), 1026–1106. https://doi.org/10.1093/imrn/rnn153;
3 Davis, R., & Chen, T. (2022). Computing volumes of adjacency polytopes via draconian sequences. Electronic Journal of Combinatorics, 29(1). https://doi.org/10.37236/9768
4 Chen, T., & Mehta, D. (2015). On the network topology dependent solution count of the algebraic load flow equations. https://doi.org/10.48550/ARXIV.1512.04987

Research Fellow: Camden Di Carlo (2024) **Concentration:** Biochemistry

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

Title of Project: Oxime Cyclization and Chiral Enolate Approach Toward the Synthesis of a Tn Antigen Mimic

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

Project Summary:

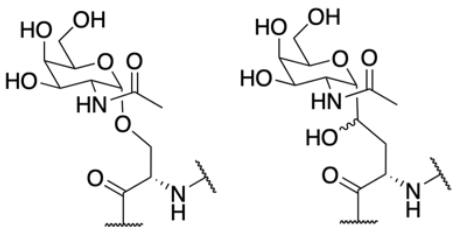
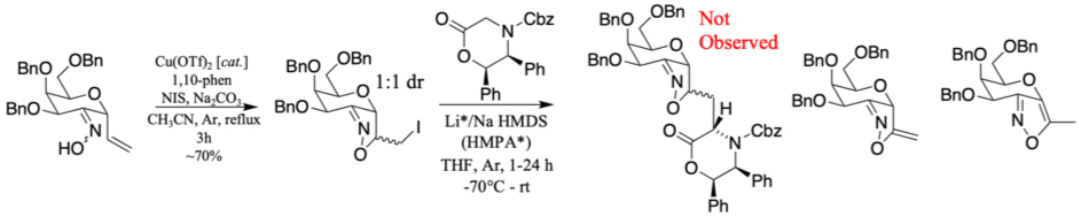


Figure 1: Tn antigen (left) and a Tn antigen analog (right).

When cells make membrane proteins, they often attach various sugars to the proteins via a process called glycosylation. However, in many types of cancer cells, the glycosylation process is disturbed, leading to some proteins having fewer (or simpler) sugars attached to them. Since these simpler glycoproteins are not typically present in significant quantities on the cell surface, their detection may indicate that cancerous cells have developed. In fact, the immune system is capable of recognizing these abnormal glycoproteins, and as such they are considered to be antigens. One of these glycoproteins is called Tn antigen, an N-acetylgalactosamine, pictured on the left in Figure 1. Due to their ability to stimulate the immune system, these antigens are the focus of some immunological research in hopes of developing a vaccine against cancer.

Unfortunately, because of various factors, the wildtype Tn antigen is not ideal for these studies, leading to an interest in studying analogs to better understand how the immune system reacts to these antigens. Hence, many organic chemists have made synthesizing various analogs the focus of their research, and such is the focus of the Nolen Lab. Our goal has been to synthesize the Tn antigen analog pictured on the right in Figure 1, which contains a carbon linkage and a hydroxyl group, rather than an oxygen linkage. The carbon linkage will provide greater metabolic stability, while the hydroxyl group will mimic the hydrogen bonding network present in the aqueous environment of the body, shaping the preferred conformation of the molecule.



Scheme 1: Oxime cyclization reaction and subsequent attempt at a chiral enolate substitution reaction.

With the galactose sugar backbone already present in the previously- synthesized oxime, we theorized that the amino acid moiety could be added through an enolate substitution reaction. To that end, we were able to successfully cyclize the oxime into the isoxazoline iodide in a 1:1 diastereomeric ratio in approximately 70% yield (Scheme 1). With the iodide — a good leaving group — to facilitate the substitution reaction, several attempts were made using William's chiral oxazinone. The enolate was formed using either lithium or sodium hexamethyldisilazide (HMDS), and the bulky phenyl groups control the stereochemistry at the alpha carbon due to sterics. However, the expected product was never observed, only the elimination products shown in Scheme 1. As a result of this roadblock, the Nolen Lab has opted to approach the synthesis from a different angle going forward.

Research Fellow: **Jared Diks (2025)** **Concentration:** **Undeclared**

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

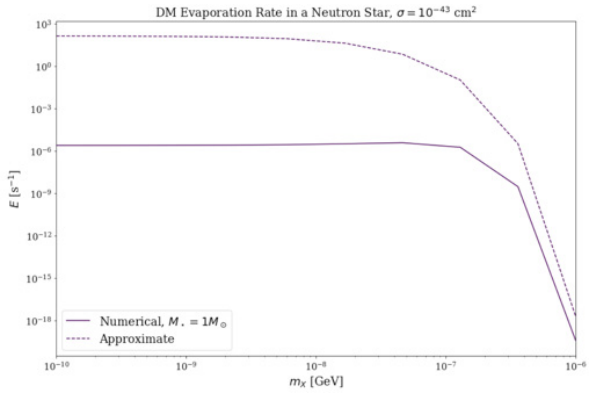
Title of Project: **Dark Matter Evaporation From Compact Celestial Bodies**

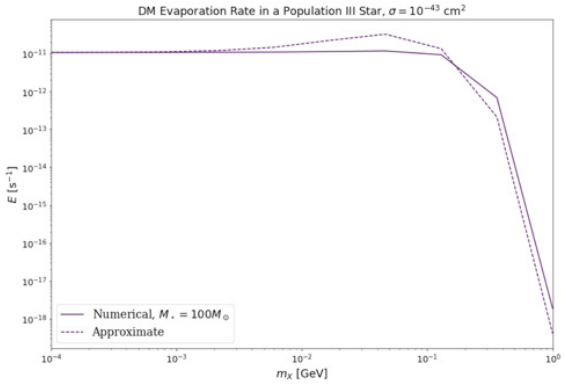
Funding Source: **Justus '43 and Jayne Schlichting Student Research Fund**

Project Summary:

Dark Matter, or DM, is one of the most mysterious concepts that astrophysics predicts. It is a substance that, if proven to exist, would interact very rarely if at all with the normal baryonic matter that makes up everything we can see and touch. However, just like everything else, DM is affected by gravity, meaning it can be "captured" by the gravitational fields of stars. For this to occur, a DM particle must collide with an atomic nucleus within a star such that the DM particle is slowed down below the escape velocity of the star. However, in some cases, the exact opposite phenomenon may occur. In a collision between a high velocity baryonic nucleus (usually a proton) and a captured DM particle, the DM particle may be accelerated above the escape velocity of the star, such that it is no longer captured and flies off into space. This is known as Dark Matter evaporation, and it is theorized to occur within many types of celestial bodies. Current research is relatively developed on this phenomenon in certain celestial bodies such as the Sun, but has not yet been applied to compact celestial objects such as Neutron Stars (NS) and White Dwarves (WD).

In my research, I aim to do exactly that. Assuming that these celestial bodies are effectively represented by the n = 1.5 polytropic model, I am working on creating a tool that accepts inputs of star parameters such as radius, mass, core temperature, core density, and the appropriate polytropic index to calculate the DM evaporation rate for any celestial body that can be modeled by a polytrope. Due to the focus on Neutron Stars and White Dwarves, I assumed a theoretical NS-like compact object of 1 solar mass, radius 10 km, and core temperature 2.3e5 K, that can be modeled by an n = 3 polytrope for the purpose of testing, and found that there is a large discrepancy between a known approximation of the evaporation rate and the fully numerical version. This discrepancy, (seen in the left [n=3 NS] plot below but not the right plot [100 Msun PopIII]) only occurs when the object is compact, so my current goal is to explain the discrepancy, then develop an improved approximation that can be applied to any polytrope, and is sufficiently robust as to be applicable to highly compact objects.





Research Fellow: Yinuo Ding (2023) **Concentrations:** Sociology; Asian Studies

Faculty Mentor: Janel Benson **Department:** Sociology & Anthropology

Title of Project: Integration of Asian International Students: Engagement with Professors and Other Authority Figures

Funding Source: SOSC Division

Project Summary:

This summer I examined Chinese international students' experience at U.S. higher education institutions, especially how Chinese international students form relationships with faculty and staff members at U.S. universities. I am particularly interested in whether high school location, US or home country, influences international students' expectations of university life and campus relationships.

To examine these questions, I conducted 54 semi-structured interviews with Chinese international students from six highly-selective universities and colleges. Both participants that attended high school in the U.S. and China do not utilize university resources very well, and they seldom develop relationships with staff at these resources. Chinese international students feel many services are not applicable to them because the staff at university resources often know little about the conditions of international students. In addition, many events held by the university resources failed to deal with the time difference and other problems created by the pandemic, which further makes them less motivated to engage. However, students who attended U.S. high schools are particularly advantaged in terms of developing beneficial relationships with professors. During high school, they either live in dorms with teachers who are called "dorm parents" or live with local host families. Both situations create opportunities for them to get in touch with teachers or local elders in a more casual setting and naturally make them realize that these authority figures are often approachable and helpful. In addition, U.S. high schools often provide English as a Second Language program that helps international students to overcome the language barrier, and many teachers consciously pay attention to international students to provide extra help or even lower grading standard sometimes. Therefore, students learn to negotiate with teachers during this process. On the other hand, students that attended Chinese high schools do not get similar support in college. Many participants that attended Chinese high schools also mentioned their "natural fear of teachers" that prevented them from making connections with professors, which is the result of traditional Chinese culture and their previous education experience.

These interviews show international students that do not attend U.S. high schools might need more support in college similar to the support that U.S. high schools provide, but the problems they encounter differ by college type. For liberal arts colleges, the small size of the school and the close relationship between students and professors is one of the biggest advantages, so making connections with professors is easier and more important. However, because professors in liberal arts colleges are more used to having personal relationships with students, it is sometimes intimidating for Chinese international students who attended Chinese high school and are used to keeping a distance from teachers to react properly in the beginning. Their previous language training also mostly focused on academic content rather than daily communication. For students at research universities, most classes are not discussion-based, and going to office hours and developing a relationship with professors is not the normality. The huge size of the class greatly increases the competition between students to acquire resources. For students who plan to go to graduate school or obtain a research position in college, reaching out to professors requires more strategic and proactive actions. In this case, Chinese international students who attended U.S. high schools often achieve their goals more efficiently.

Research Fellows: **Anna Donovan (2024)** **Concentration: Environmental Studies**
Keiona Williams (2024) **Concentration: Geology**
Faculty Mentor: **Linda Tseng** **Departments: Environmental Studies; Physics**
Title of Project: **Microplastics Adsorption of the Antibiotic Ampicillin**
Funding Source: **UNST Division**
Project Summary:

The abundance of microplastic (MP), typically defined as a plastic particle 5 mm or less, is increasingly prevalent and pervasive as they have infiltrated soils, bodies of water, and drinking water. While harmful by themselves, MPs' interactions with other substances have proven detrimental effects on the environment, humans, and plant life. Since there is an abundance of MPs as well as antibiotics in water and soil as a result of ubiquitous use of antibiotics in mariculture systems and a lack of adequate scientific management, the antibiotics may attach to MPs through adsorption. This summer, we conducted research on the MP adsorption of an antibiotic to better understand the sorption processes in plastics and the contribution of MPs to antibiotic resistance, using the adsorption rates of the results. Antibiotic resistance enables microorganisms to become capable of reproduction and survival in the presence of antibiotics. We conducted research because knowledge about plastisphere microbiota is still poor and the risk of micropollutants increasing in the food chain is high.

Microbes may preferentially choose to colonize on MPs with the aid of their biofilm. Microplastics therefore become a hotspot for enriching antibiotic resistant bacteria (ARB) and antibiotic resistant genes (ARG). In this study, we utilized three plastic substrates, micro-sized polyethylene (PE), styrene butadiene rubber (SBR, a synthetic tire rubber ingredient), and natural latex (NL), a natural tire rubber ingredient), to measure the adsorption rate of the antibiotic ampicillin. The measurements were taken at 0, 1, 2, 3, 5, and 8 hours. Using a UV-vis spectrophotometer, we monitored ampicillin at 230 nm to determine ampicillin remaining in water after exposing the plastics to a solution containing ampicillin. Then, sonication was performed to agitate plastic particles so that the adsorbed ampicillin would be released into water, which was once again measured on the spectrophotometer to determine the adsorption of the ampicillin onto the plastics. We fit our data using the pseudo-first and second order kinetic models. These models described our data poorly, illustrated by a lack of statistical significance ($P<0.5$) between our data and the models using the Chi-square test. Nonetheless, we determined a ranking of the kinetic rates from fastest to the slowest, NL > SBR > micro-sized PE. Our data were insufficient to determine whether equilibrium has been reached within 8 hours.

Future studies should focus on whether synthetic rubbers will contribute to antibiotic resistance in microbes because there is a wealth of information about ARG and ARB on common MPs but not for synthetic rubber. Another future direction is to focus on the transport of rubber particles, and whether they have an impact on the ecosystem. In terms of improving our experiments, since the chosen models did not fit our data well, using different models to describe our data, as well as using different time intervals, are worth considering for similar future studies. Additionally, we find that research on how tire rubber particles may potentially interact with sewage water and micropollutants it contains could be crucial to understand broader implications. A potential implication of accumulation of micropollutants onto tire particles is an increase of ARG and ARB. Materials that provide habitats for harmful bacteria will negatively affect human and environmental health. While actions must be taken to decrease MPs pollution, more research is necessary to fully understand the influence these pollutants have on microorganisms, the ecosystem, and human health.

Research Fellows: Wesley Dorow (2023) — **Concentration:** Biochemistry
Ayub Khan (2023) — **Concentration:** Undeclared
Faculty Mentor: Ephraim Woods — **Department:** Chemistry
Title of Project: Ozone Adsorption on Aerosol Surface Iodide
Funding Source: NASC Division
Project Summary:

The interaction between gas phase ozone and aerosolized iodide can be measured by observing the ionization which occurs when a specific wavelength of light strikes an aerosol particle. To measure this, we created an experimental setup, where we could aerosolized different ions, adjust the time in which these aerosol particles are able to interact with added ozone, and shoot a laser at varied wavelengths in order to ionize the aerosol-ozone adducts. The electric charge of collected particles is measured, giving us a signal for aerosol particles which have iodide particles that have been ionized by the laser. A count is taken for particles which have not been ionized by the laser, meaning the baseline signal is only based on the charge of the aerosol particle itself. The signal was divided by the count in order to derive a phi value, which was used to draw conclusions regarding ozones' role in the photochemistry of aerosol particles. We observed a drop in signal when pressures of ozone were higher in the system, suggesting that ozone adsorption onto these particles causes a decrease in photoelectric activity.

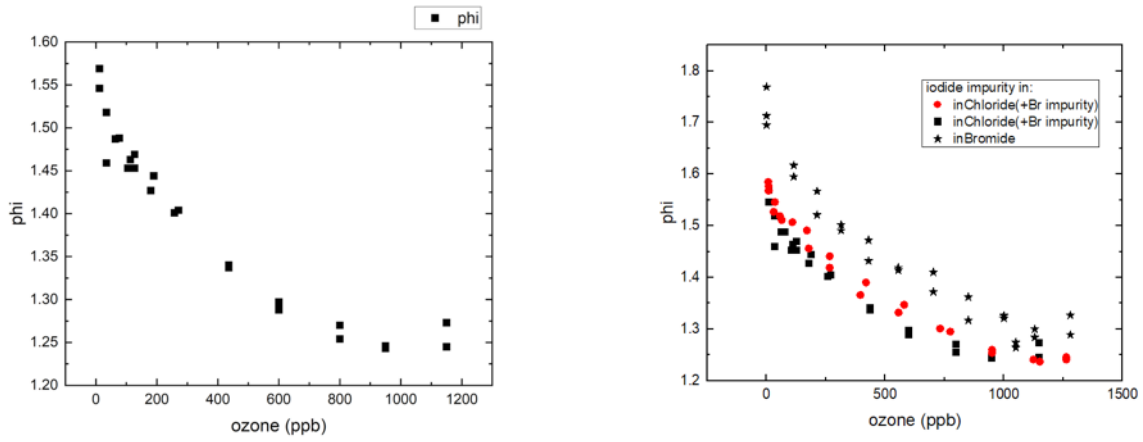


Figure 1: (Left) Pressure scan of the Phi value (Signal / Count) for 3 grams/ Liters of NaCl with Iodide particles. As the pressure of ozone (ppb) increases, the phi value drops, suggesting that Ozone causes photoelectric activity to drop in aerosol particles. (Right) Pressure scans for a variety of different aerosol solutions interacting with ozone.

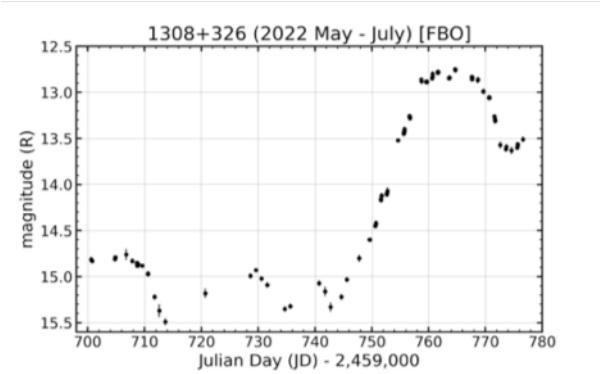
We compared the pressure scans for ozone on iodide to ozone on iodide and bromide, and found that they had similar curvature, suggesting that bromide has very little impact on the reaction kinetics between iodide and ozone.

Research Fellow: **Norah Du (2024)** **Concentrations:** **Philosophy; Physics**
Faculty Mentor: **Thomas Balonek** **Department:** **Physics and Astronomy**
Title of Project: **Optical Variability of Quasars and Stars at the Colgate Observatory**
Funding Source: **NASC Division**
Project Summary:

In this project, I, Ha-Eun Choi, and Maddie Hulburt have worked in Foggy Bottom Observatory with professor Balonek for two months to study the optical variabilities of quasars. We get magnitudes of the quasars and compare and combine our data with data from other observatories and surveys to see the trend of quasar's activity and to examine whether our data are compatible with others. In this process, 1308+326 shows an unprecedented outburst and has become our main focus.

1308+326 is a blazar. A blazar is a special type of quasar. Quasars are powered by the supermassive blackhole in the center of a galaxy. The attracted and unabsorbed matter spins around the supermassive blackhole to form the accretion disk. Friction between matter provides heat and turns the energy into the form of electromagnetic waves. Quasars also give out jets perpendicular to accretion disks. When the jet points towards the Earth, the quasar can be classified as a blasar. Therefore, when we observe the change in magnitude of 1308, we are seeing the activity of its jet. Studying the outburst of 1308 can give us insight about the factors leading to active state and inactive state of a galaxy.

The optical outburst observed has been the brightest through the fifty years since its discovery. 1308 had other activities from the 1970s and 1980s, and 2001 to 2007. Since 2019, this object has stayed between 17th and 15th magnitude. Later in June 2022, there was an unprecedented rise in magnitude and the quasar was consistently above 13th magnitude. The graph below containing our data on 1308 from May to July shows the outburst we observed.



It can be seen that 1308 has some small bursts which last for about two weeks. According to papers on this object, during all its three active states, there are small bursts together with a large outburst lasting for weeks to months. 1308 probably has intervals of multi-years activity. Besides the activities with long intervals, 1308 may also have small peaks with an interval of 3.25 days. More details about this quasi-periodic variability can be seen in Maddie's report.

We used red light to observe 1308, and its outburst can be observed with multiple wavelengths from visible light to gamma ray. Details about this part can be seen in Ha-Eun's report.

Research Fellow: **Max Edelstein (2023)** **Concentrations:** **International Relations; Economics**

Faculty Mentor: **Pierce Donovan** **Department:** **Economics**

Title of Project: **Finding front doors: Program evaluation with observational data from El Salvador**

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

Project Summary:

We perform the first program evaluation using Judea Pearl's (1995) front-door criterion. In late 2021, the El Salvadoran government rolled out "Chivo Wal- let," a mobile banking application that allowed citizens to transact with busi- nesses, save money securely, and send/receive money to others with very low transaction costs. There was a significant financial incentive to create an ac- count, and a majority of the unbanked population downloaded the app within a single month. We measure lasting impacts on saving and risk sharing be- havior as a result of downloading Chivo Wallet. While neither assignment into treatment nor eligibility for being a survey participant were random, the rollout of the app was fraught with randomly-assigned errors and fraud, and importantly, this post-treatment mediation allows us to recover estimates of the impacts of downloading Chivo Wallet with a cheap, single-wave phone survey.

Research Fellow: Changwen Fang (2025) **Concentrations:** Philosophy; Political Science
Faculty Mentor: Robert Kraynak **Department:** Political Science
Title of Project: Eros and Philosophy: A Comparison of Plato, Freud, & Marcuse
Funding Source: Center for Freedom and Western Civilization
Project Summary:

In the beginning of Book 8, Socrates asks Glaucon (584d-e):
"And do you realize that of necessity there are as many forms of human character as there are of constitutions? Or do you think that constitutions are born 'from oak or rock' and not from the characters of the people who live in the cities governed by them, which tip the scales, so to speak, and drag the rest along with them?
No, I don't believe they come from anywhere else.
Then, if there are five forms of city, there must also be five forms of the individual soul.
Of course."

From book 8 to book 9 of the Republic, Plato follows the city-soul analogy raised at the end of book three and resumes discussing the four main kinds of corrupted cities- timocracy, oligarchy, democracy, and tyranny and the four kinds of individuals that correspond to them at the beginning of book five. In the process, he discusses not only what each form of city and person is like, but also how each stage of decline occurs and how each kind of city and personal character first comes to be. Based on Plato's threefold division of the human soul characterized by reason, spirit, and appetite discussed in the previous book, he ascribes each degenerated type of city and person to the domination of spirit and appetite. On the surface, the cause for the decline of the cities and men appears to be that another, whether spirit or various appetites, replaces one ruling part of the soul. However, in this paper, I will first respond to Bernard William's criticism of Plato's analogy between city and soul as an imprecise form of analogy by elucidating a unified principle of spirit and desire. Through the parallel of the decadence of the city and soul, I will argue that the analogy between the city and soul still stands. Specifically, the eventual government of the city and each person's soul is corrupted by a complex struggle for power among the soul's and city's parts. I will further argue for a causal relationship between the city and soul that preserves the analogy where the individual's corruption starts the regime's degeneration. As a chain effect, the decadence of the regime gives rise to chances that permit the decay of individuals. To support my thesis, I will first sketch the primary picture of Plato's moral psychology and regime, introducing every three parts of the soul and city with details and examples. Then, after presenting the account for different parts of Plato's soul, I will examine each case of transition in the timocratic, oligarchic, democratic, and tyrannical individuals and regimes to support my interpretation of the degraded individuals and cities.

Research Fellow: **Jessie Farrell (2024)** **Concentration:** **English**

Faculty Mentor: **Alison Koleszar** **Department:** **Geology**

Title of Project: **Investigating Drivers of Variation in Explosivity at Augustine Volcano**

Funding Source: **NASC Division**

Project Summary:

As part of the Colgate BLAST (Bubbles, Lavas, and Silicic Tephras) Group, I am conducting research on Augustine Volcano, an intermediate arc volcano in the Eastern Aleutians of Alaska. Augustine is ranked #12 on the list of highest threat volcanoes in the US because it is frequently active and presents a danger to air travel with its proximity to Anchorage, one of the top cargo cities in the world (Ewert et al., 2018). In the modern (post-1741) era, Augustine has had relatively small eruptions, but previously, the volcano had much larger, more explosive eruptions. The reasons for Augustine's eruptive variability are unknown. Augustine's modern eruptions, particularly the 2006 eruption, are extremely well-studied, but the older tephras lack detailed research. To address this knowledge gap, our group conducted detailed sampling of tephra deposits at Augustine this summer with an emphasis on deposits from Tephra B (390 ybp) and Tephra M (750 ybp).

During sample collection we gathered detailed stratigraphy for both Tephra B and M (Fig. 1). Eruptions do not typically occur in one explosion; rather, an eruptive period is made up of multiple events. For example, the 2006 eruption at Augustine was observed in real time and then divided into 13 separate events (Power, Coombs, & Freymueller, 2010). Although we are unable to create such a detailed timeline for these older eruptions, we can gain insight into how these individual eruptions varied by sampling the top, middle, and bottom of the layers. For each field location, I am making stratigraphic columns that include our observations of every tephra and the layers in between. Strat columns situate each sample being studied and are a resource for any future research at Augustine because they document where the various tephra deposits have been found on the island and their characteristics (thickness, clast size, etc.) at each site.

I am conducting bubble number density (BND) analysis on Tephra B and M to understand the vesiculation and ascent history of the magma prior to eruption. A faster ascent rate produces numerous small bubbles, whereas a slower ascent rate allows time for the bubbles to coalesce (Shea et al., 2010) (Fig. 2). I sieved samples to quantify the distribution of clast sizes (grain size analysis) and selected the largest clasts of the dominant eruptive material from the top, middle, and bottom of both Tephra B and M. I am making epoxy mounts for SEM imaging, processing the images in Photoshop, and running them in FOAMS, a Matlab script that calculates and quantifies the BND. I will compare the data from the two eruptions to the 2006 eruption. I am also taking physical density measurements of material from both Tephra B and M to quantify vesicularity. Clast density varied between the explosive and effusive phases of the 2006 eruption (Benage et al. 2021). By collecting density measurements throughout Tephras B and M, we can see how density varied during different stages of Augustine's more explosive eruptions.

This study will be useful to the scientific community because it will fill in gaps in Augustine's eruptive record, and it can show how intermediate arc volcanoes undergo changes in their explosivity and thus in the hazards they pose.

Figure 1 (left). Sloane Kennedy (WWU) observes while I use numbered pins to identify the tephra layers at a field site on Augustine Volcano. These observations are used to construct stratigraphic columns. Photo by Mahina Robbins.

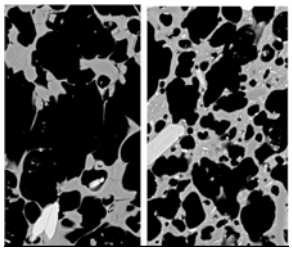


Figure 2 (right). SEM images of tephra from Augustine. Larger vesicles have coalesced, indicative of a slower ascent (left). Many small bubbles indicate nucleation during faster ascent (right). Width of each image is 75 μm. Images courtesy of Dr. Matt Loewen.

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

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

Title of Project: Dating Boulder Creek Granite with a Prototype Spaceflight Mass Spectrometer

Funding Source: NASC Division; NASA New York Space Grant

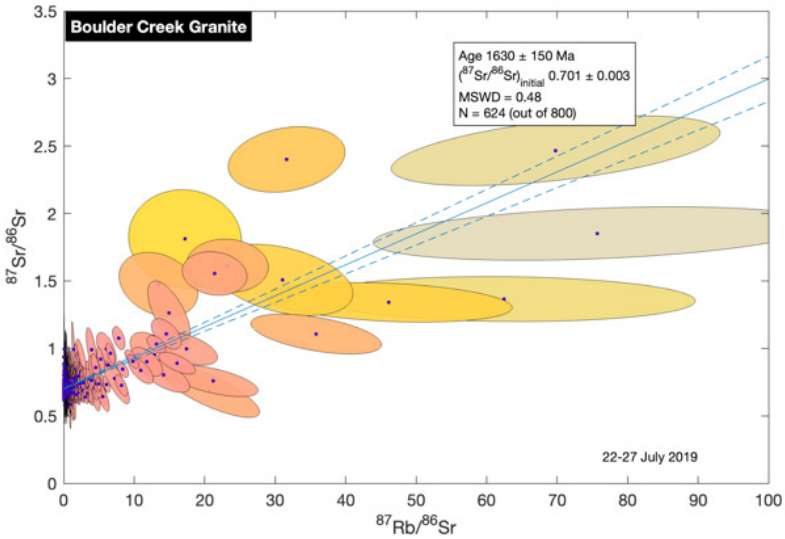
Project Summary:

We are developing a laser-based mass spectrometer that can date rocks on a future mission to the Moon or Mars. Here, we have tested the prototype on a rock sample from Earth called Boulder Creek Granite. Rock ages are computed from measured abundances of five isotopes: radioactive 87Rb, its decay product 87Sr, and stable, non-radiogenic 85Rb, 86Sr, and 88Sr. Boulder Creek Granite has been unexpectedly hard to date (Foster, 2016), and when these data were acquired in 2019, they were overlooked because of significant background noise. Here we show that we can empirically subtract that noise and extract meaningful age data.

For the Boulder Creek Granite data sets taken from July 22-27, 2019, a series of changes were made to the MATLAB program to help optimize the data analysis. In the first set of data taken from the 22-24, there was a swell in most of the spectra's baseline. There was a sloping baseline in the second data set taken from the 25-27. The faulty baseline caused two major problems during analysis in both data sets. First, it made it difficult to identify small peaks like 86Sr. Second, it created less precise and/or incorrect measurements of all isotopic abundances. This inaccurate baseline was believed to be caused by a plasma producing a background of ions in spectra. These ions are mysterious because, in some spots (e.g., #063 on 20190722), the ions produced from one set of resonance lasers exceed the ion populations produced with either none or both sets of resonance lasers. Without any theoretical basis, the decision was made to subtract a smooth-function fit to this baseline empirically. A swell shape baseline was used for the first data set, and a straight line baseline was used for the second data set.

Two hyperbolic tangent functions were multiplied together to form a baseline that properly fits the swell seen in the first set of data. Then a linear function was used to fit the second data set's sloping baseline. Parameters for the functions were changed between data points to ensure that the baseline would properly fit each spectrum. Furthermore, only noise found between peaks was used in the baseline calculation. Empirical baseline fitting succeeded in >95% of cases. Failures were identified by hand, and those data points were removed.

In conclusion, by creating a new baseline for the data and removing a select few data points, we were able to create an accurate and acceptable set of data ready for final analysis. After combining the two data sets and creating an isochron plot, we determined an age of the Boulder Creek Granite. The isochron plot produced an age of 1630 ± 150 Ma for the sample (Figure 1). This result is very exciting because it is well within the acceptable age of 1700 ± 40 Ma determined by Peterman et al. (1968), and the uncertainty of ±150 Ma exceeds NASA's benchmark for precision.



Research Fellow: **Kyleigh Frank (2024)** **Concentration:** **Biology**

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

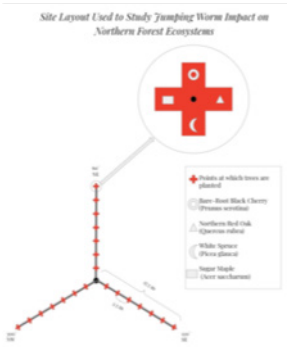
Title of Project: **Jumping Worm Invasion and Impact in the Northern Forest**

Funding Source: **Oberheim Memorial Fund**

Project Summary:

My summer research focused on exploring the spread and impact of Asian jumping worm species (namely *Amynthas agrestis*, *Amynthas tokioensis*, and *Metaphire hilgendorfi*) on the Adirondack region of the Northern Forests. This project was a part of a larger collaborative effort that spans colleges and universities of the Northeast Region with the common goal of encouraging early detection, facilitating a greater understanding of the Northern forest floor's vulnerability to invasion, and obtaining an increased comprehension of the biology of the invasive species. Jumping worms consume leaf litter and leave behind distinct granular castings that effectively change the soil structure. This alteration has negative impacts as it pertains to soil nutrients, increased erosion, and makes it more difficult for shallow-rooted plants to situate themselves in the ground. We sought to gain a greater understanding of areas that are at risk of an invasion, and to understand how these soil alterations may affect the growth of shallow-rooted saplings.

The first and one of the primary goals of the project was to create protocols through which individuals of varying degrees of expertise could detect, report, and monitor jumping worms in the area through iMAPinvasives. I worked to test and utilize some of the designed protocols and surveyed affected areas in the southern Adirondacks. The survey was designed to collect information pertaining to the depth of the leaf litter as well as the pheretimoid casting layer. General information about location, worm presence and trees found in close proximity to the worm or worm castings were also recorded. In addition to engaging concerned individuals, this project also served to give us a better understanding of where jumping worms are, how they may have gotten there, and the impacts they may have on leaf litter and surrounding biodiversity. This project will also allow us to inspect the environmental conditions in which jumping worms are found so that we may better understand areas at risk.



To identify the effects of jumping worms on forest regeneration and tree growth, we chose site pairs in relative close proximity to each other and replicated them across the Northern Forest (particularly in the Lake George area and northern Vermont) with varying levels of jumping worm abundance. At each site, we planted four tree species native to the region (bare-root black cherry, northern red oak, white spruce, and sugar maple) along three transects in increments of 2.5 m with seven in each direction. The growth and the survivorship of these trees are to be monitored in the ongoing project to help us understand how jumping worms may affect sapling development and determine which tree species may be at risk.

Through this summer research, I was able to assist in making strides towards setting the groundwork for the ongoing project that seeks to track the spread of jumping worms, identify areas at risk, and observe the effects as they pertain to sapling development and soil quality. To adequately design early detection protocols, assess the environmental conditions vulnerable to invasion, and determine the impact of these jumping worms, future researchers will continue to work on the project through the spring of 2024, at which point the project will ideally reach its conclusion.

Research Fellows: **Maoreen Gao (2025)** **Concentration: Undeclared**
Olivia Malcomson (2024) **Concentration: Computer Science**
Faculty Mentor: **Jing Wang** **Department: East Asian Language & Literature**
Title of Project: **The Needham Questioning: of the Unquestionable**
Funding Source: **AHUM Division**
Project Summary:

At the beginning of his seminal work, Science and Civilisation in China (SCC), Joseph Needham posed the question "Why did China not develop modern science?". This question became known as the "Needham question" and ultimately framed the scope of research on the history of Chinese science. However, this line of questioning would become problematic as other researchers and historians applied their own interpretations to Needham's research.

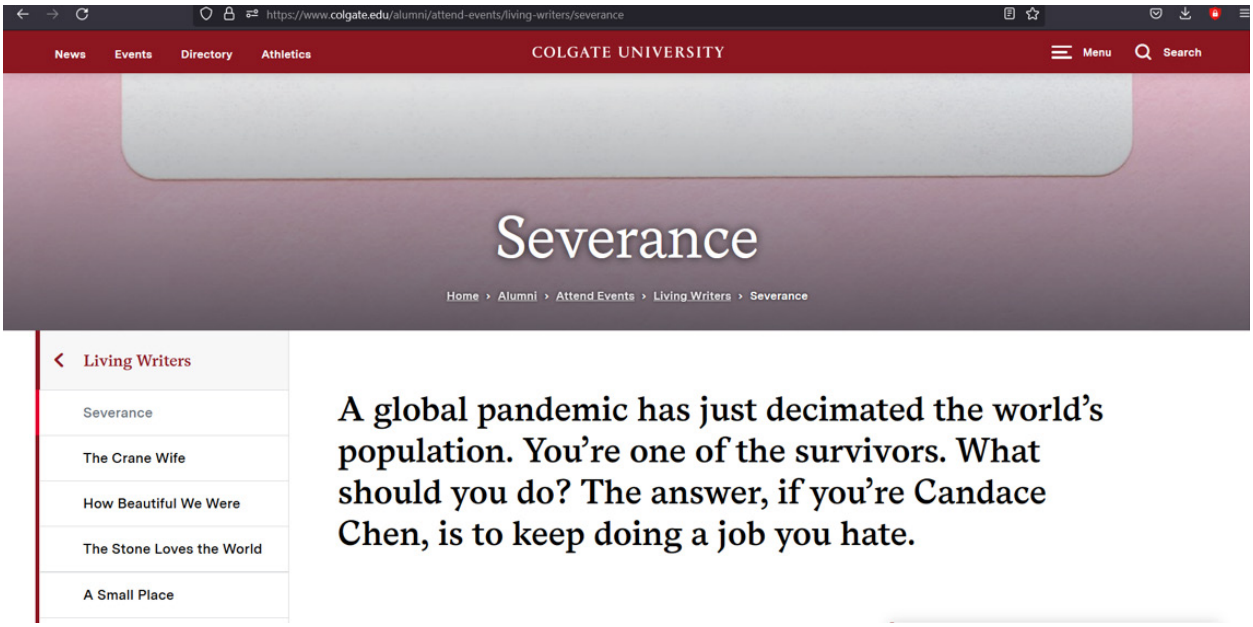
To learn about the history of Chinese science, one must learn about Chinese history and culture. Throughout the summer, we compiled, analyzed, and discussed raw materials and texts as part of a larger effort to deconstruct some of the Eurocentric narratives perpetuated about China in the context of global science history. We discussed the logical flaws in some of these arguments with Professor Wang. While studying modern science history, it's reasonable to ask why Europe has developed modern science earlier than other civilizations, but it's impossible to receive some solid answers with the question format 'why something did not happen.' We and Professor Wang looked into the footnotes of various books and articles, attempting to access the primary sources of some famous influencing arguments. In these close looks into the secondary sources and primary courses, we as the research assistants learned the process of a long-term research and the critical thinking of examining the assumptions or ideologies hidden behind the arguments.

Moreover, we expand the range of the research, accessing Western and Chinese philosophies, modern political science and religions. We transcribe multiple videos and talks by modern scholars or influencers, whose opinions challenge the previous academic viewpoints. Also, we scan chapters in piles of books and summarize the contents for Professor Wang. Then, we will meet and discuss how these materials matter in the study of Needham and Chinese science history, how they either concede, question or challenge the established popular arguments. Sharp questions will be thrown out over the table, to help a more thorough and critical zoom-in of the materials. The conversation will go out of the range of Chinese science, into various aspects of life, like health, weather, and geography, etc. The wide range of topics allow us to examine the big picture of the science development in China and its correlated influence.

Overall, this summer of research allows us to experience, practice and learn the skills and the critical thinking required for our future research. We will be able to apply the neat, careful and organized attitude to other studies and we will be prepared to go through the research we are interested in pursuing.

Research Fellow: **Max Gardinier (2024)** **Concentration:** **English**
Faculty Mentor: **Jennifer Brice** **Department:** **English**
Title of Project: **Creative Writing Fellows**
Funding Source: **AHUM Division**
Project Summary:

Over the summer, I and three other researchers, under the guidance of professor Jennifer Brice, helped coordinate the Living Writers program here at Colgate. 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. Our research group read all ten books written by this year's incoming Living Writers authors and we met weekly to discuss and debate each book in depth and plan how to move forward. We also discussed our work, which consisted of writing content for the Living Writers' website.



We wrote biographies of writers and short summaries of their books, researched reviews, interviews, and articles involving the authors, and worked together to curate which content should be included on each respective books' webpage. Examples of disputed content included specific quotes (from books as well as authors) and reviews of each authors' books.

In addition, we worked in Colgate's writers conference, which ran from June 19th to June 25th, as liaisons and aides, helping writers navigate campus, printing copies for instructors, facilitating during lectures and Q&As, and introducing guest readers.

This research program forced the five of us to work together, in constant communication with each other, to delegate work between us and solve any conflicts that arose. By the end of the summer our group was tight-knit and joyous. This work felt incredibly rewarding and I am keenly aware that I learned a great deal during my time here.

Research Fellow: Eliza Ge (2023) **Concentration:** Anthropology

Faculty Mentor: Nancy Ries **Departments:** Sociology & Anthropology; Peace and Conflict Studies

Title of Project: "Rareness" as a Political Issue: A Discussion of the Definition of Rare Disease in China's National Healthcare Policies

Funding Source: SOSC Division

Project Summary:

My research explores how the definition of rare disease has been negotiated in China's national healthcare policies. Unlike categories of diseases with similar medical resemblances, rare disease stands for a socially constructed category of statistically uncommon disorders. The notion of rareness is plastic enough to adapt to local needs and constraints of the social actors who employ them while robust enough to maintain a common identity. This means that although we can generally describe rare diseases as uncommon disorders, what in particular is or is not rare diseases depends on who, where, and what time period you ask. For instance, the Japan Pharmaceutical Orphan Drug Law (1993) operates on a definition of a disease that affects 1 in 2,500, while the Federal Law on the Foundation of Health Protection in Russia (2011) operates on a definition of 10 in 100,000. In China, the phrase rare diseases was hardly meaningful before early 2000. However, in the last ten years, the use of the phrase has increased exponentially in the fields of public policy and patient advocacy even though China has not yet developed a legal definition of rare disease at the national level. Central and local governments enact different versions of rare diseases in practice based on their positionalities, and together they negotiate this uncertain notion within a social system.

Drawing on Annemaire Mol's (2002) approach to the ontological multiplicities, I argue that the definition of rare diseases in China is bounded to specific stakeholders, sites, and situations. Specifically, the meaning of rare disease varies in the central government healthcare agenda and local governmental budgets for medical insurance.

At the national level, the Communist Party translates the conceptualization of rare diseases into its political will for building xiaokang (moderately prosperous) society and promoting independent innovation in medicine. Since the 18th National Congress of the Chinese Communist Party in 2012, the Communist Party has been striving for completing its political agenda of the xiaokang society by 2020. President Xi Jinping stressed on many occasions that there is no prosperity without a healthy population (2014). To advocate for the rights to healthcare for minority groups, he propagated the principles of universality, equity, and integrality by proposing that "no one is left behind" (2017). Addressing diseases with a small population and costly, challenging treatments exemplifies the Party's efforts in ensuring prosperity for all populations. The meaning of rare disease is closely intertwined with the Party's commitment to the public interest. Ironically, the commitment has been broken as the state reallocates medical resources towards the urgent care of COVID-19. Rare-disease patients are pushed into systematic disparities in access to healthcare services especially when lockdowns disrupt professional health maintenance.

At the local level, the definition of rare disease largely depends on governmental budgets for medical insurance. When defining the boundaries of a group, social actors are essentially deciding what resources are allocated to what groups of people. Since the funding for medical insurance is highly decentralized at provincial and municipal levels, local governments' ability and willingness to mobilize financial resources for rare diseases are different. Moreover, within China's current framework of basic medical insurance and critical illness insurance, there is a lack of consistent standards for rare disease medical insurance. Which stakeholders (patients, municipal government, provincial government, commercial insurance) should pay for what percentage is still heatedly debated. Each region can only make limited progress on rare disease policies in light of the specific local conditions. The decentralization of responsibilities to rare diseases leads to varied definitions and policies. According to the Chinese Organization of Rare Disorders, hemophilia has been included in 64 cities' categories of Outpatient Special/Chronic/Critical Diseases while homozygous familial hypercholesterolemia is only listed in 1 city's category (2020:96). The selective inclusion of rare diseases further demonstrates how local governments negotiate the alignment of resource allocation and national political objectives.

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Research Fellows: **Eric Goodney (2024)** **Concentration: Biochemistry**
Amelia Seasholtz (2023) **Concentration: Biochemistry**

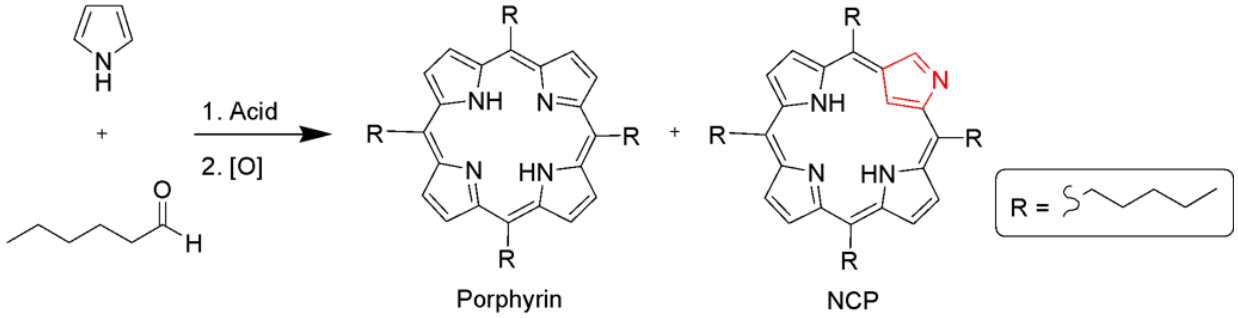
Faculty Mentor: **Rick Geier** **Department: Chemistry**

Title of Project: **Investigation of the Reaction of Pyrrole and Hexanal Leading to a Meso-Substituted Porphyrin and N-Confused Porphyrin**

Funding Source: **Warren Anderson Fund; NASC Division**

Project Summary:

Porphyrins are heterocyclic organic macrocycles that have biological and non-biological relevance. A well-known example of porphyrin is heme in red blood cells. Porphyrins are widely studied for their various properties including metal binding and spectroscopy. N-confused porphyrins (NCPs) are isomers of porphyrin with an inverted pyrrole ring. Aryl substituted porphyrins and NCPs have been widely studied. However, reactions leading to meso-alkyl substituted porphyrins have not been systematically examined, and the synthesis of meso-alkyl substituted NCPs has yet to be reported in the literature.



Our research group previously began an investigation of reaction conditions leading to tetrapentylporphyrin and NCP. HPLC along with a new TLC analytical method were used to quantitatively monitor reaction yields. Goals for this summer included further exploring the interplay of key reaction conditions on the yield of both porphyrinoids, identifying reaction conditions for the efficient synthesis of tetrapentylporphyrin and NCP, and identifying ways to further refine our TLC analytical method.

This summer, we broadened the scope of reaction conditions examined. We also further assessed our TLC analytical method as the application of TLC to quantitatively monitor porphyrin-forming reactions has not been previously reported. We began by preparing calibration curves for both HPLC and TLC detection, and we compared the calibrations to those obtained from our group's prior work. We proceeded with examining three new acid catalysts/co-catalysts, and we completed an initial survey of acid concentrations with a fourth acid catalyst. In the future, we will complete our analytical-scale reactions by examining three additional acid catalysts, and promising reaction conditions will be performed on a preparative scale.

Research Fellow: Eli Gould (2023) **Concentration:** Political Science

Faculty Mentor: Matt Luttig **Department:** Political Science

Title of Project: Polarization In America: Origin and Impact

Funding Source: Center for Freedom and Western Civilization

Project Summary:

Polarization, the extreme ideological divide between the Democratic and Republican parties, has continued to grow over the past several decades. While polarization remains apparent today, this research paper concludes that division has always been a foundational identity of the American mind. Alexis De Tocqueville's observations about America in the 1800s give an early prediction of ideological extremes plaguing American democracy. The Frenchman believes local and meaningful conversations safeguard against societal division. He predicts that without these safeguards, democracy would erode due to pressure from the majority and religion and eventually fail. Building on this conversation, findings by political psychologists Jonathan Haidt, Lilliana Mason, and Marc Hetherington & Jonathan Weiler all reference systemic issues that align with De Tocqueville's theories. Jonathan Haidt's social intuitionist model, which explains human behavior and cognitive processing, can help explain the impact of subconscious decision-making on polarization. In the case of Lilliana Mason, her social sorting theory reasons that individuals have grown increasingly partisan. Marc Hetherington and Jonathan Weiler credit underlying authoritarianism with widening the divide between political parties. Comparing these theories and De Tocqueville's account, today's societal division can be seen as a systematic problem in America. These authors discuss potential solutions to societal division, such as association, conversation, and courage. This paper builds on these previous findings and offers eight bold strategies to decrease polarization today. The solutions discussed are increasing contact, common goals, proportional voting, none of the above, referendums, outspoken politicians, redistricting, and a third political party. If polarization remains ignored, democracy will continue to deteriorate. This paper finds evidence that division has always been a fundamental part of the American mind and offers solutions for polarization today.

Research Fellows: Trevor Guerrina (2023) **Concentration: Molecular Biology**
Cha Thompson (2025) **Concentration: Environmental Studies**

Faculty Mentor: Amy Leventer **Department: Geology**

Title of Project: Antarctic Paleoclimate Records

Funding Source: NASC Division; Norma Vergo Prize

Project Summary:

The impacts of global change are indisputable today, recognized around the world through extreme weather events, floods and droughts, and catastrophic wildfires on land. The oceans are equally impacted by global change, as shown by ocean warming, increased acidity, and changing extent of sea ice and ocean salinity. In the polar oceans, many of these changes are amplified due to positive feedbacks that have runaway impacts. The response of ocean ecosystems to these changes is complex and incompletely documented. An improved understanding of the changes happening in the ocean depends on documentation of the modern polar ecosystem and continued investigation of the ecosystem in the future. This project provides some of the initial documentation - a snapshot of the ocean today. Future studies, similar to this one, are needed to understand our changing oceans, which are a critical component of global change.

The specific objective of this project was to document the distribution of microplankton in surface water samples collected along a latitudinal transect in the Southern Ocean, between New Zealand and Antarctica. Microfossils are commonly used as proxies to reconstruct past oceanographic conditions. These data provide a longer term perspective for the changes occurring in today's ocean. Interpretation of paleoenvironmental preferences of each taxa is based on understanding the specific oceanographic conditions under which they thrive in the modern ocean. However, this information is poorly documented; our research aimed to add to this fundamental database of the spatial distribution of species in the Southern Ocean. Collection of each water sample was accompanied by measurements of the physical characteristics of the seawater, including temperature, salinity, and the presence or absence of sea ice. Each water sample was filtered through a 0.45 μm mesh and filters were mounted onto stubs which were examined in the scanning electron microscope (SEM). We identified individuals to the species level by comparison to reference literature and documented the diversity of microplankton with photographs that were compiled into a catalog of plates consisting of images of common and rare species. These plates were compared to each other to better understand the conditions in which specific microplankton, such as coccolithophorids, reside. The plates were then made available to international taxonomic experts for verification, and will be made publically available online. Over the longer term, the catalog will be used for future Antarctic expeditions as a baseline, to document changes in species distribution in a changing ocean. These changes, including ocean warming, decreasing salinity due to sea ice melt, and increased ocean acidity, will have a measurable impact on the Southern Ocean ecosystem. Our catalogs are a first step toward documenting the impact of global change in high southern latitudes.

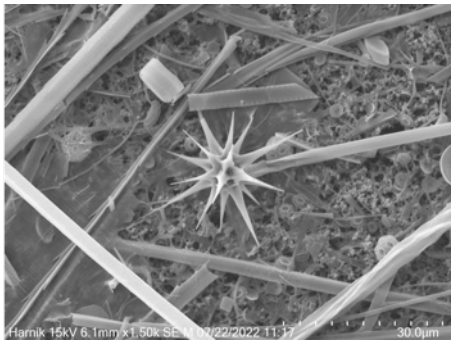


Figure 1: An Acantharian surrounded by various species of diatoms and coccolithophorids, viewed under 1,500x magnification on the SEM.

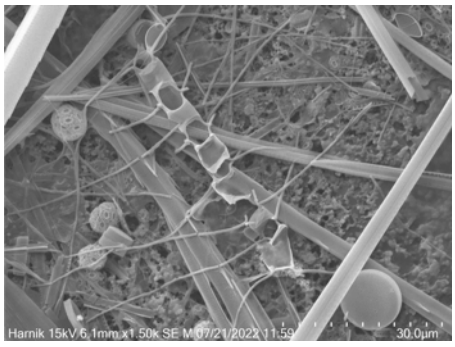


Figure 2: A chain of Chaetoceros neglectus surrounded by other diatom species and coccolithophorids, viewed under 1,500x magnification on the SEM.

Research Fellow: Noah Hann-Deschaine (2024) **Concentration:** Physics
Faculty Mentor: Ramesh Adhikari **Department:** Physics and Astronomy
Title of Project: Bio-derived materials for energy harvesting and hydrophobic surfaces
Funding Source: NASC Division

Project Summary:

As technology advances, so does the strain on nonrenewable resources used in industry. With the introduction of biologically derived materials into new fields, the bulk of these demands would be alleviated. Triboelectric nanogenerators (TENGs) generate electricity using the triboelectrification effect, in which two insulating materials make contact, whereupon their surfaces exchange charges, which can be harvested to produce a current. Adoption of these generators would allow for the harvesting of oft-overlooked sources of energy, albeit large-scale production of TENGs is currently impractical due to the inherent environmental cost of the electronic components. However, the replacement of nonrenewable components with inexpensive, biodegradable, and ubiquitous rubber and paper, rubber-based triboelectric nanogenerators (R-TENGs) are a welcome alternative that addresses many of the inherent problems associated with their nonrenewable counterparts.

To produce optimal electrical output from the R-TENGs, the impact of variables such as elapsed time, material combinations, frequency, electrode size and configurations, were investigated and documented. The ideal configuration of the R-TENG was able to produce an open circuit voltage of 33 V, short circuit current of 3.5 μA, as well as charge capacitors of different sizes.

Secondly, hydrophobic surfaces, which repel water due to their inherent chemical or physical properties, have numerous essential applications, from the oil-water filters used to clean up our contaminated oceans, to anti-corrosive coatings in medical equipment. However, two of the main drawbacks of hydrophobic materials are both the high cost and limited longevity of such materials. These non-renewable hydrophobic surfaces need to be retreated or replaced regularly, resulting in non-biodegradable waste. Additionally, nanowires are difficult to produce in all but the most extreme conditions, and their ingredients are expensive, resulting in high costs, and limited use cases. However, with the inclusion of renewable materials, and a cheaper method of production, the cost and environmental impact of hydrophobic surfaces can be mitigated.

Investigated the effects of diphenylalanine vertically assembled nanowires in aniline vapor at high temperatures on different substrates, and in both hydrous and anhydrous conditions, in order to determine the optimal conditions for nanowire growth. Utilizing diphenylalanine, prepared in solution of HFIP with varying concentrations, spread onto a thin film on different surfaces, we determined the optimal surface conditions and material for the growth of nanowires. Using these treated surfaces, we imaged the formation of nanowires, and tested the hydrophobicity with water droplets.

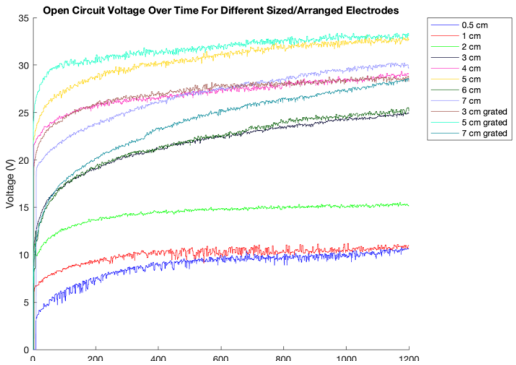


Image A: Graph of the impact of time on the open circuit voltage of a series of electrodes from 0.5 cm to 7 cm, as well as grated variants of 3 cm, 5 cm, and 7 cm.

Image B: Drop of water on a 1 cm2 square of jute, treated with diphenylalanine nanowires to create a hydrophobic surface.

Research Fellow: **Jadan Hand (2024)** **Concentration: Spanish**
Faculty Mentor: **Liangyong Mei** **Department: Chemistry**
Title of Project: **Synthesis of Indole-Fused Heterocycles through a Cascade Thiocyanation and Cyclization**
Funding Source: **NASC Division**

Project Summary:

Indole-fused polycycles are molecules composed of an indole, which is an aromatic heterocycle, composed of a benzene and pyrrole, and additional ring structures. They are found in a wide range of both natural products and pharmaceutical compounds. Drugs consisting of indole-fused polycycles have been trialed as treatment for Alzheimer's (Latrepirdine) and Parkinson's Disease (Pergolide), as well as treatment for inflammatory diseases such as eczema (Exotine B). Thus, developing an efficient method of synthesis is paramount.

Electrophilic thiocyanation is characterized by the addition of a thiocyanate group to the indole, which can then be further converted to different sulfur functional groups pr undergo intramolecular nucleophilic attack. Our research sought to yield an indole-fused polycycle through a thiocyanation/intramolecular cyclization cascade of indole substrates via electrophilic thiocyanation and subsequent intramolecular nucleophilic attack.

We pursued the desired indole-fused polycycle through single vial reactions containing a target substrate, a non-catalytic amount of the oxidant Selectfluor, and a thiocyanate. Surprisingly, the results obtained did not corroborate with the preliminary results on which the proposed reaction was based. Through X-ray crystallography of the transformed product we were able to determine the rather unexpected structure. The subsequent structure was greatly helpful in explaining the results of H1NMR spectra (Figure 1). Interestingly, when the same reaction was performed under argon gas, it yielded a molecule more consistent with the preliminary findings (Figure 2). Further exploration is needed to determine both the nature of the mechanism and the structure of this other compound.

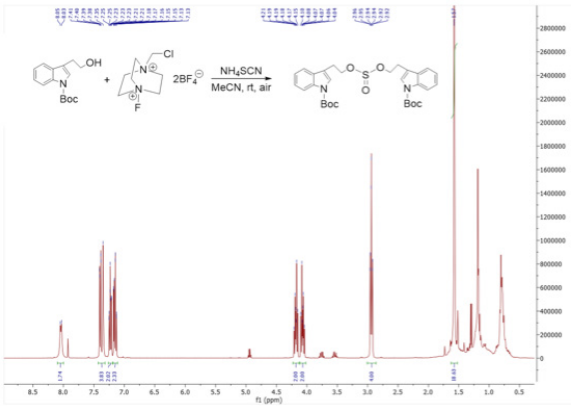


Figure 1. H1NMR of the unexpected sulfite ester.

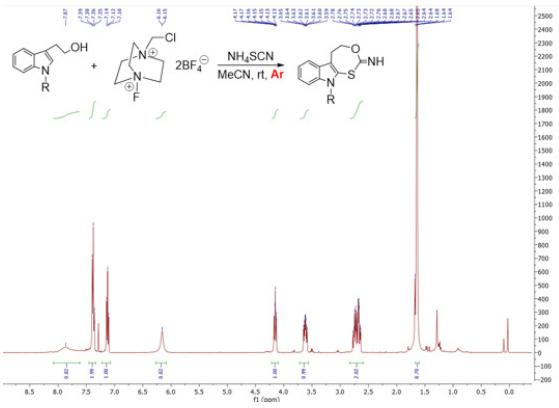


Figure 2. H1NMR of indole-fused polycycle under argon gas.

Research Fellows: **Maddie Handley (2025)** **Concentration: Undeclared**
Sohee Kim (2025) **Concentration: Undeclared**
Felix Mo (2024) **Concentration: Chemistry**
Derrick Qu (2023) **Concentration: Philosophy**

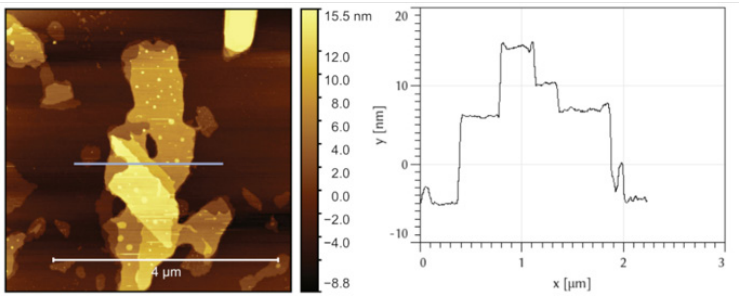
Faculty Mentor: **EricMuller** **Department: Chemistry**

Title of Project: **Towards Understanding Heterogeneous Ice Formation in Atmospheric Clouds: Nanoscale Imaging of Bacterial Ice-nucleating Membrane-bound Protein**

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

Project Summary:

Left: AFM image of cell membrane
Right: Cross-section height of the membrane



The melting point of water, 0°C, is commonly known. However, pure water can remain liquid even as it is supercooled to as low as -38°C before homogeneous ice nucleation occurs. Although freezing is energetically favored at 0°C and below, there is a kinetic barrier to nucleation. In contrast, impurities such as minerals or biological particles in the water can induce heterogeneous ice nucleation at higher temperatures. The best biological ice nucleators contain proteins that can induce ice nucleation in small water droplets within a few degrees of 0°C . Pseudomonas syringae is a bacteria and model system that features such proteins on its outer membrane. We are using it to study the relationship between proteins and ice nucleation.

Although Pseudomonas syringae is one of the most widely used model systems, fundamental knowledge about the chemical mechanisms leading to warm temperature ice nucleation remain elusive in large part because the model system itself is not well-controlled and poorly characterized. This model system is most commonly studied in the form of a freeze dried powder from a crude extract of cellular material. We aim to build a more well-characterized model system by purifying the ice-nucleation-active proteins in their native and membrane-bound form. We have successfully isolated membrane fragments from lysed cells using a combination of ultracentrifugation and dialysis. We then characterized our samples using both atomic force microscopy (AFM) and scanning electron microscopy (SEM), and we have shown that they retain ice-nucleation activity using drop-freeze assay measurements. Further spectroscopic measurements using nanoscale infrared spectroscopy (IR-sSNOM) identified vibrational signatures of ice nucleating protein in the isolated membranes.

Further investigations will measure individual ice nucleating sites by nanospectroscopy. Specifically, we are working to integrate each of the techniques we have employed in a multimodal approach that will identify individual nanoscale active sites and characterize both their chemical properties and ice-nucleation activity in order to understand the fundamental mechanisms of ice-nucleation.

Research Fellows: **Yiduo He (2024)** **Concentrations: Anthropology; International Relations**
Joseph LaMuraglia (2024) **Concentration: Anthropology**
Jordan Nichols (2023) **Concentration: Anthropology**

Faculty Mentor: **Santiago Juarez** **Department: Sociology & Anthropology**

Title of Project: **Noh K'uh Archaeological Project 2022**

Funding Source: **SOSC Division**

Project Summary:

This project is part of an ongoing set of archaeological work that is designed to investigate the rise of urbanism within the Maya highlands at the field site of Noh K'uh, which is adjacent to an Indigenous community, Puerto Bello Metzabok, Chiapas, Mexico. Metzabok is an indigenous community of Lacandon Maya that works diligently to preserve the local rainforests and the archaeological remains. Previous LiDAR investigations presented 175 architectural features and over 200 unconfirmed structures; therefore, a primary goal of the 2022 field season is to utilize field survey methods to verify the newly identified architectural features with Noh N'uh's urban core identified in LiDAR data. This season also included laboratory analysis of ceramic artifacts excavated from previous field seasons. This is a project that is based on community archaeology where the local Indigenous community will take an active role in assisting with investigations.

The summer 2022 field season utilized total station mapping to investigate features of interest identified in the LiDAR data. With the participation of local indigenous team members, our fieldwork required exploring the nearby rainforest to find, identify, and map earthen mounds that contain urban structures that altered the environment. The urban structures that we found included but were not limited to domestic spaces such as homes and temples. During our field research, our field team encountered and mapped over 20 new structures that were either previously unconfirmed or invisible to the LiDAR data.

Although the site is primarily recognized as a Late Preclassic (400 BC to AD. 250) space, indigenous Lacandon Maya began repopulating the region as recently as 200 years ago. The recent history of repopulation led to an unforeseen direction for this project, where we conducted rescue archaeology. As a result of the COVID-19 pandemic, the Lancandon in Metzabok have experienced an increased surge of vandalism to their ancestral shrines and archaeological sites. During exploratory work, the field team encountered the remains of a living space later recognized as the "House of Jose Gabino." The space featured 17 ceramic pots that showed evidence of being used in the recent past. Our Lacandon team members urged us to switch the project trajectory to remove and analyze these pots to protect their local patrimony. From here on, our team also mapped the site of the pots, removed the material remains and relocated them to the field laboratory for preservation and analysis.

Research Fellow: **Jeisanelly Hernandez (2024)** **Concentration:** **Astronomy/Physics**
Faculty Mentor: **Ramesh Adhikari** **Department:** **Physics and Astronomy**
Title of Project: **Electronic Leaves**
Funding Source: **NASC Division**
Project Summary:

As society becomes more tech-based, there has been a rise in harmful e-waste polluting the Earth. This project looked at the conductivity of a variety of plant leaves to further the research into and the construction of biodegradable electronic devices. Using different methods of measurement and varying controlled factors, we collected electrochemical data, for possible constructions of Resistive Switching Devices and Plant Based transistors. Some species of the plant leaves we looked at this summer were from the Pothos plant, A. Arborea tree, the Shumard Oak tree, the Great Mullein plant, and a few others collected from around the Colgate Campus. Using different species of leaves allows a variety of results for the conductive behavior due to natural differences in internal structure, water content and storage, and ion content.

Using the Keithyly 2612B SMU, we collected dual sweep IV curves to look at the conductive behavior of the plant leaves at ±1V, ±5V,±8V,±10V. A common behavior we saw throughout the different leaves was a current voltage hysteresis pattern in the IV curves, showing changes in the current and voltage during the IV sweeps. The peaks for the reading voltage on the IV curves varied based on factors such as moisture/ water content, location of the probes on the leaf, and the input voltage for the IV sweeps. This hysteresis pattern is suggestive of memristive behavior for the conductivity for the leaves. We also looked at the conductivity of polymer infused leaves. Using the polymer, PEDOT:PSS, we used the vacuum infusion method from Stavrinidou to combine leaves with the polymer. We vacuum infused a leaf from the Pothos plant and from the A. arborea plant and measured the conductive behavior of both with the PEDOT:PSS. With the PEDOT:PSS we observed similar current voltage hysteresis patterns for the IV curves. We also observed more linearity in the IV curves as the moisture content decreased in the leaves. We believe that use of more species of leaves and controlled factors for the leaves would be needed for furthering this research.

Fig 1. PEDOT:PSS vacuum infused A. arborea leaf.

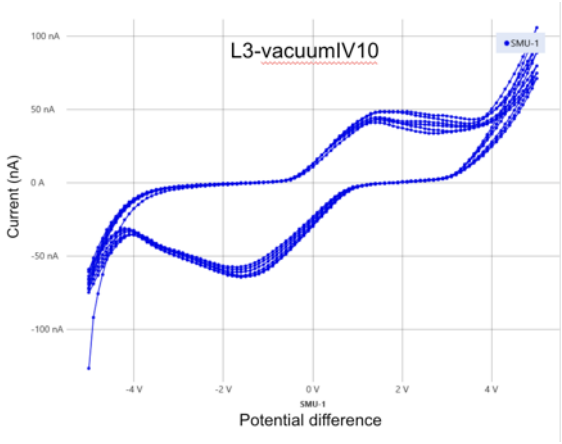


Fig 2. IV curve of PEDOT:PSS vacuum infused A. arborea leaf showing a current voltage hysteresis pattern with reading voltage peaks around -1.6V and +1.6V . Input voltage was ±5V for the dual sweep IV settings.

Research Fellows: **Anna Hill (2024)** — **Concentration: Biochemistry**
Nicole Rodgers (2025) — **Concentration: Undeclared**
Nilesh Shah (2025) — **Concentration: Biochemistry**
Esther Wu (2023) — **Concentrations: Biochemistry; Neuroscience**

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

Title of Project: **New Chemical Tools to Study Biological Systems**

Funding Source: **Warren Anderson Fund; Michael J. Wolk '60 Heart Foundation; Picker Interdisciplinary Science Institute; NASC Division**

Project Summary:

The goal of our research is to design small-molecule chemical probes to study biological systems. During this summer, efforts were directed to the synthesis and purification of a variety of peptides, which are a series of amino acids bonded to each other. These will be used to explore the development of new methods for modifying cysteine residues in proteins and the implementation of enzymatic protein labeling strategies. In particular, we are interested in developing new methods for modifying cysteine residues in proteins to deliver a variety of cargo. These tools will allow us and others to explore protein biochemistry and better understand the nature of protein folding and aggregation, processes that play important roles in many neurodegenerative pathologies such as Alzheimer's disease and Parkinson's disease.

To synthesize these peptides, we used resin beads as solid supports to anchor growing peptide chains. Protected amino acids were iteratively deprotected and coupled to extend the chain, until we obtained the necessary sequence. Subsequent purification by high performance liquid chromatography gave the desired peptides. We are also developing new methods to covalently modify cysteine residues with chemical reagents in a highly selective and rapid fashion. Our reagents exhibit high reactivity towards cysteine in pH 7 buffer at room temperature, enabling the efficient functionalization of proteins and peptides at micromolar concentrations. These reagents can be easily derivatized to provide straightforward access for conjugation of structurally complicated functional cargo.

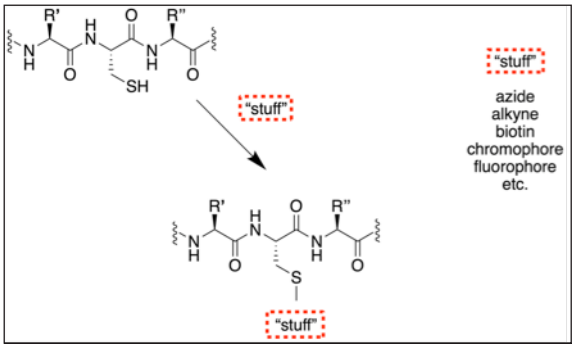


Figure 1. A generic scheme for cysteine labeling using our methods.

Research Fellows: **Tingkuan Hsieh (2024)** **Concentration: Environmental Geography**
Sophie Schadler (2023) **Concentration: Environmental Geography**

Faculty Mentor: **Peter Scull** **Department: Geography**

Title of Project: **Inventorying Colgate Landholdings with GIS**

Funding Source: **Byron R. Hanke '33 Endowed Fund-Environmental Studies**

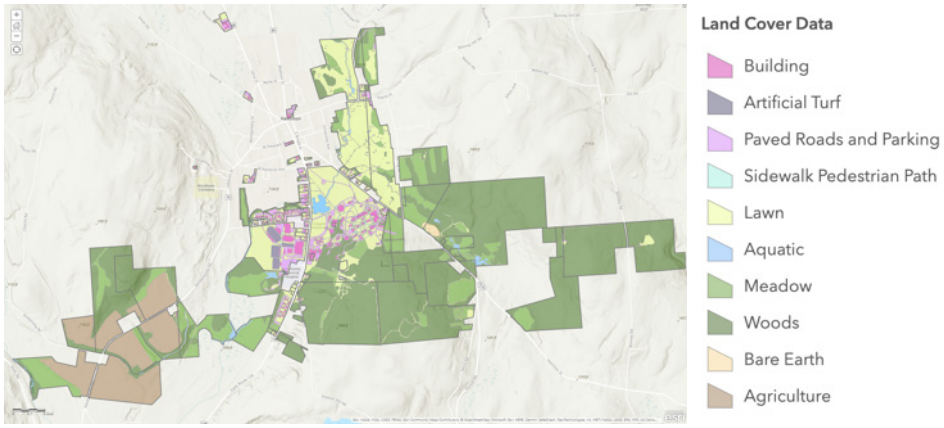
Project Summary:

The task for this project was to digitize a map of Colgate's entire landholding using ArcGIS. County tax maps and two satellite imagery basemaps were used to define the extent of Colgate's property and generate land cover data. Colgate Building & Grounds requested this research project in order to have an updated digital map of Colgate and to be able to calculate the area of specific land cover types. Building & Grounds can use this map for a variety of tasks, such as to determine the total length of road and sidewalk they need to plow and the total area of lawn they need to mow.

Colgate owns 106 parcels of land in Madison and Franklin Counties combined. County tax maps were used to define the extent of Colgate's landholdings. The basemaps came from New York State Web Mapping Systems (WMS, 2017) and ESRI World Imagery (2021). The project was projected in North America Datum 1983 StatePlane New York Central FIPS 3102 (US Feet).

The bulk of the project was spent manually dividing each land parcel into smaller polygons according to land cover type. Each polygon was classified as 1 land cover type from a list of 10 provided by B&G (building, paved roads and parking, sidewalk pedestrian paths, lawn, meadow, woods, artificial turf, aquatic, agriculture, and bare earth). We divided parcels into polygons by looking at the WMS and ESRI basemaps and a Computer Aided Design model of Colgate's campus. When the imagery was obstructed by trees, we visited the parcels in person and sketched out the surface features on an app called Fieldmaps that allowed us to access our ArcGIS data remotely.

After classifying each polygon and merging our data, we created a printable compilation of all 106 land parcels, called a map series. Each page shows a map of one land parcel, the total parcel acreage, and the percentage of each land cover type within the parcel. In addition to the map series, a digital version of the map is publicly available on ArcGIS Online, titled "Colgate Landholdings 8/4/22". We also created a user's guide to help people navigate the online map.



This map shows Colgate's property within the Town of Hamilton, color coded by land cover type.

Research Fellow: **Emma Hubbard (2023)** **Concentration:** **International Relations**

Faculty Mentor: **Edward Fogarty** **Department:** **Political Science**

Title of Project: **Tackling Human Trafficking: Examining Cross-National Variation in Compliance with the Global Compact for Migration**

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

Project Summary:

The Global Compact for Migration (GCM) was adopted in 2018, and is the first contribution to global governance which comprehensively addresses migration management. Almost four years after its adoption, compliance with the GCM among signatories has varied. This study relies primarily on data from countries' voluntary national reviews of their progress on the implementation of GCM objectives for the 2022 International Migration Review Forum (IMRF) to analyze factors that led to cross-national variation in compliance with the GCM. This study focuses on states' adoption and implementation of policies, programs, and laws to achieve objective 10 of the GCM: the reduction of human trafficking in the context of international migration. This study finds that the domestic factors of greater administrative capacity and a greater degree of political liberalization lead states to have greater compliance, and the IOM's use of institutionalized alliances and capacity-building programs are systemic-level factors that influence upward levels of compliance, helping to overcome domestic limitations.

Research Fellow: **Jordan Hurt (2024)** **Concentration:** **Art and Art History**

Faculty Mentor: **Carolyn Guile** **Department:** **Art and Art History**

Title of Project: **Analyzing Cultural Heritage Policy through the Example of Ukraine**

Funding Source: **Center for Freedom and Western Civilization**

Project Summary:

The destruction of cultural heritage is a serious threat for Ukraine during its current defense against Russian warfare. This destruction offers an opportunity to evaluate the efficacy of international law and organizations designed to protect cultural heritage. This article assesses present efforts to preserve cultural heritage through examining the UNESCO World Heritage Site of the Saint Sophia Cathedral in Kyiv, Ukraine and the challenges the cathedral faces against armed conflict, information warfare, and limitations to international law. By examining endangered Ukrainian cultural property, such as the St. Sophia, in danger of Russian destruction, the article suggests that a re-evaluation of international law concerning cultural property protection is in order, as well as a re-evaluation of Western narratives of Ukrainian (and Central European) history. As a result, Ukrainian cultural heritage may prevail under enhanced protection from international law, which additionally enhances the preservation of cultural property worldwide for the future.

Research Fellow: Joan Jatto (2025) **Concentration: Undeclared**

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

Title of Project: Raising Suicide Prevention Awareness in Madison County, New York

Funding Source: Upstate Institute

Project Summary:

This summer, I had the opportunity to advocate for and raise awareness of suicide prevention for Madison County, New York, working as a Field School Fellow for the Madison County Council on Alcoholism and Substance Abuse (BRiDGES). BRiDGES is a local nonprofit organization that works to connect community members and those affected by addiction, suicide, substance misuse, and mental health to support and resources. The organization's mission is to provide advocacy and services to individuals, the community, the workforce, and families, through programs that promote good and healthy environments.

My work with BRiDGES this year is specifically centered around the STEPtember for Suicide Prevention Walk, which is an initiative to raise awareness about and reduce the rate of suicide and provide plans for suicide prevention in Madison County. BRiDGES had decided to host an in-person STEPtember Walk in September 2022. In order to make this day successful and accommodate as many participants as possible, I worked with my coworkers to create content on Canva to promote the walk for the organization's social media and updated the walk's social media platform as well as the website and registration process for the in-person participants. The goal of my work was to increase registration from community members all over Madison County and nearby areas to show their support for local suicide prevention.

Working with BRiDGES has allowed me to gain real insight into the world of nonprofits. This Fellowship increased my knowledge of ways to mitigate major health issues in upstate New York, and I appreciate the valuable support I received from the Upstate Institute along the way.

Research Fellow: **Aaron Jaynes (2023)** **Concentration:** **Molecular Biology**

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

Title of Project: **Analyzing changes in the gut microbiome of Ethiopian children at risk of parasitic worm infection**

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

Project Summary:

The microbiome of a particular environment includes all of the microorganisms–bacteria, viruses, fungi–and their genetic material within that environment. The human gut microbiome is composed of trillions of individual bacteria belonging to hundreds of different species; the composition of this bacterial community in the gut microbiome is known to influence an individual's health, both positively and negatively. Two factors that may influence the makeup of the gut microbiome are parasitic infections and drugs. Soil-transmitted helminths (STHs) are species of parasitic worms that can cause debilitating symptoms, and prophylactic treatment involving mass distribution of deworming drugs is common in high-risk countries. The goal of our study is to analyze the changes in the composition of the human gut microbiome in Ethiopian schoolchildren; we look to answer whether STH infection alone affects the gut microbiome as well as if the deworming drug alters the gut microbiome in the presence and absence of STH infection. To do this, fecal samples were collected from a group of Ethiopian schoolchildren that were unable to take the deworming drug. These samples were assayed for the presence of STHs and sent to our lab. We then performed DNA extractions on all of the samples before sending them out for the bacterial 16S rRNA v4 region to be amplified and sequenced. We confirmed that the DNA extractions were successful by amplifying the 16S rRNA v4 region and observing bands on gel electrophoresis. The extracted DNAs were then submitted for sequencing. While waiting for the sequences to return, we have been creating a microbiome analysis workflow in R, a statistical computing program, that will aid us in analyzing the gut microbiome composition of each sample and determining whether there are differences in the microbiomes of STH infected and uninfected children. In the future, we will receive a second round of fecal samples from children who have been given the deworming drug, which will allow us to further analyze any changes in the gut microbiome and address whether the drug causes significant alteration in microbiome composition.

Research Fellow: Dean Kardas (2024) **Concentrations:** Mathematics; Philosophy
Faculty Mentor: David Dudrick **Department:** Philosophy
Title of Project: Resurrection and Rationality: A Study of Opposing Epistemic Attitudes
Funding Source: Center for Freedom and Western Civilization
Project Summary:

The goal of this essay is to show, philosophically and historiographically, that belief in the resurrection of Jesus Christ can be both well-founded and rational. The resurrection is both the principal claim of Christianity and a stumbling block for those who cannot believe it. Since the end of the 20th century, Christian apologetic efforts moved in a new direction in the wake of form-criticism that attempted to deconstruct New Testament documents. The new effort of apologists has thus tried to demonstrate the resurrection *without* relying on any of the New Testament records, e.g., the Gospels, Acts, Pauline Epistles, etc. The result of this effort, largely spearheaded by Dr. Gary Habermas, was the *minimal facts* methodology of argument. Since its inception, it has become the universal standard for apologetic attempts to demonstrate the rationality of belief in the resurrection. This essay examines the minimal facts methodology and identifies a significant epistemological error in its reasoning that prevents it from being successful. An alternative approach to demonstrating the rationality of resurrection belief is given in its place, using what has been called a "*maximal facts*" approach. This approach analyzes what it terms "undesigned coincidences" within the New Testament records. It then uses Bayesian reasoning to show that belief in the resurrection is rational. In sum, this essay studies the two primary epistemic attitudes that can be taken when analyzing the rationality of belief in the resurrection of Christ, and concludes that the maximal facts approach succeeds where the minimal facts approach fails. Belief in resurrection is then briefly considered from a more detached, philosophical theological perspective that attempts to make the resurrection more reasonable to the scientific mind of the 21st century.

Research Fellow: **Natalia Kim (2024)** **Concentration:** **Molecular Biology**
Faculty Mentor: **Priscilla Van Wynsberghe** **Department:** **Biology**
Title of Project: **Investigating the role of KIN-20 in miRNA production**
Funding Source: **Michael J. Wolk '60 Heart Foundation**
Project Summary:

Circadian rhythms are defined as physical, mental, and behavioral changes that follow a 24 hr cycle. They are important regulators of human health and physiological activities. In the model organism *C. elegans* (nematode worm), there are many circadian cycles. However, the central pacemakers or molecular mechanism underlying circadian rhythms in *C. elegans* aside from their roles in the developmental path are not yet known. There are many proteins of high homology in the *C. elegans* circadian cycle. KIN-20, in particular, is the *C. elegans* a homolog of CK1ε/Δ and Doubletime.

MicroRNAs (miRNA) are ~22 nucleotide RNA sequences that are involved in RNA interference (RNAi) and it is thought that KIN-20 may have a critical role in the early production of miRNAs. One way that KIN-20 is thought to influence miRNA processing is through ddx-17. Ddx-17 is a DEAD-box helicase protein that is involved in the biogenesis of miRNAs. It has previously been shown to regulate miRNA production at the primary miRNA processing step in both humans and *C. elegans*. However, it is not known whether KIN-20 impacts ddx-17 in *C. elegans*. Consequently, the purpose of this research project was to better understand whether KIN-20 also regulates the expression of miRNAs through ddx-17. Thus, the goals of my research were (1) to perform ddx-17 knockdown through RNAi in N2 and KIN-20 worms to analyze let-7 miRNA levels and (2) to analyze miRNA levels using small RNAseq.

The purpose of the first experiment was to create a ddx-17 knockdown model using ddx-17 RNAi. Experimental design for ddx-17 RNAi consisted mainly of cloning efforts to obtain the necessary vectors and transformed E.coli for the RNAi. cDNA from N2 worms were used as a template to create an insert. The insert then underwent a PCR cleanup, restriction digest, and gel extraction to isolate the digested insert. Vectors were provided by the E. coli L4440 strain and were miniprepped, digested, and isolated using a gel extraction. The insert and vector were then ligated and transformed into the E. coli NEB5-α strain plasmid amplification. Following overnight incubation, plasmids were then isolated through a NEB5-α miniprep and transformed again into competent HT115 cells.

The purpose of the second experiment was to quantify total let-7 miRNA levels and compare them between N2 and KIN-20 mutant worms. Experimental design for the let-7 qPCR analysis included egg preparations from N2 and KIN-20 mutant worms. The worms were allowed to hatch overnight and plated the next day. Following initial plating, the N2 and KIN-20 mutant worms underwent a 28 and 36 hour incubation at 25°C, respectively, to ensure collection of worms at the L4 larval stage. Total RNA was extracted from worms, followed by reverse transcription to create cDNA. Finally, qPCR was run to quantify the amounts of let-7 expressed in N2 vs. KIN-20 mutant worms. As expected, let-7 levels were significantly decreased in KIN-20 mutant worms in comparison to N2 worms.

Thus, during this research I performed cloning to create a vector for ddx-17 RNAi and quantified let-7 levels in N2 vs. KIN-20 mutant worms. Both of the aforementioned experiments are still in progress. Future directions will be to continue working on successfully creating a ddx-17 RNAi strain. This will allow the quantification and comparative analysis of let-7 levels in N2, KIN-20 knockdown, ddx-17 knockdown, and KIN-20 & ddx-17 knockdown worms. Finally, performing small RNA seq will allow us to gain further insight into whether KIN-20 affects multiple small miRNAs.

Research Fellow: **Sowon Kim (2022)** **Concentration: Arts and Humanities**

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

Title of Project: **Supporting and Integrating Refugee and Immigrant Communities in Utica, NY: Working at the Midtown Utica Community Center**

Funding Source: **Upstate Institute**

Project Summary:

This summer, I was a Field School Fellow with the Midtown Utica Community Center (MUCC), an inclusive, multicultural, and refugee-friendly community center in Utica. Founded in 2014, MUCC provides a variety of afterschool programs, summer youth employment opportunities, holiday meals, vaccine clinics, college readiness workshops, filmmaking workshops, and more for the local refugee population. I worked with MUCC as a grant writing fellow.

Over the last eight years, MUCC has served more than 4,000 community members, fostering connections between local refugees, migrants, and the broader Central New York communities. Despite the growing refugee community in Utica that MUCC serves, MUCC has only one full-time employee (the executive director, who also comes from a Karen family) and is otherwise operated by many volunteers and interns. In addition, MUCC resides in a church built in 1906, which is inaccessible, energy-inefficient, and contains health hazards such as asbestos in the basement. In order to reach sustainability, MUCC is seeking to expand staffing. Also, this summer, MUCC applied for NYS Consolidated Funding Application (CFA) this summer for building renovation.

My main responsibilities as a grant writing intern included assisting with the CFA, drafting support letters for the grant application, facilitating on-site community events as needed, and creating a spreadsheet that keeps track of past grant proposals. The spreadsheet records information such as proposal titles, dates of submission, amount of funding requested, dates declined or accepted, and more. Finally, towards the end of my eight-week fellowship, I created a short guide for the next grant writing intern, hoping it would help orient the next person who would pick up where I left off.

This was my first time working as a Field School Fellow and I would not change any part of it. I applied to be a Field School Fellow because I wanted to learn more about the Central/Upstate New York communities by engaging with them directly. As a Comparative Literature major, I was also curious to know what it is like to work as a grant writer. Working at MUCC allowed me to gain such experience. While I was often challenged to manage different expectations, the Upstate Institute staff provided so much support and guidance. Without them, I wouldn't have been able to navigate the challenge as successfully. Also, the field trips on Fridays to local sites such as the Shakowi Native American Museum were incredibly interesting and I couldn't believe it took me four years at Colgate to visit them. It was a joy to work for the Upstate Institute with a congenial group of fellow students.

Research Fellows: Izzy King (2023) — **Concentration:** Geology
Gary Kuang (2023) — **Concentration:** Geology; Geography
Sophie Naylor (2024) — **Concentration:** Geology
Tommy Subak (2023) — **Concentration:** Astrogeophysics

Faculty Mentor: Joe Levy — **Department:** Geology

Title of Project: Water Tracks Come Salty Only

Funding Source: National Science Foundation; NASC Division; Hackett-Rathmell 1968 Memorial Fund

Project Summary: Water Tracks Come Salty Only

While Antarctica is traditionally thought to be covered with snow and ice, there are extreme desert regions called dry valleys defined by their arid and frigid environment [1]. Specifically, within the McMurdo Dry Valleys, water tracks have been identified [2]. Water tracks are seasonal meltwater features present as dark wet streaks during the summer and light dry streaks during winter [3]. They contain increased soil moisture, believed to be sourced from snowmelt and ground ice motion [3]. Previous studies describe formation to be controlled by temperature, topography, insolation, precipitation, melting, and energy balance in the system [4]. They are sustained in frigid environments by salinity, due to the freezing point depressor Calcium Chloride. While comparatively higher CaCl2 concentrations in water tracks are widely observed [6], the mechanism driving Ca-Cl-rich brine flow is still unclear. This study aims to determine if cation exchange is responsible for high CaCl2 concentrations in water track brines and ponds in McMurdo Dry Valleys.

Some have proposed cation exchange processes using high Ca-Cl levels at specific sites [6]. To determine the greater applicability of the cation exchange model throughout the dry valley water tracks, numerous transects across the region were sampled. The area is one of the coldest and driest places on Earth, with a mean annual temperature of -20°C and less than 100mm of precipitation per year. 95 soil samples were collected during the 2012-2016 summer seasons by Prof. Levy. This study could aid understanding of habitability [2] and has applications in astrobiology for similarities on Mars.

To measure soluble salts in brines, soil water was extracted, shaken, centrifuged, then vacuum filtered and measured for electrical conductivity (EC). Ion Chromatography (IC) was used to find soluble salt concentrations and dissolved solids. To study cations, samples were prepared then analyzed using an ICP-Mass Spectrometer at SUNY-ESF Baker Laboratory.

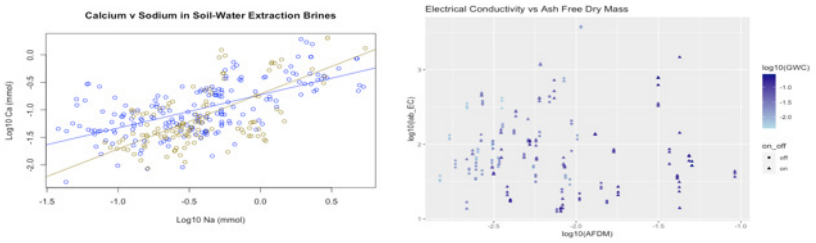


Fig. 1. (left): Calcium and sodium concentrations in on (blue) and off (gold) track soils. Fig. 2. (right): Electrical conductivity, organic matter, and water content in on- (circle) and off- (triangles) track soils. lab_EC: electrical conductivity, AFDM: ash-free dry mass, GWC: gravimetric water content.

Figure 1 shows Ca and Na clustering in on and off-track samples. In dilute brines, Ca is higher in track samples. However, in more concentrated brines, both sample types have high salts with little distinction between groups. Track samples have higher organic matter and water content but show lower EC values, while off-track samples show the opposite. The relationship between salt concentrations in brines imply that cation exchange is responsible for differential chloride concentrations. Extremely cold and saline conditions may lead to sodium ions replacing Ca ions on soil as CaCl3 is unable to form, increasing the concentration of Ca anions [6]. Higher Ca concentrations in on-track samples suggest that cation exchange is occurring in brine flow (Fig. 1). Furthermore, in dilute brines there is a clearer distinction between samples, where on-track has higher Ca concentrations, suggesting that cation exchange is preferred on tracks. Conversely, the clustering of on and off-track samples in high concentrations indicates that cation exchange may not be the ruling factor.

Acknowledgements: Thank you to Professor Joe Levy who advised our work and baked us many pastries. Additional thanks to Deb Driscoll and the workers at the SUNY ESF Baker Laboratory.

References: [1] Wilson A. T. (1979), Nature [2] Levy J. S., et al (2013), Antarctic Science [3] Levy J. S., et al (2011), Geophysical Society of America [4] Levy J. S., et al (2012a), Geophysical Research Letters [6] Toner J. D. and Sletten R. S. (2013), Geochemica et Cosmochimica

Research Fellows: Matthew King (2023) — **Concentrations:** Geology; Economics
Jacob Steinberg (2023) — **Concentration:** Environmental Geology

Faculty Mentor: William Peck — **Department:** Geology

Title of Project: Genesis of Adirondack graphite deposits

Funding Source: NASC Division; Doug Rankin'53 Endowment- Appalachian Research

Project Summary:

The eastern Adirondack Mountains used to serve as a national hub for graphite mining and processing during the 19th and early 20th centuries, reaching their peak during World War I. While none of the original graphite mines are still operating, their ruins and rock waste piles still exist scattered throughout the Ticonderoga area. As a whole, the Adirondack Mountains consist of mainly Proterozoic rocks that formed as a result of multiple igneous and metamorphic events. Given this complex geologic history, the origins of graphite-bearing rocks in the Adirondacks are not well understood. Currently, graphite is a critical mineral for different chemical processes as well as electrical components such as Li-ion batteries. Geologically, graphite carbon originates from two primary sources: carbonaceous sediments and magmatic fluids. Due to the complicated history of the Adirondack mountains, the original source of the carbon at these mines is unclear. We took samples from mine sites and prospects where a variety of rock types are exposed: Lead Hill, Columbia, Crown Point, Penfield Pond, Pulpit Point, and Betsy Cook. Graphite in the collected samples varies in shape and size, suggesting differences in the genesis of each rock. By better understanding the formation of graphite in the Adirondacks, we can apply these concepts to modern graphite mining and exploration. In this research project, we sought to analyze the rock and mineral geochemistry from old Adirondack mines to discover the source of carbon and the conditions of mineralization in these deposits.

Upon returning to Colgate, we prepared samples for a broad range of analytical processes. Some samples were subject to loss on ignition (LOI) processing to estimate graphite content. Samples were reduced to powder and heated for three hours in a 1000°C furnace to remove any volatile elements from the rock, determined by mass loss. After the LOI process was done, we took our powders to Hamilton College, where x-ray fluorescence (XRF) analysis was conducted. Samples were combined with double their weight of lithium tetraborate flux and fused into glass beads, which were used for XRF spectroscopy. These data allow us to determine the chemical composition of the bulk rock. Samples were also made into optically-thin slides for microscope observation. This allowed us to directly observe the mineralogy of our samples. Graphite-rich samples were selected for carbon-isotope analysis, which was a focus of our research. Graphite was removed from the rock and placed into a tin cup, along with at least ten times as much CuO. These cups were combusted and evolved CO2 was measured using a mass spectrometer to obtain carbon isotope ratios. These data will allow us to constrain possible geologic settings for carbon production at our study localities.

Research is ongoing, but preliminary data are available. Marbles have the lowest SiO2 contents, followed by amphibole/pyroxene and calc-silicate gneisses. Granitic gneisses and pegmatites are the most silicious. Certain elements exhibit significant correlations across rock types. For example, Na2O is positively correlated with SiO2 content, while CaO is negatively correlated with SiO2. Some rocks from similar localities seemed to have similar $\delta^{13}C$ values. Rocks taken from Lead Hill have $\delta^{13}C$ values between -3.5 and -6‰. Rocks from Pulpit Point show in two groups, one of which has $\delta^{13}C$ values around -1.5‰, and the other of which is between -4 and -6‰. Rocks taken from the Betsy Cook Prospects have the highest $\delta^{13}C$ values of 0‰.

Work on this topic will continue in the future. The project will still focus on the isotopic signatures of carbon in Adirondack graphites. Our analysis will expand to other samples collected in the field. Additionally, we will attempt to extract zircon crystals from our samples for geochronology.

Research Fellows: **Shane Knopp (2023)** **Concentration: Computer Science**
Tom Richards (2024) **Concentration: Geology**
Alexa Trubiano (2023) **Concentration: Geology**

Faculty Mentor: **Aubreya Adams** **Department: Geology**

Title of Project: **Seismic Imaging of the Alaskan Subduction Zone**

Funding Source: **National Science Foundation; Doug Rankin '53 Endowment - Geology Research**

Project Summary:

The Alaskan Subduction Zone is one of the most seismically active but variable areas in the world. Some parts, such as the Shumagin Gap, creep generating magnitude < 6.5 events. However, the nearby Semedi Segment is locked and produces magnitude > 8.0 earthquakes over long timescales with relatively fewer smaller magnitude events. Our study explores the observed variation using ground motion data collected in 2018-19 from multiple seismic station networks including 105 Alaska Amphibious Community Seismic Experiment network land and ocean bottom seismometers. This project uses seismic imaging to develop a model of the surface and shear wave velocities to capture the subduction of the Pacific Plate under the Alaskan Peninsula and investigate earthquake dynamics.

We used multiple seismic inversions to image the Alaskan Subduction Zone. One inversion uses surface wave propagation through geologic domains in the lithosphere and asthenosphere, causing variations in observed wave amplitudes and phases, to calculate phase velocities. The Earth velocity structure causing such changes can be inferred by inverting seismic data recorded from an array of stations using the interference between two plane waves. Finding 3D shear wave velocities in the Earth requires an inversion of surface wave dispersion curves because they constrain velocity by period for each node, which is influenced by a range of depths. The results yield shear wave velocities with true depth (Fig. 1) which can be used to create a three dimensional interpretation of the earth structure at the study area instead of periods (Fig. 2).

The results of this project inform the properties of the upper mantle at the study area. We repeatedly see the relationship between wave velocity and depth, showing how the mantle generally becomes more dense. We also see the distinct properties of the zones, including the initial high velocities of the Pacific Plate before becoming one of the slowest. The Volcanic Arc is slower than most areas at short periods due to melt before becoming much faster as the periods increase. This further captures the northwest movement of the subducting Pacific Plate also seen in Fig. 2.

For the future of this project, these results will be combined with shear wave velocities from a partner study using complimentary Love wave tomography to find shear wave velocity anisotropy in the mantle. Certain anisotropic patterns will inform the researchers on the chemical properties of the subducting plate, including the potential presence of hydrous minerals. A hydrated mantle would consequently lubricate the interface and explain the presence of creping tectonics at the Shumagin Gap.

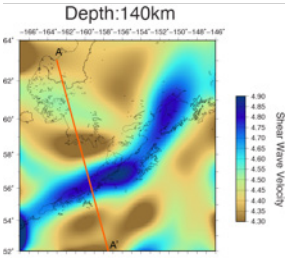


Figure 1 (left) | Shear wave velocities at 140km. Subducting slab is visible in dark blue. Lower velocities are in the green to brown range. Red line is the cross section used for Fig. 2.

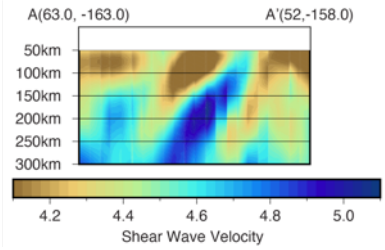


Figure 2 (right) | Shear wave velocity cross section from Point A to A' on Fig. 1 at depths 50 to 300. Note the distinct area of shear wave velocities greater than 5.0 km/s in dark blue, imaging the slab. Slow velocities closer to the surface and updip to the slab indicate melt generation from dehydration of the subducted plate.

Research Fellow: Teagan Krane (2023) **Concentration:** Environmental Biology
Faculty Mentor: Tim McCay **Department:** Biology
Title of Project: Surveying Gardens for Invasive Pheretimoid Earthworms in Central New York
Funding Source: NASC Division
Project Summary:

This summer, I studied invasive Asian earthworms, also known as 'jumping worms' or 'crazy worms' for their unusual thrashing movements. They are visually identifiable by their behavior in addition to a cream-colored clitellum that encircles the bodies of sexually mature adults. *Amynthas agrestis*, *Amynthas tokioensis*, and *Metaphire hilgendorfi* are frequently found together in North America and are known to change the structure and nutrient concentrations of soil through the rapid consumption of leaf litter and production of loose castings. This increases erosion and water percolation, creating harsher conditions for shallow-rooted plants. My research focused on surveying properties in Central New York for the presence of jumping worms and collecting data from homeowners regarding potential means of introduction into these properties. I also inspected areas adjacent to gardens containing jumping worms in an attempt to better understand their dispersal patterns.

Fig. 1. *Metaphire hilgendorfi*, the largest of the three jumping worm species.

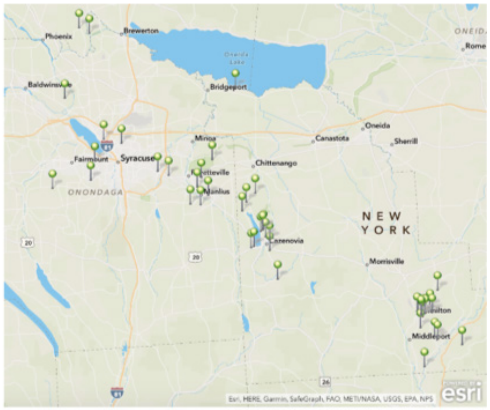


Fig. 2. Distribution of properties surveyed across CNY.

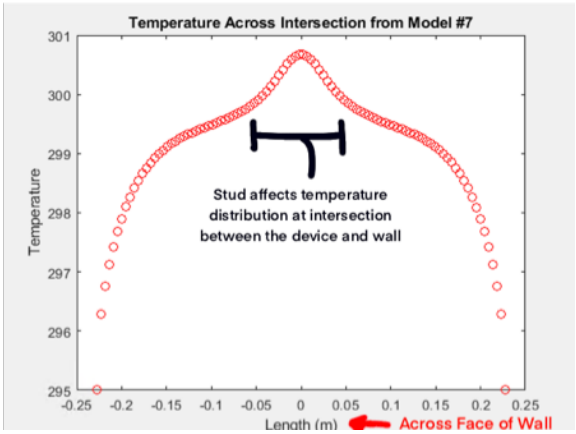
I collected the contact information for over fifteen gardening clubs across Central New York and coordinated with the Syracuse Master Gardeners to find a distribution of homeowners willing to participate in the survey, and we ultimately surveyed forty six properties. At each property, we used small trowels and hand rakes to comb through the top layers of mulch or soil, as jumping worms are epi-endogeic and dwell near the soil surface. I collected and later euthanized any jumping worms we found using 70% ethanol and then preserved them in 7% formalin for at least twenty four hours. I then transferred the worms into 70% ethanol for long-term storage as I work to identify each worm, as the three species can be indistinguishable prior to examination under a microscope. I created a Google Forms survey that will be distributed to the homeowners following my completion of the worm identification with questions pertaining to their understanding of how long their properties may have been infested with jumping worms and whether they introduced any materials such as mulch or soil into their properties. I will also include a report for each homeowner detailing any species of jumping worms found in their yard along with links to educational resources.

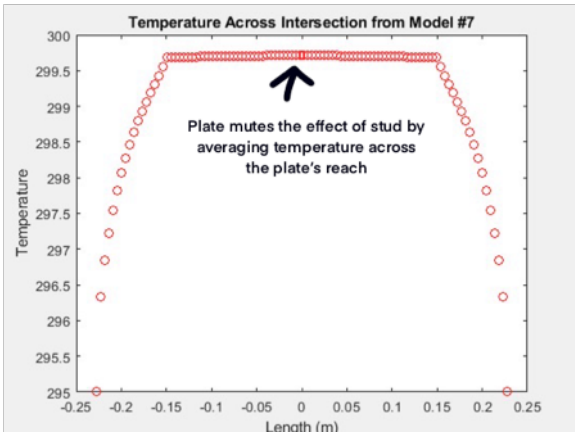
Thirty nine of the forty six properties we surveyed were found to contain jumping worms. By incorporating previous years' survey data with data that is being collected currently, we can build up a dataset for the distribution of these worms across Central New York. Our lab observed anecdotally that bulk mulch seemed to be the primary culprit for introducing jumping worms into many properties we visited. Future research regarding the sources of imported materials into properties could provide greater insight into the means by which these worms are dispersing across North America so rapidly.

Research Fellow: Jackson Kustell (2025) **Concentration:** Undeclared
Faculty Mentor: Beth Parks **Department:** Physics and Astronomy
Title of Project: The Heat Seeker - Modeling Heat Flow Through Walls
Funding Source: Volgenau-Wiley Endowed Research Fellowship
Project Summary:

Insulation is essential to an efficient and comfortable home, but most homeowners don't know if they have enough. A homeowner must find a trusted energy expert to assess the insulation's R-value, a measure of its thermal resistance.. The Parks lab is seeking a solution to this problem by creating an inexpensive device that measures the insulation quality by measuring two temperature differences: between inside and outside and also across the device itself. This summer, the Parks lab has been testing and refining this device so that it more accurately reads the R-Value.

While other members of my team have been taking measurements on a physical prototype of the device and mock-up wall, my mission has been to create a computer program that simulates and measures a "virtual wall." The "Heat Seeker" program is written in MatLab using over 2000 lines of code. I spent much of the summer testing and refining the program's features, which include but are definitely not limited to: generating and solving models in both 2D and 3D, applying non-uniform features including studs and siding, plotting temperature, and running multiple different models in parallel using parallel computing. The full release can be found on: https://github.com/MajorRelativity/TheHeatSeeker





Though most of my summer was spent updating and refining The Heat Seeker, I managed to make a few important discoveries using the model. One of the major problems that we've been dealing with is the way that studs interrupt our ability to accurately measure the insulation value of the wall. Studs, having a lower thermal resistance than the insulation around it, act as a short to the whole system. This means that the teampurate in front of the stud will be higher than our device expects, leading to inaccurate results. This temperature disturbance is demonstrated by the top contour plot. My model discovered that by placing a highly conductive metal plate at the intersection between the device and wall, the plate will average the temperature over the wall (shown in bottom plot) surface and lead to a significantly more accurate reading of the insulation's R-Value.

This program will be a significant aid in understanding the nature of our device, and though our research is far from complete, The Heat Seeker will help us take steps in the right direction.

Research Fellow: **Ege Kutlubas (2024)** **Concentration:** **Physics**
Faculty Mentor: **Ramesh Adhikari** **Department:** **Physics and Astronomy**
Title of Project: **Role of Aromatic Amino Acids on Conductivity of PEDOT:PSS**
Funding Source: **NASC Division**
Project Summary:

The polymer mixture poly (3,4-ethylenedioxythiophene) polystyrene sulfonate (PEDOT:PSS) is a commonly used stable conducting polymer with its seemingly increasing conductivity when mixed with organic solvents. The amino acids can enhance charge transport via their interaction with the PSS chain, linearizing them to create larger closed packed globules of PEDOT. Furthermore, the transparency of the polymer films increases with increase in aromatic amino acid contents in the film signifying potential application of this composite film as transparent electrodes. Similar conductivity and transparency of that indium tin oxide (ITO) with decreased cost and increased organic material content makes Aromatic Amino Acid- PEDOT:PSS films a great alternative in solar cells.

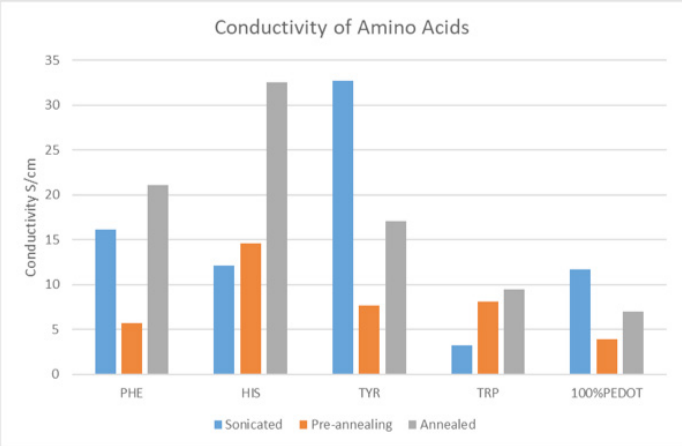


Figure 1: Conductivity of 50% Amino Acid - PEDOT:PSS solutions

Upon testing the conductivity of percentage films of amino acid-PEDOT:PSS solutions, 50% content of amino acid increased the conductivity of the solution the most. Histidine, Phenylalanine, Tryptophan and Tyrosine were the aromatic amino acids that were used to increase conductivity. One batch of samples were annealed, another batch was dried, another batch was sonicated and annealed. The resulting conductivities are shown in Figure 1.

Annealing has shown increase in conductivity. Sonicated Tyrosine sample has shown increased conductivity due to formation of string-like structures on its surface.

Applying methanol to the 50% Phenylalanine solutions further increased the conductivity of the films. Methanol was applied in various ways: dropcasted on top of the sample, the sample being dipped inside methanol, the solution being mixed with methanol. Methanol application has proved to increase the conductivity almost by 1000 times.

In light of these findings, the potential applications of PEDOT:PSS aromatic amino acid films as cost-effective alternatives to transparent electrodes can be regarded even more highly.

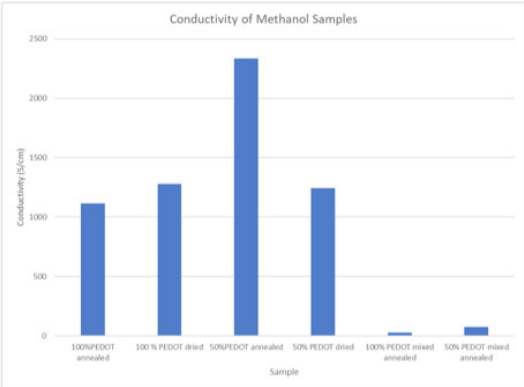


Figure 2: Methanol Conductivities

Research Fellow: Will Lam (2023) **Concentration: History**

Faculty Mentor: Graham Hodges **Departments: History; Africana and Latin American Studies**

Title of Project: Runaway Advertisements and Enslaved Database

Funding Source: SOSC Division

Project Summary:

This summer, I scanned and organized data from antebellum runaway advertisements in the Freedom on the Move database under the guidance of Professor Hodges. This work was a continuation of research that I had conducted last year. I continued inputting pertinent biographical data into excel spreadsheets, such as the enslaved persons' age, gender, skills, place of origin, presumed destination, etc. After 10 weeks, I had logged information from over 1,000 advertisements from all 50 US states. I also added biographical information to entries that I had completed last year, and then highlighted particularly noteworthy entries. The information that I gathered and its trends will be eventually used by Professor Hodges to write an upcoming history book.

I noticed several recurring observations and trends while analyzing the advertisements. First, many of the advertisements stated that they had imprisoned a presumed enslaved person, and requested the enslaver to contact the jail. In some of these instances, the imprisoned person had not given their name, nor informed the jailor that they were enslaved. As a researcher of these sources, this implied to me that many jailers had often targeted and jailed black individuals without any grounds. Another recurring trend that I noticed was the presumed destination of many runaways. The most common presumed destinations were states and regions that had abolished slavery. Occasionally, certain skills were assumed to play a factor in the runaway's escape and forging of a new life. For example, several individuals had been enslaved aboard steamships, and many advertisements claimed that they might seek employment as a free boat worker. Furthermore, in multilingual communities such as New Orleans, the runaway's language speaking abilities were listed to further identify them. The most common languages listed were English, French, and Spanish. Finally, advertisements often noted whether or not the enslaved person was able to read or write, and many that could were suspected of having forged a free pass to travel to other states. Some enslavers claim in the advertisements that they believed white persons had facilitated a runaway's escape, whether it be an attempt to free them, or a cynical motivation of selling them to another enslaver for financial gain.

This research opportunity has taught me the significance of primary research, and the challenges that come along with it. The advertisements contained language that reinforced the oppressive power structure of Antebellum America; many contained racist and sexist terminology. Past historical documents often contain bigoted terms, and present-day researches must handle this fact with sensitivity as to not inadvertently neglect or reinforce past prejudice. In the database, I would note the connotations of several antebellum phrases. I would reflect and note the particular inherent biases that runaway advertisements possessed in the excel spreadsheets. Finally, this research experience taught me how historical research demands the tedious combing through of sources and data. This type of repetitious work can illuminate historical actors' experiences and lead to groundbreaking insights.

Research Fellow: Rebecca Landry (2024) **Concentration:** Molecular Biology

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

Title of Project: Raccoon Rehabilitation

Funding Source: Upstate Institute

Project Summary:

Raccoons are very intelligent animals, and they are well known for the masked markings around their eyes, their ringed tails, and their mischievous tendencies. They are fascinating creatures to take care of, and they are one of the only species to adapt to more human intervention as opposed to wholly favoring the wilderness. In the state of New York, raccoons are classified as a Rabies Vector Species (RVS) which creates extra constraints for individuals interested in assisting with the rehabilitation of these animals. The Gordon Wildlife Center near Hamilton has many projects underway promoting the ease of working with this species and creating materials for the general public's use to remove the stigma around these impressive animals, and I was able to participate in many of them this summer as a Field School Fellow for the Upstate Institute.

Inhumane methods of trapping and relocating raccoons account for 74% of the raccoons taken in at Gordon Wildlife this year. I researched methods to avoid orphaning cases through inhumane raccoon removal and created materials to be shared regarding preventive measures and humane removal. I also compiled a database of active licensed nuisance trappers including contact information. In the future, we will introduce these suggested changes to the general public and wildlife nuisance trappers across the state to encourage taking these actions.

Currently, the process of becoming a licensed RVS volunteer or rehabilitator is inaccessible largely due to how the RVS training course is administered. To combat this, we wrote and designed a training module with the intention for it to be available online at any time of the year. This addresses another goal to improve training programs for professionals and volunteers interested in wildlife rehabilitation. We also hope to create standardized feeding and vaccination protocols for raccoon care to provide a reliable reference for rehabilitators new to the field.

There is a shortage of licensed rehabilitators to take in raccoons and legally give them the proper care necessary for their well-being. Gordon Wildlife is a Class II Licensed RVS facility that allows us both to rehabilitate raccoons and train assistants, ultimately teaching and encouraging future rehabbers. Future goals include working with Girl and Boy Scout Troops to provide projects that will earn them their highest awards while also benefiting our rehabilitation center by spreading awareness and getting young people interested.

Networking is an important aspect of growing the wildlife rehabilitation community, and social media is the most efficient way to connect with others. The center is already well established on Facebook, and I was able to create a TikTok account to reach another audience. We hope to continue to grow these platforms to provide educational information to the general public in easily accessible ways and promote awareness of this field of work.

There is a dire shortage of veterinary staff available to aid wildlife rehabilitators — the state provides no funding, and as no one "owns" the animals, there is no one to help with the costs of veterinary bills, vaccines, medications, etc., and rehabilitators are unpaid volunteers. We are establishing a medical center near our primary campus where we plan to offer low-cost or free medications, care, and exams to wildlife rehabilitators. We provided veterinary medical assistance to rehabilitators from over 25 counties across the state last year alone and our presence is growing to try to meet the ever-increasing demand. We are currently raising funds and writing grants towards the purchase of an x-ray machine at this building.

Research Fellow: Catie Lang (2024) **Concentration:** Biology

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

Title of Project: Sparganophilus Distribution in the Watersheds of the Northeast

Funding Source: NASC Division

Project Summary:

This summer research project revolved around the native earthworm species: Sparganophilus eiseni, the mud worm. The main objective of this study was to determine the redistribution pathways of this species in regions of New York State. Previous work has indicated that mud worms may have expanded beyond the last glacial maximum. This work aims to provide evidence of well-established mud worm populations outside their published range. During this summer, we traveled to the Adirondacks, Madison County, Sherburne County, Chenango County, and various other locations in Central New York. The coordinates of each location were marked using Google Maps, and each location was ensured to be public property using the application LandGlide. At each site, worm sampling was performed using hand searching and small hand tools. All worms found were collected and brought back to the lab to be processed and identified. The secondary objective of this project was to observe the habitat preferences of Sparganophilus eiseni. This required a collection of substrate and water samples at each site to be tested in the lab. These collections were tested for pH levels as a means of gauging which environments mud worms are capable of establishing themselves in.

Figure 1. S.eiseni

S.eiseni are particularly unique as they have a distinctively long and thin body, as well as a tendency to curl their body into a knot. These mud worms can often be found in the sediment next to rivers or streams. Observations in the lab suggest that S.eiseni are not highly sensitive to water pH, as the mud worms were present in pH ranges from 7.3-8.6. Along with this, S.eiseni were observed in soils ranging from pH of 7.0-8.0. We should continue to build upon this data by expanding the range of samples and exploring more sites in upstate NY in order to establish certainty.

As the coordinates of each site were collected, these points were plotted on a map of Central New York. The map includes data gathered from the summer of 2021 as well as data from 2022. Both the presence and absence of Sparganophilus eiseni were recorded, in order to give a visual aid of the pathways in which the mud worm has recolonized. From this map, it can be observed that S.eiseni have moved farther North and Northwest as they branch from the Chenango River. It seems that S.eiseni are moving along the topography of CNY as they move from higher elevation to lower. Although this information has been recorded, it is vital to continue this work into the academic year as a means to create a story as to how far the mud worms have recolonized.

Figure 2. Map of S.eiseni distribution

Research Fellow: Jasper Lim-Goyette (2023) **Concentrations:** Biochemistry; Molecular Biology
Faculty Mentor: Geoff Holm **Department:** Biology
Title of Project: Cellular Metabolic Responses to Mammalian Reovirus Infection
Funding Source: Beckman Scholars Program

Project Summary:

Mammalian reovirus is known to infect and kill cancer cells without causing disease in normal human cells. Because of this, reovirus is administered in clinical trials to treat certain types of cancer. This type of treatment is called oncolytic virotherapy. The mechanisms of oncolytic virotherapy remain poorly understood. The Holm Lab seeks to understand how cancer cell metabolism could play a role in reovirus oncolysis, in order to optimize cancer therapeutic strategies. This summer, the Holm Lab has specifically focused on the role of JNK cell signaling pathways, since these pathways have implications in cancer metabolic reprogramming and reovirus apoptosis. The data gathered suggests that JNK inhibitors may reduce reovirus protein translation, but not affect overall replication.

Cancer cells exhibit distinct metabolic phenotypes that allow for rapid proliferation and sustained growth. The main metabolic characteristic is increased glycolysis, even under aerobic conditions. In some cancers, aerobic glycolysis has been shown to be dependent on the oncogenic RAS protein. Interestingly, reovirus preferentially infects cells with oncogenic RAS. Although it is commonly accepted that oncogenic RAS helps reovirus evade host immune detection through PKR inhibition, it is also possible that reovirus benefits from altered host metabolism, either through RAS or independently of RAS. To further support this point, data from the Holm Lab has shown that cells infected by reovirus have different metabolic phenotypes. Different strains of reovirus exhibit increased levels of ATP synthesis, different reliance on glutamine oxidation and fatty acid synthesis, and changes in overall metabolic phenotype (Characterized by Colgate's Seahorse XF96 Bioanalyzer).

After the Holm Lab identified the JNK pathway as having a potential role in metabolic reprogramming, the effect of JNK inhibition on reovirus infection was tested using two different JNK inhibitors. Plaque assay with HeLa cells showed no difference between cells treated with either JNK inhibitor and untreated cells, indicating that viral replication was unaffected by JNK inhibition. Interestingly, both HeLa and HEK293 cells showed little to no viral protein synthesis following treatment of one of the JNK inhibitors: JNK Inhibitor V. Cells treated with the JNK inhibitor SP600125 and untreated cells both showed viral protein synthesis following reovirus infection. Future work in the Holm Lab will investigate JNK inhibition in relation to metabolism, as well as other mechanisms and properties of reovirus metabolic reprogramming, especially within cancer cells. Studying these effects in cancer cell lines may ultimately pave the way for better treatments in oncolytic virotherapy.

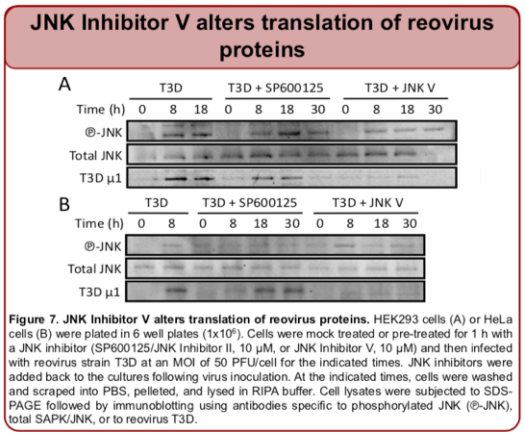


Figure 7. JNK Inhibitor V alters translation of reovirus proteins. HEK293 cells (A) or HeLa cells (B) were plated in 6 well plates ($1x10^6$). Cells were mock treated or pre-treated for 1 h with a JNK inhibitor (SP600125/JNK Inhibitor II, 10 μM, or JNK Inhibitor V, 10 μM) and then infected with reovirus strain T3D at an MOI of 50 PFU/cell for the indicated times. JNK inhibitors were added back to the cultures following virus inoculation. At the indicated times, cells were washed and scraped into PBS, pelleted, and lysed in RIPA buffer. Cell lysates were subjected to SDS-PAGE followed by immunoblotting using antibodies specific to phosphorylated JNK (℗-JNK), total SAPK/JNK, or to reovirus T3D.

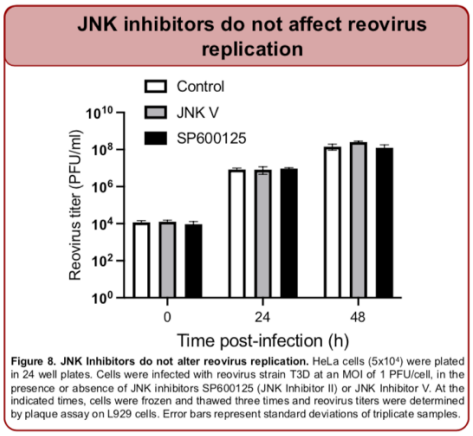


Figure 8. JNK Inhibitors do not alter reovirus replication. HeLa cells ($5x10^4$) were plated in 24 well plates. Cells were infected with reovirus strain T3D at an MOI of 1 PFU/cell, in the presence or absence of JNK inhibitors SP600125 (JNK Inhibitor II) or JNK Inhibitor V. At the indicated times, cells were frozen and thawed three times and reovirus titers were determined by plaque assay on L929 cells. Error bars represent standard deviations of triplicate samples.

Research Fellow: Henry Lin (2024) **Concentration:** Astrogeophysics
Faculty Mentor: William Peck **Department:** Geology
Title of Project: Tectonic affinity of the Frontenac terrane, Ontario
Funding Source: NASC Division
Project Summary:

Zircon ($ZrSiO_4$) is a mineral that is resistant to physical and chemical change; it does not weather easily, both physically and chemically. It is commonly found in igneous and metamorphic rocks, and its structure accommodates trace elements, such as U, that happen to be present during its formation. Thus, we are able to analyze the ratio of U and its decay product, Pb, in zircon grains to determine the age of those grains, and perform this analysis on samples from a large variety of rock formations. The samples examined are from the Grenville Province, a belt of billion year-old rocks extending from eastern Canada into the United States, which includes Ontario and the Adirondack Mountains. In this project we sought to determine the common ages of samples from different parts of the Frontenac Terrain in Ontario, as well as the Adirondack Mountains (New York), to determine the relationship between different parts of the Grenville Province as well as the ages of relevant past metamorphic events.

Prior to the start of the project, Professor Peck crushed five samples of metamorphic rock from the Frontenac terrane and one igneous rock from the Adirondacks, separated zircon, and sent them to the Arizona Laserchron center at the University of Arizona for analysis. The samples were mounted in epoxy along with standard zircons of known age. Between 35 and 315 spot locations were selected using cathodoluminescence images for each sample. The laser ablation returns data for various elemental abundances and isotope ratios, which are used to calculate ages for our samples. We then used several Excel macro-enabled worksheets, as well as an Excel macro called Isoplot, to extract statistical information from our data. Some samples contain zircon grain from different source regions during their sedimentary deposition, so we first used Age Pick (one of the macro worksheets) to determine peak ages in our data that correspond to the most common ages in each sample. We then used Normalized Probability to plot different sets of sample data, as well as data from older research, against each other to visually check for similarities. We also used Overlap-Similarity to check for degree of peak overlap between different samples as well as the similarity between the samples. Finally, we used an Isoplot tool called “unmix multicomponent data using Gaussian deconvolution” to check for potentially overlapping peaks that only appeared to be a single population using Age Pick. We found that our two Frontenac quartzite samples contained the greatest variety of ages, from the 1100s up to 3500 Ma. Our two gneiss samples and one marble sample had less variety, with the marble ages all under 2400 Ma and the gneiss ages under 1700 Ma. All of the Frontenac samples had a population of metamorphic zircon formed at 1180–1190 Ma.The metamorphic ages we found (1190 Ma), as well as major igneous peaks (with the 1800s being the most common), are in concordance with known past geologic events in the area. Our samples also contain a small number of old, inherited zircons, up to 3500 Ma. These may have traveled far from where they formed, possibly from the Archean Superior province to the west of the Grenville Province.

We also analyzed the Adirondack sample, a fayalite granite from near Ausable Forks. Zircon from this igneous rock contains various inclusions, documented using the scanning electron microscope. We selected the laser spots to analyze the age of zones containing different inclusions. Our two largest peaks are at 1126±9 and 1135±9 Ma. It appears that inclusions of K-feldspar and quartz correlate better with the older peak while Na-Feldspar, mixed feldspar, and inclusionless grains are associated with younger ages.

Research Fellow: Yinuo Lin (2023) **Concentrations:** Art and Art History; Geography
Faculty Mentor: Julie Dudrick **Department:** Upstate Institute
Title of Project: Value Proposition Project with New York State Association for Rural Health
Funding Source: Upstate Institute
Project Summary:

This summer I worked as a Field School Fellow with the New York State Association for Rural Health (NYSARH) on a value proposition project. NYSARH is a non-profit, membership association, dedicated to rural health and well-being. Their mission is to "improve the health and well-being of rural New Yorkers and their communities." The purpose of this project is to access NYSARH's service from an outsider's perspective. The project consists of 28 interviews, a survey, a written report, a presentation to the board members, and a pamphlet for future use (shown on the right).

The outcomes are based on the information gathered through the interviews and the survey, which I analyzed and summarized into three parts in the report: NYSARH's current members and prospective members, and their needs; NYSARH's current focus and service; parallel interests between NYSARH and its members, and how they could promote the association in the future.

NYSARH's service is mainly targeted toward health-related organizations, networks, and companies in rural New York. The three areas that they have been working on are advocacy, networking, and education. NYSARH's connection with other sectors in rural areas gives their service unique value: they could provide their members with efficiency, innovation, and collaboration.

By joining NYSARH, arural health organizations will have their voice represented collectively in front of the representatives. NYSARH is also a very efficient resource for them to get the latest information about legislation and regulations related to their field. Furthermore, as a platform, NYSARH's networking event is a great opportunity for its members to learn from each other's practices, and get inspired by their peers. Communication between members will be mutually beneficial for all parties and have the potential to generate innovative ideas about some common obstacles to rural health. Lastly, as rural health is an inseparable part of the rural economy and society, NYSARH's relationship with other rural sectors shows the great opportunity for collaboration between healthcare and other needed services in rural areas, such as housing, farming, and education.

Research Fellow: Ridley Lindstrom (2024) **Concentration:** Political Science

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

Title of Project: Democracy Building in Nigeria: Political History and Challenges of Achieving Democratic Consolidation

Funding Source: Center for Freedom and Western Civilization

Project Summary:

With the re-emergence of democracy in May of 1999, there was a great sense of hope and high expectations for the Nigerian Fourth Republic among the citizenry who had been heavily exploited at the hands of their own politicians and leaders for decades. A large portion of the Nigerian populace still believed that it was possible for their nation to have a form of government that truly adheres to democratic culture and values. Alarmingly, 23 years after restoring democracy in the nation, the government has failed to show any evidence of attaining true democratic governance in which the government is held accountable and responsive to all its citizens. This essay critically examines various aspects of Nigerian society and culture which have evidently created an environment in which democracy is unable to thrive or even perform its most basic functions. This essay will examine the extent to which the western style of governance, being a democracy, can be implemented in a developing African nation such as Nigeria given its political and social challenges which have directly resulted from its colonial background. It argues that Nigeria's Fourth Republic has failed to achieve democratic consolidation due to various challenges to governance such as electoral violence and malpractice, widespread corruption, poverty and unemployment, ethno-nationalism and ethnic conflict, religious violence, and the government's inability and unwillingness to address these challenges in a productive manner. Additionally, this essay concludes that although the full benefits of democracy have yet to be achieved and the consolidation of democracy has yet to be seen, democracy is still the most suitable form of government moving forward if we are to see increased welfare for the common Nigerian.

Research Fellows: **Edward Lynch (2023)** **Concentration: Chemistry**
Drew Tompkins (2023) **Concentration: Chemistry**

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

Title of Project: **Density Functional Theory Examination of Electronic Structure, Spectroscopy and Mechanism in Transition Metal Systems**

Funding Source: **NASC Division**

Project Summary:

Our project, under the leadership of Professor Keith, seeked to determine a plausible reaction mechanism involving many different transition metal systems using computational methods, specifically density-functional theory or DFT. Density-functional theory is a computational method used for the purpose of approximating the energy of multi-atom molecular systems. DFT is very useful for our project because once we know the energies of all the molecules participating in a certain reaction, we are able to create potential energy surfaces which tell us which reaction mechanism is most energetically favorable. We used a program called Gaussian to complete all DFT calculations.

The reaction mechanism which we were interested in this project was a carbonyl (CO) substitution reaction with trimethylamine N-oxide with three different transition metal centers (Cr, Mo, W), which are all transition metals in group 6. We also wanted to see how the reactivity of these complexes would be affected by adding ligands onto these transition metal systems (NMe3, PPh3, AsPh3, pyridine). One of the main unknowns along the way of this project was determining the structure of transition states of this reaction. Transition states are not reactants, products, or intermediates of a reaction, but they are what exists between these states and are most effectively determined computationally because of their extremely short-lived nature in real world settings. Determining the energies of transition states is crucial to proposing a reaction mechanism, which our group has not yet completed. Although we have not completed our final proposed mechanism, we are in the process of determining energies and structures for these transition states which will ultimately lead to the completion of this project.

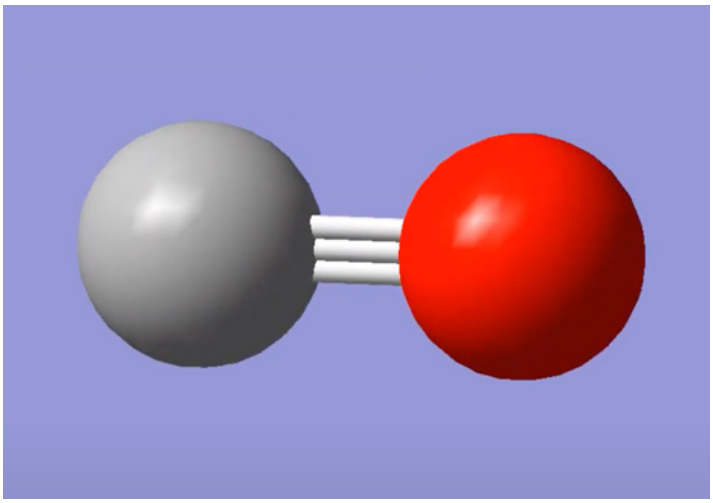


Figure 1: This is a carbon monoxide molecule (CO) which was built in the program Gaussian for DFT calculations.

Research Fellow: **Kaitlyn Macdonald (2023)** **Concentration: Biology**

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

Title of Project: **Investigating the effect of oral glucosamine supplements on the gut microbiome of sled dogs**

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

Project Summary:

The gut microbiome is composed of genetic information from a wide array of bacteria, archaea, and fungi that have evolved to inhabit the digestive tract. The diversity and abundance of these microbes can be affected by environmental factors, such as air quality, food availability, and organism health. Glucosamine is a naturally occurring compound that alleviates symptoms of arthritis by promoting the growth of soft cartilagenous tissue between joints. To evaluate whether the consumption of glucosamine has an effect on the gut microbiome of dogs, fecal samples were collected from 28 sled dogs at two time points. Twenty-five of the dogs were subjected to an intense exercise regimen between sample collections, and 6 of the dogs received regular glucosamine supplementation to their diets. DNA was extracted from the fecal samples using the DNeasy PowerSoil Pro Kit and 16S rRNA was amplified from the extracted DNA using PCR. The 16S region was targeted due to its presence in all prokaryotes and for its sequence variability, which allows effective identification of bacteria present. All samples were sequenced and computer processing of the DNA sequences was used to identify the bacterial composition and diversity of each sample. Principal coordinate analyses performed to examine microbial similarity indicated clear grouping of those dogs who took glucosamine and those who did not. Dogs who took oral glucosamine supplements were found to have a lower Shannon Diversity index than those who did not. Further analysis is needed to determine which bacterial taxa are dissimilar between the treatment groups and how differences in bacterial composition might affect the dogs. These data provide an important step in our emerging understanding of the effects of dietary supplements on microbiome composition and gut function.

Research Fellow: **Ruby Macfarlane (2025)** **Concentration:** **Undeclared**
Faculty Mentor: **Julie Dudrick** **Department:** **Upstate Institute**
Title of Project: **Sexually Transmitted Infections in Madison County**
Funding Source: **Upstate Institute**
Project Summary:

STIs are a subset of communicable diseases passed from person to person through sexual contact. Common STIs include chlamydia, gonorrhea, syphilis, genital herpes, human papillomavirus infection (HPV), and human immunodeficiency virus (HIV). Symptoms range in severity and as such, testing is the only way to confirm diagnosis.

Current data demonstrate Hamilton accounts for 15.6% of STI cases in Madison County. This is likely an underestimate due to the impact on healthcare access, including routine STI screening, during the COVID-19 pandemic. Globally, the World Health Organization (WHO) estimates there were 374 million new infections of chlamydia, gonorrhea, syphilis, and trichomoniasis in 2020.

Importance

- High Prevalence: Approximately 1 in 5 Americans have an STI.
- Financial Burden: Americans spend $16 billion in medical costs on STIs annually.
- Long-Term Health Effects: Untreated STIs can cause infertility, pregnancy complications, cancer, and an increased risk of HIV infection.

Barriers

Both routine screening and symptomatic testing are necessary for patients and their partner(s) to receive appropriate treatment in addition to preventing the spread of STIs.

- Cost: STI testing and treatment can be quite expensive. For the 5% of Madison County residents, and many more without comprehensive insurance, this cost can discourage individuals from seeking routine screening.
- Stigma: Historically, the narrative of acquiring STIs was portrayed as immoral behavior. The stigma persists today and prevents individuals with suspected infections from seeking health care.
- Lack of Comprehensive Sexual Education: Misconceptions around STIs promote incorrect information, increasing the likelihood of infection along with decreasing the rate of testing.
- Lack of Access to Testing and Treatment Centers: During the COVID-19 pandemic, Madison County lost their only free provider of STI testing and treatment: Planned Parenthood.

Madison County

Based on data from 2019 to the present, cases of STIs are most prevalent among the 15-24 age group. Additionally, following national trends, chlamydia is the most common STI in Madison County. Using this data allows public health officials to determine a course of action to address the prevalence of STIs.

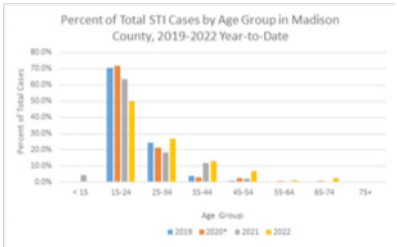


Fig 1: Percent of total STI cases by age group in Madison County.

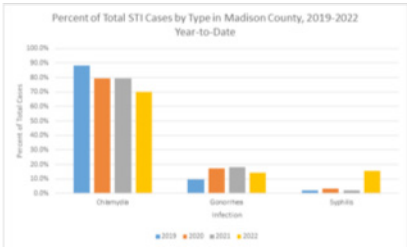


Fig 2: Percent of total STI cases by STI in Madison County

Research Fellow: **Agrim Mangla (2024)** **Concentration:** **Molecular Biology**

Faculty Mentor: **Liangyong Mei** **Department:** **Chemistry**

Title of Project: **Synthesis of Indole-fused Heterocycles through a Cascade Thiocyanation and Cyclization**

Funding Source: **NASC Division**

Project Summary:

Indole fused heterocycles have a variety of biochemical and pharmaceutical applications in drugs used for treating inflammatory diseases along with helping with nausea after certain medical treatments such as surgery and chemotherapy. The main goal in the eight weeks was to get a synthesis pathway to make indole fused heterocycles. My focus was to synthesize indoles with functional groups such as indole alcohol and carboxylic acid.

I synthesized a tert-butyloxycarbonyl (Boc) protected indole alcohol called Boc-protected 3-indole ethanol. The first step was to start with 3-indole ethanol and Imidazole acted as a base to strip the hydrogen off of the alcohol functional group. There was protection with tert-butyl dimethyl silyl chloride (TBSCl). Afterwards, there was dimethyl amino pyridine used to take the hydrogen off of the nitrogen on the indole and the tert-butyloxycarbonyl (Boc) group was added on to the nitrogen of the indole alcohol. This step led to getting a Boc and TBS-protected indole substrate. Finally, there was a hydrolysis step resulting in Boc-protected 3-indole ethanol. The right product was confirmed with Proton Nuclear Magnetic resonance spectroscopy. The low yield at the last step was due to the product being lost during flash column purification.

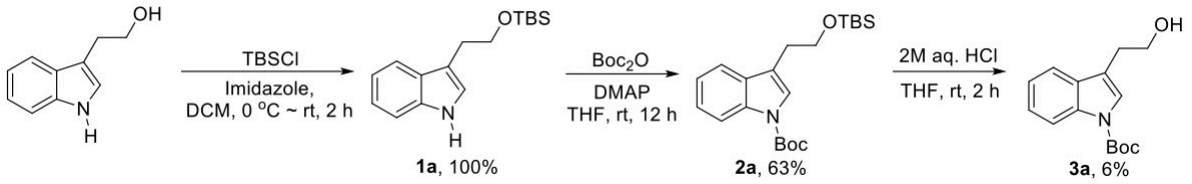


Fig. 1 Synthesis of Boc protected 3-indole ethanol

An indole carboxylic acid called Boc protected 3-indole ethanoic acid was synthesized by first using 3-indole ethanoic acid and an acid-catalyzed esterification with ethanol and sulfuric acid. The result is a 3-indole ethyl ethanoate and then Di methyl amino pyridine was used to strip a proton off of the Nitrogen on the indole and attach a Boc group on the Nitrogen of the indole, which made a Boc protected indole ester. Finally, a hydrolysis step was performed to make Boc-protected 3-indole ethanoic acid. These products were determined correctly by 1H NMR. The yield in the last product was not determined because there was too little product recovered.

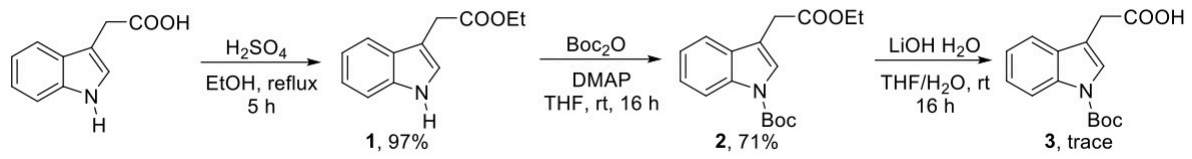


Fig. 2 Synthesis of Boc protected 3-indole ethanoic acid

Research Fellow: Jenna Mapley (2024) **Concentration: Mathematics**
Faculty Mentor: Meg Gardner **Department: Educational Studies**
Title of Project: Virtual Galápagos Curriculum
Funding Source: SOSC Division
Project Summary:

Over the last few summers, research groups have been collecting information, media, and other assets to craft an exploratory mystery about the Galapagos Islands. This summer a group of student researchers and I have taken all of those resources and turned them into an interactive virtual field trip that leads kids through the Galapagos mystery while learning about all different scientific disciplines. The mystery that needs to be solved is: how are the two endemic species of iguanas that live on the Galapagos older than the islands themselves? There are four trips the students will take that are labeled, the island life cycle, currents, iguanas, and volcanoes modules. Each one will help to reveal a new clue for the mystery. My job in this project was to make the supplemental lesson plans and teaching material so that this can be used for science curriculum for third, fourth, and fifth grade students. I also created math worksheets and full unit plans to go with each module to emphasize the connection between math and science. These materials will be able to be used by school, teachers, and individual students all around the world to learn about different science disciplines, their connection to math, the Galapagos islands, and relate these things to their own sense of place.

Each of the virtual field trip modules has an accompanying one week unit plan. This plan starts off with a pre-trip slideshow that is used to explore the knowledge students have on the topic and give them some important background information. The students' funds of knowledge can be assessed by the teacher and the background knowledge they gain will allow them to completely understand each field trip. They are then given three days to complete the field trip with all of the activities, demonstrations, videos, and worksheets. On the last day, after they have finished the field trip, there is a final activity that is used to review the important trip information as well as relate what they've learned to their own sense of place. In this way the students are able to learn and engage in their own community including the physical characteristics and the history which is an important aspect of place based learning. They will appreciate the aspects of the Galapagos islands like the wildlife, environment, history, and community and acknowledge that importance in their own place. Each lesson plan also outlines all of the NGSS standards (NY and national) that each of the trips address. This way teachers can see the purpose and implement them into their curriculum. Each plan also outlines the ways in which these trips cater to the needs of all students through all the differentiation considerations.

Math aspects were created to go with each of the field trips as well. When going through each of the virtual trips there is a hotspot or icon that leads the student to a math worksheet. There are six of them in the four modules and for each module, one math problem is turned into a week-long unit plan. The four weeks are about unit conversions, calculation of volume, mass, and density, calculation of speed, and how to read and write graphs. There are also two extra worksheet math problems in two of the units, one involving addition and subtraction of numbers in the thousands and another about reading charts. For the week-long plans, there is an introduction to the material followed by a buildup of learning that leads to solving the final problem. For example in the math unit about conversion they learn what conversions are, how to do small then more complex conversions, and then solve the problem of how long did it take for the iguanas to float to the Galapagos. This same format is repeated for all of the math units and allows for students to see all of the work that goes into solving math problems as well as how math and science are interconnected when scientific mysteries need to be solved.

Research Fellow: Chris Mardirossian (2024) **Concentration:** Film & Media Studies
Faculty Mentor: April Sweeney **Department:** Theater
Title of Project: Rewilding: A Micro Festival of Works by Romina Paula: LABORATORY #1
Funding Source: AHUM Division
Project Summary:

This summer, I assisted in a residency focused on the work of Argentinian playwright, Romina Paula. This opportunity allowed me to understand better how to go from concept to page to stage. Beyond my new knowledge, I could further appreciate how art comes to be made. Seeing how a director works with actors was a memorable experience. Conversely, observing how actors take director notes and begin to incorporate them into their performance was enlightening. My work was separated into two interconnected segments. One portion focused on supporting the early stages of FAUNA, an upcoming English production of Paula's. The other part was centered around creating a new piece from Paula. Paula frequently implements similar themes (often focused on gender and its performance) throughout her work. She likes to tie in work from other playwrights.

At the start, I immersed myself in the work of Paula. I read and analyzed all of the plays that Paula has written to get a better understanding of her work and the themes she is drawn to. Through this, I learned more about gender roles and some of the differences between the United States and Argentina. Familiarizing myself with her work of Paula was a vital part of the process as it clarified her intentions as an artist. Working alongside Paula was an invaluable experience. Paula almost exclusively writes for actors that she knows well. For her new play, she brought an Argentine actor with her in addition to using a NYC-based couple. Coincidentally, one was Argentinian-American. April Sweeney was also incorporated into her work for a total of four actors. For two weeks, Paula instructed them through guided improvisation while Paula began to write her new play. I assisted by contributing to conversations on gender discourse and provided feedback to the actors and playwright. Our work culminated in a viewing experience as we saw the Off-Broadway production of Fat-Ham, a Black queer re-imagining of Hamlet. Intimate improvisations and informal discussions proved to be successful in creating a play.

After Paula left, we began working on rehearsals for FAUNA. Early in the summer, I completed training to become a Covid Compliance Officer to ensure that our production followed all Covid-19 measures. I also created a document outlining our overarching goals and values to create a positive environment for all members of the production. Before we started rehearsals, I attended the auditions for FAUNA, where I read lines with actors and observed the casting process. Rehearsals mirrored the previous two weeks. April used guided improvisation to allow each performer to step into their role more and unearth different variations of their respective characters. I provided feedback to the actors to help explore their characters from new perspectives. Additionally, I helped actors memorize lines and was on book to remind them of their lines if they had forgotten them.

This residency has truly informed my thinking about my career. As I seek to blend film, theater, and queer issues together, I will look surely look back on my time spent here. Working alongside a playwright, director, and actors was an opportunity that I am lucky to have had. While my primary interests lie in film, this project has cemented the idea that I will return to theater at some point in my career.

Research Fellow: Jack McGrath (2023) **Concentration: Biology**

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

Title of Project: Effects of Invasive Earthworms on Water Infiltration and Nutrient Cycling

Funding Source: NASC Division

Project Summary:

My summer research project focused on invasive earthworm species in the Northeast. These invasive species can be divided into two groups: European lumbricid earthworms and pheretimoid earthworms. Pheretimoid earthworms are commonly referred to as jumping worms because of their distinctive "jumping" or thrashing behavior. European earthworms have been present in the northeastern US for several hundred years whereas the arrival of jumping worms is fairly recent. My goal was to understand the differences between these two groups of earthworms and how they can differentially affect soil quality. It has already been established that European earthworms do not have serious negative impacts on soil quality, and it is thought that jumping worms will have different impacts due to their castings, which differ from European worms. The granularity of jumping worm castings can change a lot about soil characteristics, such as water percolation, nutrient cycling, and other factors that can affect plant growth and surrounding ecology. However, a direct comparison between European earthworms and jumping worms has not been examined yet. I spent the summer planning and developing an experiment that will demonstrate the differences between these two groups of worms and determine if the invasion of jumping worms will have detrimental effects on soil quality in the Northeast.

My experiment will utilize several different species of European earthworms to represent the biodiversity that is present in the Northeast. The European earthworms I will be using are *Lumbricus terrestris* and *Dendrobaena hortensis* because they are fairly common and represent different ecotypes. There are three different lifestyles, or ecotypes, that earthworms can have. Epigeic earthworms live very close to the surface of the soil, endogeics live deeper in the soil, and anecic worms create vertical burrows that can extend 12 inches below the soil. *L. terrestris* is an anecic species and *D. hortensi*s is epigeic. There are three species of jumping worms that are prevalent in the US, *Metaphire hilgendorfi*, *Amynthas tokioensis*, and *Amynthas agrestis*. All three of these species are epigeic, so I plan to utilize *M. Hilgendorfi* because they are the largest and have the best survival rate in previous experiments.

The experiment that I have planned will run during the upcoming fall semester and will involve microcosms that contain different combinations of jumping worms and European worms. These combinations will help us quantify the effects of European worms on soil, the effects that jumping worms have on soil, and if these two groups can live together. By better understanding these differences, we can determine if jumping worm invasion and spread throughout the Northeast will have negative impacts on the surrounding environment, or if their impact will be similar to that of European earthworms. I plan to add water to the microcosms and then collect it as it drains and analyze it to understand the changes in nutrient retention of the soil in the microcosms

Research Fellow: Frankie McLaughlin (2024) **Concentration:** Biochemistry

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

Title of Project: Enolate Alkylation Approach Toward Tn Antigen Analog

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

Project Summary:

In a healthy cell, a complex chain of sugars attach to proteins on the exterior of the cell surface. These complex sugars are produced from the glycosylation process, however, in cancer cells, the glycosylation process is hindered. Therefore cancer cells have much simpler glycoprotein structures, one example being Tn Antigen (Figure 1). Because Tn Antigen is frequently present in cancer cells, it is a sought after molecule to synthetically produce for immunological research, however, its ability to generate a response from the immune system is weak. The goal of the Nolen Lab is to synthesize an analog of Tn Antigen (Figure 2) such that it is metabolically stable and able to mimic the conformational preferences of Tn Antigen. Preparation of this mimic will provide a tool to test how the immune system responds to cancer cells.

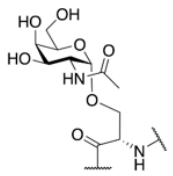


Figure 1: Tn Antigen

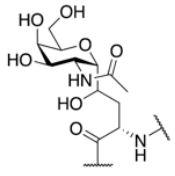
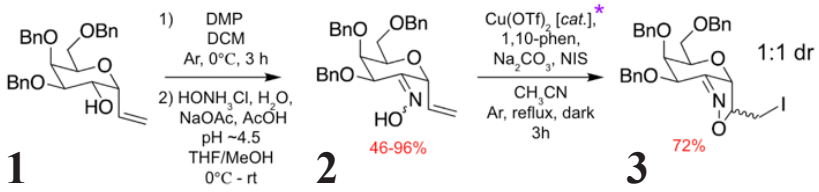
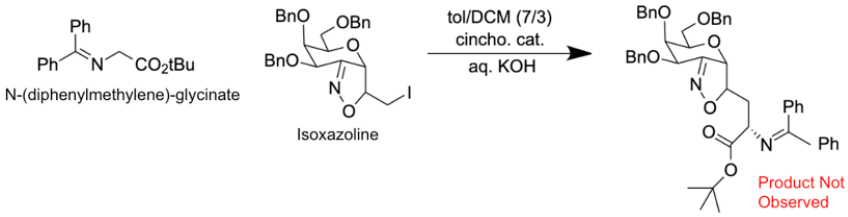


Figure 2: Tn Antigen Analog

Scheme 1 represents the sequence of reactions carried out to produce Isoxazoline from the alcohol. At first, the alcohol 1 is oxidized with DMP and converted into an oxime 2 with the following carbonyl addition. The oxime 2 was converted in the isoxazoline iodide 3 in good yield to give a 1:1 mixture of separable diastereomers using a copper (II) catalyst-mediated radical mechanism.



Scheme 2 represents the enolate chemistry which should take place where the enolate Ion present in the glycinate undergoes an SN2 rxn and acts as a nucleophile to attack the carbon bound to the iodine, which will act as a leaving group. The reaction was determined to be inert, as the isoxazoline iodide 3 and starting material was all that was in the product. The reaction is inert because of the steric hindrance from the bulky isoxazoline iodide 3.



Although the Nolen Group was not able to produce isoxazoline, its sterically hindered primary carbon renders the enolate ion SN2 rxn with glycinate inert. Following this setback, the group has been diverted toward a different synthetic approach to produce Tn Antigen analog.

Research Fellow: **Morgan McMahon (2025)** **Concentration:** **Undeclared**
Faculty Mentor: **Julie Dudrick** **Department:** **Upstate Institute**
Title of Project: **Village of Hamilton Government Operations**
Funding Source: **Upstate Institute**
Project Summary:

I had the opportunity to work in the Village Office this summer as a Field School Fellow with the Upstate Institute. My goal for this project was to learn more about municipal government operations. Many political science courses focus on state and federal government operations. In contrast, this Fellowship allowed me to learn about the many similarities and differences that local government has with state and federal operations. With a population of about 2,000, which increases to over 5,000 when Colgate students are in town, Hamilton functions like a small city. I did a lot of work with the utility billing process, something that is unique to Hamilton, as they provide all utilities (water, gas, and electric) to village residents and businesses. In attending various staff and board meetings, I was able to understand issues that the Village is currently dealing with. For example, the Village is examining policies regarding short-term rental usage, such as AirBnB listings, within the Village. The codes enforcement office plays a large role in enforcing all New York State and local laws regarding all building permits, demolitions, and renovations. I was able to learn about these respective processes and the role of the planning board and the zoning board of appeals, two committees of community members that are responsible for approving many new projects in the community.

The Village of Hamilton maintains many departments, such as its own police force, fire department, airport/airpark, public works, natural gas, wastewater, and electric. In addition to the planning board and zoning board of appeals, other commissions include the municipal utility commission (MUC), recreation commission, Fourth of July committee, tree committee, airpark-airport commission, historical commission, and the library board of trustees. These committees are all composed of community members and meet once a month or as needed. The residents of the village elect a mayor and four trustees, each of which serves for a term of two years. The village clerk is in charge of the supervision and operation of the village office, while the village treasurer is tasked with maintaining accurate records of all financial transactions that involve the village and village personnel. The Director of village operations oversees the MUC and works closely with the electric, water, and sewer departments. The village administrator has to provide economic and efficient direction, coordination, and control of the day-to-day activities of the village.

The biggest takeaway from the work I did with the village office is how many people it takes to run a small municipality like Hamilton. From the outside looking in, many people are unaware of the teamwork and resources required to make this operation go smoothly.

Research Fellow: Tiasia McMillan (2024) **Concentration: Sociology**
Faculty Mentor: Julie Dudrick **Department: Upstate Institute**
Title of Project: LIRS and Community Sponsorship
Funding Source: Upstate Institute
Project Summary:

The organization I worked with this summer as a Field School Fellow is The Center in Utica. The Center, formerly known as the Mohawk Valley Resource Center for Refugees, helps to assist refugees in the integration process into the community while providing the necessary resources. Some of these resources include housing, English tutoring, immigration services, healthcare access, driver's license access, and other resources that may be necessary for their arrival in the United States.

My project for this summer was focusing on research on the Lutheran Immigration and Refugee Service (LIRS) Community Sponsorship Program. LIRS is a faith-based nonprofit organization that provides support for refugees entering the United States. It is one of the nine resettlement agencies that work with the U.S. Department of Health and Human Service's Office of Refugee Resettlement. LIRS has a community sponsorship program called the Circle of Welcome, which involves the local community in the resettlement process. The Circle of Welcome program will help to raise money for refugee services and will help resettled refugees navigate these resources. This will be done with the help of the surrounding community, by giving community organizations the opportunity to co-sponsor or support a refugee family.

Additionally, I have also been collecting information on other community sponsorship programs that The Center could consider, such as the Church World Services (CWS), which is another of the nine organizations that work with the Office of Refugee Resettlement. Bringing a sponsorship program such as one of these will help the refugee community access important and necessary resources. The result of my research project will be a presentation, available for the community, that will explain in further detail what being a community sponsor entails — as well as the impacts and benefits of this action.

In addition to the research portion of my project, I was able to get a more hands-on experience at the Center. Some activities I have participated in include organizing donation boxes, English tutoring, putting up flyers around the community, running the front desk service, setting up an apartment for a resettled family, and many more engaging, interesting opportunities.

Research Fellow: **Jordy Medina (2023)** **Concentration:** **Political Science**

Faculty Mentor: **Juan Fernando Ibarra Del Cueto** **Department:** **Political Science**

Title of Project: **State-Building, Violence, and Indigeneity**

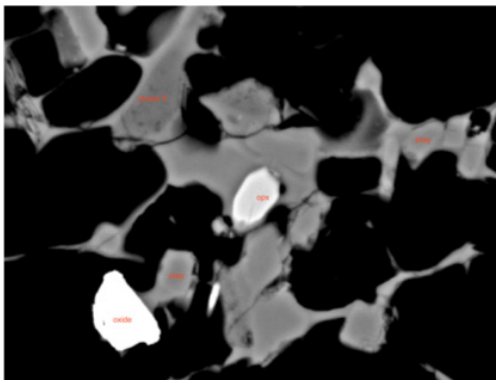
Funding Source: **Walter Broughton '63 Research Fund**

Project Summary:

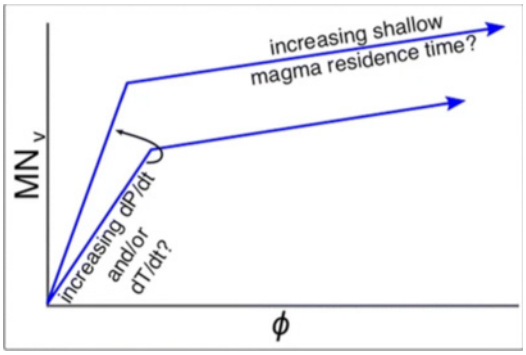
The growing levels of political and even military mobilization from the EZLN in contemporary Mexican politics bear witness to the centuries-long contentious relationship between Chiapas' indigenous communities and the nation-state. Economic sophistication, technological advancements, and the internationalization of the productive structures of the Mexican state have placed significant pressure on indigenous communities that struggle to retain traditional modes of subsistence amid globalization. Despite a context of rising levels of growth, Mexico exhibits an uneven distribution of well-being which invites us to inquire whether the country reaps the benefits of modernity at the expense of the suffering cultural and social dislocation of indigenous communities. In this essay, I will attempt to postulate that the modern nation-state is not an agent conducive to the redress of historical inequalities. In order to accomplish this, I will establish that the Criollo ideological monopoly in the articulation and execution of nation-building had marginalizing and disempowering effects on indigenous communities, resulting in their political abnegation and social invisibility. This enterprise argues further that the"illiberal" homogenizing, neutralizing, and totalizing tendencies of Criollo cultural and intellectual domination survive in the country's revolutionary episodes. Consequently, ameliorating the conditions of indigenous communities in terms that are insensitive to the cultural particularity of these communities. I advance the thesis that the universalism preached by Mexican liberal statesmen and progressive revolutionaries fails to live up to its expectations. Because liberal universalism is an intellectual tradition that is historically and culturally situated in Enlightenment Europe and its universalization is predicated on the domestication or neutralization of intellectual and cultural traditions that challenge its monopoly of legitimacy. To conclude, I review the EZLN's demands to the national government to contend that the project of the nation is incomplete and that the Chiapanecan imaginary is rich in conceptual resources to theorize a transition into a pluriversal state and politics that enhance the democratic agency of indigenous communities while honoring their alternative civilizational aims.

Research Fellow: **Abigail Melican (2023)** **Concentration:** **Geology**
Faculty Mentor: **Alison Koleszar** **Department:** **Geology**
Title of Project: **Main Drivers of Explosivity on Augustine Volcano**
Funding Source: **Doug Rankin '53 Endowment - Geology Research**
Project Summary:

My research project seeks to identify the similarities and differences in eruptive style between Tephra B and Tephra M at Augustine Volcano, which correspond to eruptions 400 and 800 years ago respectively.



Through analyzing both geochemical and physical properties of tephra, including the number density of small crystals called microlites, comparisons across and within eruptions can be made about explosivity. Microlites are crystals that are less than 30 microns (large crystals are classified as phenocrysts). Microlites grow during rapid magma ascent whereas phenocrysts are indicative of slow ascent as the crystals had more time to grow. Quantifying the number density of microlites in pumice, and geochemically characterizing the tephra components that contain them, will help to understand the driving factors of explosivity in these pre-contact (pre-1741CE) eruptions.



The most recent eruption at Augustine in 2006 has been the focus of very detailed studies (e.g Benage et al. 2021; USGS, 2010), but much less is known about Augustine's older, more explosive eruptions. This project builds off of the techniques used to investigate the 2006 eruption and will compare the 2006 eruption to Tephras B and M, two critically important explosive eruptions at Augustine. My work includes geochemical characterization of eruptive materials using XRF, and BSE imaging to quantify microlite number density. Crystallization patterns of these two eruptions might provide insight into the magma systems of Augustine, as microlite populations correlate with temperature and pressure gradients of magma ascent along with the composition of the magma (Benage et al. 2021). I anticipate that microlite number density will be higher in low silica magmas compared to high silica because more viscous magmas may ascend more quickly. This investigation that combines the physical and geochemical study of two Augustine eruptions can help elucidate the main drivers of explosive eruptions at Augustine and similar volcanoes. The implications of this research are far-reaching, and can be applied to better understand other intermediate arc magma systems both in the Aleutian Arc and around the world. Increased knowledge about what makes volcanoes explosive and the magmas that drive them can help to mitigate risks for an eruption in the future.

Image 1: BSE imaging at 500X scale, the width of the image is 50µm., of Tephra B showing plagioclase microlites, accompanied by other components seen in thin sections.

Image 2: Microlite number density increases with decompression rates during magma ascent (image from Benage et al. 2021).

Research Fellow: **Phoebe Metzger-Levitt (2023)** **Concentrations:** **Peace & Conflict Studies; Russian & Eurasian Studies**

Faculty Mentor: **Daniel Monk** **Departments:** **Geography; Peace and Conflict Studies**

Title of Project: **The History of Ukrainian Refugees and the Implications of their National Recognition**

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

Project Summary:

A population displacement like the modern Ukrainian refugee crisis has not occurred on the European continent since WWII. Now, no one would doubt the refugee status of Ukrainians fleeing the Russian invasion. However, the recognition of Ukrainian refugees today is largely tied to the first international recognition of the Ukrainian nationality. The Ukrainian nation was first acknowledged, on an international scale, by the International Refugee Organization in 1948. Yet, Ukrainian national identity long preceded its recognition. In this article, I study the development of the Ukrainian nation from 1848 through the aftermath of the Second World War. National projects in Western Ukraine, specifically Ukrainian Galicia, fostered the notion of a distinct Ukrainian nation and the possibility of a Ukrainian state. The idea of Ukrainian nationality was affected by territorial/border disputes in Western Ukraine and displacement during WWII. A large fraction of this population refused repatriation to the Soviet Union following WWII, forcing international actors to find a solution for this displaced group. To resettle this population, the International Refugee Organization legally acknowledged Ukrainian nationality and its refugee status. Although this recognition did not result in Ukrainian sovereignty or statehood, it allowed for Ukrainians to distinguish themselves from their Soviet citizenship. Now, Ukrainians have both Ukrainian citizenship and nationality, leaving no ambiguity in their refugee status. But before the continuity of the Ukrainian state and the Ukrainian nation, Ukrainian nationality was acknowledged by the international community to account for Ukrainian refugees after WWII.

Research Fellow: **Sarah Miller (2024)** **Concentration:** **Physics**
Faculty Mentor: **Ken Segall** **Department:** **Physics and Astronomy**
Title of Project: **Kuramoto Model Frequency Synchronization in Coupled Josephson Junction Array**
Funding Source: **NASC Division**
Project Summary:

Synchronization is a phenomenon observed in nature in which a system of individuals converge to a common state. Josephson Junctions (JJs) are superconducting circuit elements that individually oscillate at their own natural frequencies according to their size. When coupled, JJs form a system of coupled oscillators that can experience synchronization according to the Local Kuramoto Model. The Local Kuramoto model predicts how a system of coupled oscillators will synchronize and predicts their bifurcations based upon the junction's natural frequency and the frequency of its immediate neighbors.

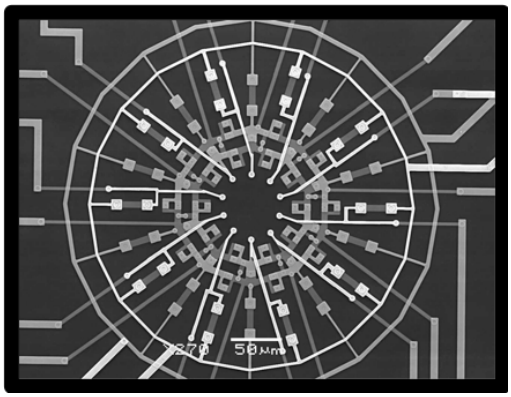


Figure 1. SEM image of sync chip

We were able to observe the synchronization and desynchronization of a 10 junction coupled array through simulations and experiments. In this array, each junction varied in size and was coupled to its neighbors using SQUIDS. Using WR Spice software we modeled and tested this design by changing the input current and measuring the average voltages of each junction to gauge the frequency that they are oscillating at. In this, we kept the coupling between the junctions constant and drove the system with increasing input current.

We experimentally tested the chip by keeping the coupling constant through a constant magnetic field and driving the system by increasing the input current. By collecting the IV curve of each junction we can see how and when they synchronize and desynchronize. In doing so, we hypothesize that the bifurcations in synchronization are influenced by modes of the coupling matrix and Kuramoto-type effects.

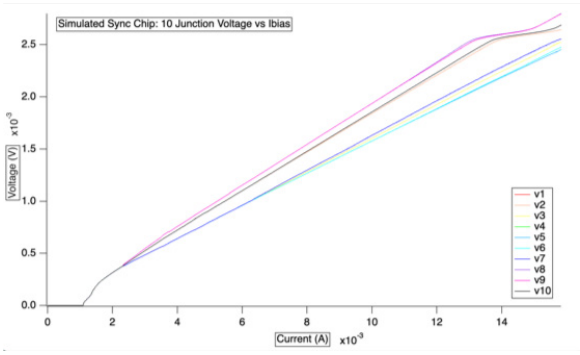


Figure 2. Simulated Sync Chip IV graph

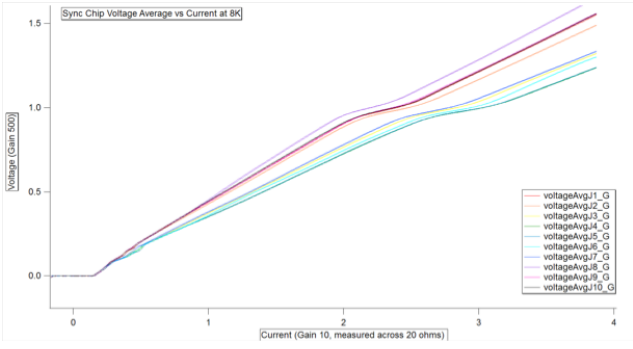


Figure 3. Experimental Sync Chip IV graph

Research Fellow: **Ariel Missaghieh (2024)** **Concentration:** **Molecular Biology**

Faculty Mentor: **Priscilla Van Wynsberghe** **Department:** **Biology**

Title of Project: **Kinase 20 and its Impact on the LIN-42 Period Protein**

Funding Source: **National Institutes of Health**

Project Summary:

Many of the genes and proteins found in the molecular clock of Drosophila are conserved in *C. elegans*. The Period (PER) protein in Drosophila is homologous to LIN-42 in nematodes, and doubletime (DBT) is homologous to KIN-20. Doubletime is known to phosphorylate Period in the cytoplasm leading to its degradation. This mechanism is part of the circadian clock which regulates physical, mental, and behavioral changes that follow a 24 hr cycle and respond primarily to light and dark. This allows organisms to adapt to and predict environmental changes so as to optimize physiology and behavior

The CLOCK (CLK) and CYCLE (CYC) proteins activate transcription of the repressor genes period (PER) and timeless (TIM) during the day. Accumulated PER and TIM proteins repress the transcriptional activity of CLK-CYC in the late night/early morning. Phosphorylation of PER by DBT (CK1ε) destabilizes it, an effect that is countered by TIM expression in the early night. Entrainment of the loop to light involves degradation of the TIM protein in response to signals transmitted by the cryptochrome (CRY) photoreceptor.

Western blotting and timepoint assays were conducted to look at the levels of LIN-42 through a 12-28 hour time course for L4 stage nematodes. A blot was run to determine if the presence of LIN-42 was consistent with the presence of LIN-42 found by students before. Only LIN-42b is being picked up and not LIN-42c even though PVW1 picks up the N-terminus for LIN-42b and LIN-42C. Usually, LIN-42 is seen cycling almost like it is following the circadian clock. Prior data suggested that when LIN-42 is not present it shows that KIN-20 is properly degrading LIN-42 through phosphorylation. There appears to be a relationship between KIN-20 and LIN-42 since in the functional KIN-20, levels of LIN-42 are cycling, but in the mutant KIN-20, levels of LIN-42 are constant and no cycling is observed.

KIN-20 is hypothesized to degrade the LIN-42 protein since the presence of protein is seen to cycle from the western blot. In nematodes, it is also hypothesized that KIN-20 mutation also fails to phosphorylate LIN-42 thus failing to degrade it. The purpose of this research is to see if the relationship between LIN-42 and KIN-20 are consistent with their homologs found in Drosophila. In the future, I would be interested in using a PF-670462 drug, a casein kinase inhibitor that targets KIN-20. It would be interesting to see how levels of LIN-42 for a timepoint are affected when KIN-20 is nonfunctional and if degradation in LIN-42 is still observed and at what times.

Research Fellow: **Marisa Modugno (2022)** **Concentration:** **Peace and Conflict Studies**

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

Title of Project: **Chenango County Historical Society & Museum: Creating an Oral History Project**

Funding Source: **Upstate Institute**

Project Summary:

The Chenango County Historical Society (CCHS) is dedicated to leading and supporting the advancement of research, education, and enjoyment of the history of Chenango County. CCHS is located in Norwich, New York, about 25 miles south of Colgate University. CCHS serves the people of Chenango County as well as neighboring counties and visitors to the area. They serve their audience by creating exhibits, hosting events, and publishing articles related to the history of Chenango County. CCHS serves a very rural community in central New York. They are dedicated to facilitating and promoting the access and enjoyment of the history of Chenango County.

This summer, as a Field School Fellow for the Upstate Institute partnered with CCHS, I managed the pilot launch of an oral history project called Chenango Stories. Chenango Stories collects and organizes audio stories and related photographs from Chenango County community members. This first phase of the project focuses on collecting stories celebrating the 175th anniversary of the Chenango County Fair. I designed a logo, created a website, recruited storytellers, and recorded stories. I collaborated with another nonprofit, OurStoryBridge, an organization that helps people at cultural institutions set up and manage oral history projects. The project launched alongside an exhibit about the Fair on August 5, 2022.

This project fits CCHS's mission as it is all about making history accessible. Stories are perhaps the most traditional mode of recording history. By recording and digitizing oral histories, this project seeks to combine tradition with the modern age. Many museum exhibits are made up of physical artifacts and descriptive text; by also displaying audio stories, the exhibit is more widely accessible to museum visitors. Moreover, the goal of this project is to capture the everyday lives of people in the Chenango county community, therefore contributing to a history museum exhibit is also more accessible.

Research Fellows: **Wael Mohamed (2024)** **Concentration: Computer Science**
Cole Ventresca (2023) **Concentration: Computer Science**

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

Title of Project: **Machine learning analyses to identify circadian-related genotypes predictive of anxiety**

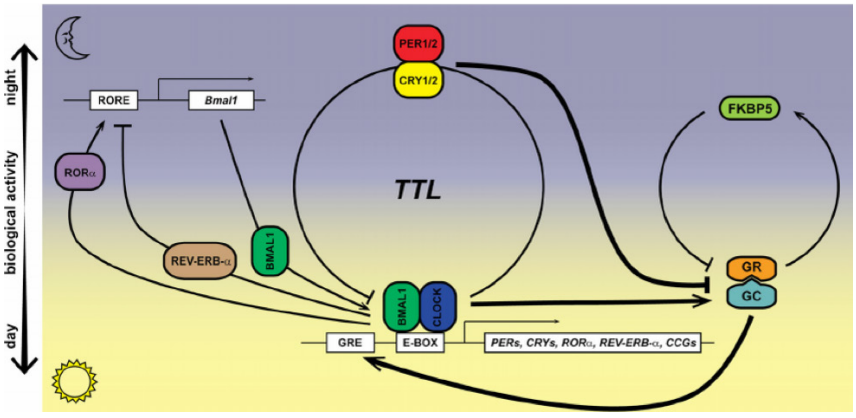
Funding Source: **Michael J. Wolk '60 Heart Foundation**

Project Summary:

For the summer, our team has worked to tease apart the nature of General Anxiety Disorder (GAD) using clinical and genetic data from nearly 500,000 40- through 69-year-old individuals within the UK Biobank, one of the world's largest and most comprehensive bioinformatics research databases. Combining a variety of statistical, networking, clustering, and machine learning techniques, we have analyzed the impact of 8 SNPs with known associations to chronotype (the body's ideal sleep regimen) on the risk of developing GAD by middle age.

In concurrence with the existing literature, we found that females were more likely to develop GAD. Additionally, our methodology yielded the expected results concerning the other non-genetic controls implemented in our study, including the Townsend Deprivation index, income, drug use, and age, confirming that our methodology was sound.

Our analyses indicate that the SNP combination of ZBTB20 homozygous in the T allele and CRY2 heterozygous in the A and G alleles is a risk factor in females but not males. Conversely, the SNP combination of PER3B homozygous in the G allele and ZBTB20 homozygous in the T allele is a risk factor for males but not females. Across males and females, the most commonly appearing SNP is ZBTB20 homozygous in the T allele. However, these results do not support the conclusion that ZBTB20 alone is a significant risk factor as it is present in protective and risk-inducing contexts. Instead, it may function as an activator or repressor when co-occurring with specific SNPs (differing between males and females). Also relevant: previous studies have tied ZBTB20 to Seasonal Affective Disorder [1], whose risk factors overlap with those for GAD. The CLOCK3111 SNPs - GG and, to a lesser extent, AA - appear significantly related to GAD in Males but not females. CLOCK3111 seems to maintain significance when considering males and females together, implying that statistical significance occurs due (in part) to the effect on males being profound enough to yield significant results even when females are present in the analyzed population. The only genes that emerge as individually impactful (to a statistically significant level) when compared with gene combinations - with their inherent information advantage - are PER3C in males and PER2 in females.



[2] In our study, we looked at genes associated with the circadian cycle in humans, including CRY1/2, PER1/2/3, CLOCK, and ZBTB20.

[1] Ho, K.W.D., Han, S., Nielsen, J.V. et al. Genome-wide association study of seasonal affective disorder. Transl Psychiatry 8, 190 (2018). https://doi.org/10.1038/s41398-018-0246-z
[2] Landgraf, Dominic & McCarthy, Michael & Welsh, David. (2014). Circadian Clock and Stress Interactions in the Molecular Biology of Psychiatric Disorders. Current psychiatry reports. 16. 483. 10.1007/s11920-014-0483-7.

Research Fellow: Tessa Mountain (2023) **Concentration:** Environmental Biology

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

Title of Project: Common Loon Monitoring in the Adirondacks: A Stepping Stone for Nest Rafts

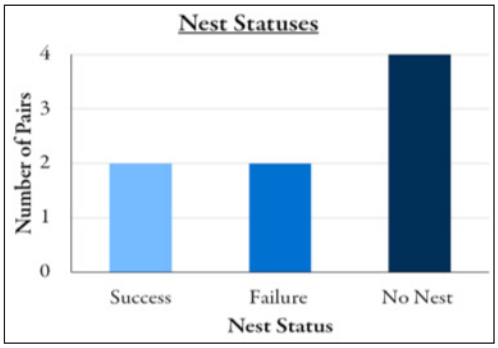
Funding Source: Upstate Institute

Project Summary:

Common loons (Gavia immer) are a unique species of waterbird and a species of special concern in New York State. Loons are a major flagship species of the Adirondacks; everywhere in this park, signs for stores, beaches, cottages, and towns are painted with the images of loons. They're featured on many Adirondack souvenirs, and anyone who lives there, even seasonally, will talk about how much they love these birds. Their bodies are optimized for diving, which includes the position of their legs at the very back of their bodies. This trait, however, makes it impossible for adult loons to walk on land, so they must build their nests directly on the shorelines of lakes. These nests are susceptible to many risks: having the eggs eaten by mammals or bald eagles, being flooded by rising water levels, or being left stranded when the water levels are too low and the parents can no longer access them. In order to help common loons build safer, more successful nests, the Adirondack Center for Loon Conservation is beginning a Nest Raft Program, which will place floating platforms in safe nesting locations. These platforms are more protected from mammals, due to their positions off the mainland, and from eagles, because they have a vegetated roof to hide the nest and the parent sitting on it. They rise and fall with changing water levels to prevent flooding and stranding, and the roof provides shade. Before these platforms can be deployed, however, it is important to get a baseline of how well loons are reproducing without them. Monitoring the loons, by visiting their lakes regularly and searching for their nests, eggs, and chicks, provides information about which pairs of loons need these platforms, and what threats may be most important to defend against.

Over the course of two months this summer, eight common loon territories across six lakes were monitored. Loons are loyal to their territories, and both males and females will return to the same site every summer, barring drastic changes to the site. Each territory was revisited on a weekly basis, and notes were taken concerning the number of loons, the presence of a nest, eggs, or chicks, and the weather conditions. Monitoring was conducted in a kayak, using binoculars to search for loons, nests, and any identifying bands on the legs of the loons.

Of the eight territories, each one had a mated pair of loons. Two of these pairs successfully built nests which hatched one chick each. Two pairs built nests which were then flooded and abandoned, and never attempted to build new nests. Four of the eight pairs were never observed with nests or chicks, suggesting they did not find the shorelines suitable enough to build, or the nests were well hidden and failed.



This data shows that, from a sample of eight, 75% of loons are not producing any offspring. This could be a huge issue for the continued survival of common loons, as each pair only lays one or two eggs each year. However, this information is going to inform nest raft placement and supports the idea that these platforms will benefit loon reproduction, as they should mitigate the flooding risks which caused the failure of half of the observed nests.

Research Fellow: **Leon Nichols (2023)** **Concentration:** **Physics**
Faculty Mentor: **Ken Segall** **Department:** **Physics and Astronomy**
Title of Project: **Neuromorphic Computing with Josephson Junction Neurons**
Funding Source: **NASC Division**
Project Summary:

Josephson Junctions are superconducting circuit components whose behavior can be described by a second-order, non-linear differential equation. This makes them an ideal tool to explore and model complicated systems, such as neurons. This abstract will give background for the study of fluxon dynamics (the behavior of a quantized amount of magnetic flux) in Josephson Junctions arrays and the possibility of demonstrating learning in a neural circuit.

Josephson Junctions can then be arranged into parallel arrays of junctions, where they are physically analogous to a set of coupled, damped, and driven pendula (Fig. 1). When cooled down below TC, current loops in the array can cause fluxons to become trapped between junctions in the array. At a certain current, ISW, or thermal energy level, a fluxon will begin to move around the array and a voltage is detectable. ISW, however, can vary significantly (Fig. 2). It is strongly suspected that this variation is caused by production uncertainty in the size of the junctions, akin to a particle moving over hills of different sizes (Fig. 1). Macroscopic quantum tunneling is also a suspect for these variations.

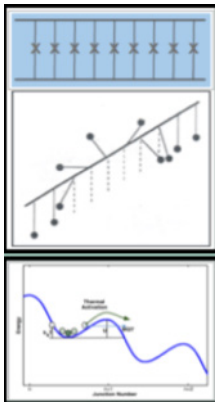


Fig. 1: shows a set of coupled, damped, and driven pendula and hill analogy.

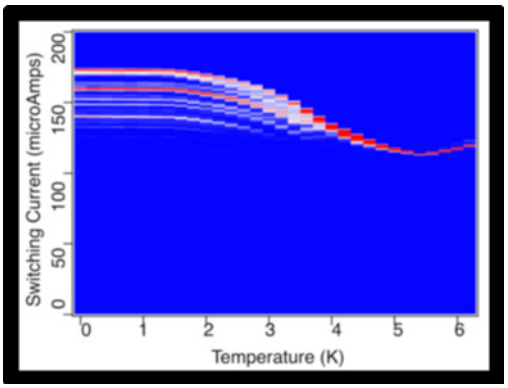


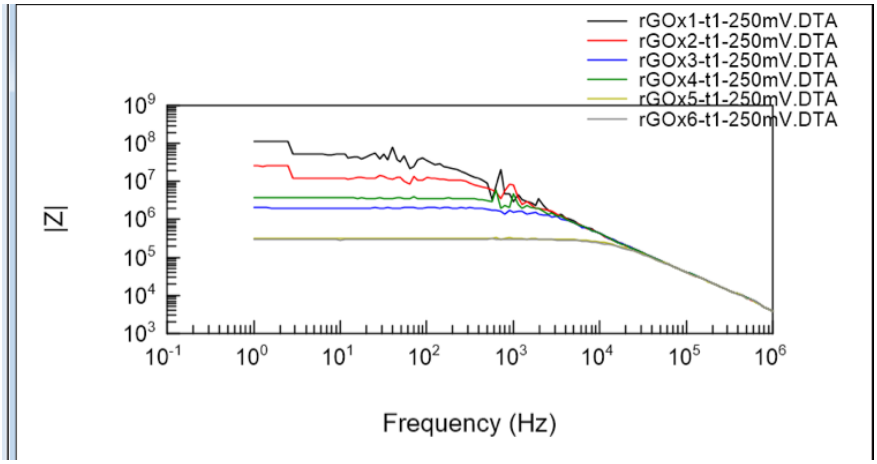
Fig. 2: Shows the variation of I_{SW} and its response to changes in thermal energy.

The demonstration of learning involves splitting artificial neuron spikes down two different “axons” compose of more Josephson Junctions and observing the difference in arrival time of these spikes to a “learning gate” composed of an inductor and a SQUID (Superconducting Quantum Interference Device). What we are able to observe here is called spike-timing-dependent plasticity (if the spikes are close, the coupling strength is increased and vice versa). In simulations, unsupervised learning and pattern recognition have been successfully demonstrated.

Research Fellow: **Hadley Pade (2024)** **Concentration: Physics**
Faculty Mentor: **Isak Isakovic** **Department: Physics and Astronomy**
Ramesh Adhikari **Department: Physics and Astronomy**
Title of Project: **Reduced Graphene Oxide and L-Phenylalanine-PEDOT: PSS Capacitors**
Funding Source: **NASC Division**
Project Summary:

Reduced graphene oxide (RGO) has been an excellent choice as a flexible electrode in capacitors; however, by itself, RGO has a low capacitance, causing it to be incorporated with other conductive materials. During weeks 1-4, I worked with professor Isakovic in studying six samples of RGO: RGOx1, RGOx2, RGOx3, RGOx4, RGOx5, and RGOx6. The last number identifies the number of times we reduced the graphene oxide. Our goal was to determine how the impedance of the RGO changed with the number of times we reduced it. Using electrical impedance spectroscopy (EIS), we measured the impedance of RGO as the frequency of the AC current increased. Initially, our AC current had a voltage of 10mV.

Nyquist Plot of all RGO samples at 250mV:



Researchers in the past have used PEDOT: PSS to create supercapacitors; however, they have combined PEDOT: PSS with other materials to increase conductivity. For weeks 5-8, I worked with Prof. Adhikari to combine a DI water/L-phenylalanine solution with PEDOT: PSS to experiment with the new combination. After coating two pieces of printer paper with the L-phenylalanine / PEDOT: PSS solution, we used them as electrodes with a polyvinyl alcohol / phosphoric acid separator; however, after testing the capacitor with electrical impedance spectroscopy and cyclic voltammetry, we found that it had no capacitance and that it was a resistor. We then attempted to use multi-walled nano-tubes (MWNT) as an electrode with our polyvinyl alcohol / phosphoric acid separator. We prepared a nitric and sulfuric acid wash for the MWNT. We then dipped our printer paper into the MWNT solution and dried it on a hot plate. Using the polyvinyl alcohol / phosphoric acid, we connected two pieces of MWNT-coated printer paper; however, after drying it overnight, cyclic voltammetry showed that it was a resistor.

Research Fellow: Aranya Pal (2024) **Concentration: Mathematics**

Faculty Mentor: Harvey Sindima **Department: Religion**

Title of Project: A Phenomenological Dive into Durga Puja and its Impact on Bengal Society

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

Project Summary:

Ever since I can remember, my year revolved around the festival of Durga Puja, for my friends and everyone else I knew around me growing up in West Bengal, India, it was the same. I remember the long wait, the month-long preparations, and finally the four-day culmination, every year for the last eighteen years of my life. The mythology behind this festival is very intriguing: the heavens were once threatened by a demon named Mahishasura, who vowed to defeat the gods and take back the drink of immortality from them and distribute it among the demons. Responsibility to battle this demon fell upon the goddess Parvati, who was then not powerful enough to do so. Thus, 9 gods gave Parvati their weapons, and she thus transformed into the 10 handed avatar that is worshiped as Durga. Durga then, after a long battle, managed to defeat and kill Mahishasura. During Durga Puja, Durga and her four children, two sons and two daughters, are envisioned returning to Earth to spend time in her ancestral home. All through my life, while I have been fascinated by this story and madly in love with the festival and seen the same with everyone around me, I have never stopped to question myself why. So, this summer, I delved into that very question, the question of how and why is the Durga Puja so dear to the people of West Bengal?

In the beginning, I had believed that the answer lies in history, and that the research was in essence a literature analysis to be done in a library. However, with the help of my advisor, I realized that it was far more valuable to focus on 'lived experience' instead to truly decipher how the Puja affects the lives of the residents of Bengal. So, we decided that I would go back home and interview individuals who have been involved with the Puja throughout their lives. Finding people to interview wasn't easy, as I wanted to interview both men and women with varied experience, who had been involved with the Puja for a long time now. With a lot of asking around, and with the assistance of my parents I was able to, however, find a suitable group of people which included senior priests, religious gurus, community leaders, and family heads. Thinking back, it is incredible how lucky I was that this group of men and women agreed to speak to a college student like me, and every interview was riveting and packed with new information.

Every person I interviewed brought a unique point of view to my research, some emphasized the communal component of the Puja: When I asked Mrs. Priti Ghosh when was last time she saw her full family, she replied "We all congregate at the Durga Puja in our village, everyone, including my nephew and nieces living abroad always come back." This festival brought people together, and through repetition of traditions through the years, made them feel as if they were returning to their mother's lap at least for those four days. Some others emphasized the importance of the spiritual experience: Mr. Somesh Acharya, the priest whose Puja I had grown up seeing, said "During the night of the 3rd day, while performing the joga, I feel like I am not in control anymore, it is as if a greater power is guiding me." While some others still, such as Mr. Rudra Mukherjee, head of other Mukherjee family, explained to me how the rituals mirror life itself. This made me realize something crucial: the Puja connected the spiritual to the mundane, elevating our daily experiences and making us feel connected to a greater reality.

The Durga Puja is central to the existence of West Bengal and its residents. Throughout history Bengalis have not had an easy time, and this festival elevates their life for four days to a different plane, where family and friends come together to celebrate, and everyone participates in a communal spiritual experience. Through this it informs familial and social structures and sculpts our behavior and common psyche to a degree. This project was certainly illuminating in its lessons, but there is far more scope in discovering the depth of the impact of this Puja, and I hope that I can continue this, or someone else will further our understanding of this elusive yet massively impactful phenomenon.

Research Fellow: **Cameron Patrick (2022)** **Concentrations:** **Molecular Biology; Anthropology**

Faculty Mentor: **Fernando Diaz Gonzalez** **Department:** **Biology**

Title of Project: **Transcriptomic Analysis of Thermal Plasticity and Heat Shock Response in Ecologically Distinct Populations of *D. mojavensis***

Funding Source: **NASC Division**

Project Summary:

Environmental temperature is often considered the "master abiotic factor" for organisms due to its effect on physical and biochemical processes. Thermal plasticity is the organism's capacity to overcome thermal stress and can involve behavioral and physiological changes with alterations in gene expression (Rodrigues et al., 2020), typically known as the heat shock response. Heat stress results in the upregulation of protease enzymes and molecular chaperones to ensure proper protein folding (Le Breton et al., 2016). While the general heat shock response is highly conserved across taxa, understanding differences in gene expression levels across developmental stages and populations is imperative to understanding the genomic bases and evolution of thermal plasticity.

The cactophilic Drosophila system and *D. mojavensis* have recently gained traction as model organisms for population genomics and transcriptomic studies, as there are four ecologically distinct sub-populations across the American Southwest and Mexico (Allan et al., 2019). To assess transcriptomic responses due to heat exposure, we analyzed RNA-Seq data of adult and larval samples from each population following thermal exposures at 36°C and 25°C. For this, we quantified genome-wide differential expression changes (DE) in adults and larvae across populations, and performed functional analyses of onthology categories associated with these genes.

We found that the number of thermally responsive DE genes is substantially higher and more conserved across populations in larvae than adults (296 vs 28 genes, respectively). The functional analysis showcases different ontology categories for DE genes in adults and larvae (figure not included). Adult samples are associated with protein refolding and chaperone-mediated protein refolding, while larvae have a wider range of biological functions, such as proteolysis, and structural constituents of the cuticle. These results raise further questions about differential heat shock response between larvae and adults and population level differences in biological pathways. Further directions for this project may include comparing the level of DE in protein folding genes and genome-level molecular evolution analysis to investigate the relationship between transcriptional plasticity with sequence evolution.

Figure 1. Venn diagrams show significant DE genes in response to heat stress in adults and larvae for each population in *D. mojavensis*.

Research Fellow: **Kailey Paul (2023)** **Concentration: Natural Sciences**

Faculty Mentor: **Ana Jimenez** **Department: Biology**

Title of Project: **How do dogs of different body masses, ages, and coats regulate body temperature before and after exercise across different seasons?**

Funding Source: **NASC Division**

Project Summary:

Domestic dogs have been demonstrated to be versatile yet hard to predict with respect to basic physiological mechanisms. For example, there is a positive correlation between body mass and whole-animal metabolism but a negative relationship between body mass and lifespan in dogs. Additionally, essential physiological mechanisms in domestic dogs, such as the relationships between thermal relations and body size and age, remain poorly understood. In this study, we looked at temperature regulation in dogs of different sizes, ages, coat types, and head morphologies across three different seasons. We used tympanic membrane temperatures (Tear) and thermal imaging to observe temperature regulation in pet dogs before and after an exercise trial. Using network analysis, we found that body mass was among the most central features for spring and summer trials, but not for the winter trials. Similarly, leg length, snout length, and paw width were the central predictors in two of the three seasons. Mediation analysis demonstrated that nose and snout length act as significant mediators of the effects of body mass on mouth temperatures in the spring. For the summer trials, nose length and paw width significantly mediated the effect of body mass on mouth temperatures. Age, however, does not seem to be a major determinant of thermoregulation in dogs according to best subset models. A cross-seasonal examination of repeated measurements showed that mouth temperature heat dissipation rates decreased with increasing temperature and humidity. Overall, our findings support our hypothesis that Tear and heat dissipation rates are positively correlated with body mass in dogs, thus, negatively correlated with mass-specific metabolism. This finding suggests that small dogs allocate a bigger proportion of their metabolism to "inefficiencies" of heat production to offset greater heat loss.

Research Fellow: Jillian Paulin (2023) **Concentrations:** Astronomy; Physics

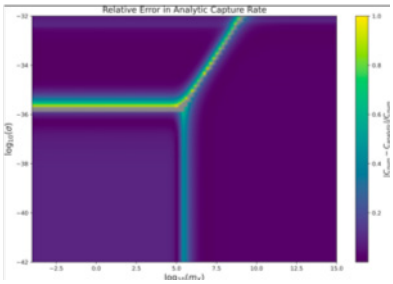
Faculty Mentor: Cosmin Ilie **Department:** Physics and Astronomy

Title of Project: Developing a General Expression for the Capture Rate of Dark Matter in Celestial Bodies

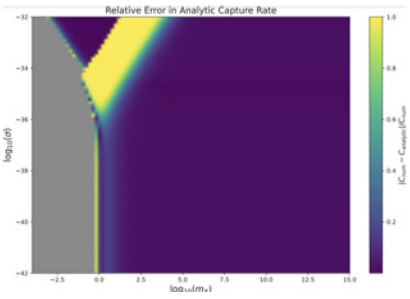
Funding Source: Justus '43 and Jayne Schlichting Student Research Fund

Project Summary:

One of the most intriguing puzzles in modern cosmology is the nature of dark matter (DM). Various observations, including data from the Cosmic Microwave Background radiation, have helped us to determine that 25% of the universe's energy exists in the form of DM. In comparison, 70% of the universe is dark energy (the component responsible for the accelerating expansion of the universe), and everything we can see and touch makes up the remaining 5%. One of the only characteristics that has reached consensus is that DM only interacts via the gravitational force with "normal", or baryonic, matter. As there is still so much to learn, the DM problem is presently attacked on all sides: via direct detection experiments, indirect detection observations, and particle production. In this project, our main focus was indirect detection with celestial bodies. Stars and planets are surrounded by some amount of DM, and ambient DM particles can be captured in these objects after scattering off the baryonic matter. Once inside the object, DM particles may annihilate, depositing energy and possibly creating observable effects through heating, which would increase the object's luminosity. Just knowing the contribution of DM to the luminosity of an object would allow us to constrain important properties of DM, such as the cross section of interaction, which describes the likelihood of DM particles to interact with each other.



In previous work, expressions for the total capture rate of DM were developed and validated in four distinct regimes of parameter space, as shown in the figure on the left. When the plot is purple, this means the numerical result matches the analytical expressions, thus validating the analytical expressions. The separations between these regimes lie along places in parameter space where values called *k* (the product of the ratio between DM masses and the ratio between both the escape velocity and dispersion velocity), τ (the optical depth of the object), or the product of the two equals 1. In previous calculations, it has been assumed that the escape velocity of the capturing object is much greater than the dispersion velocity of ambient DM particles. While this is certainly a valid assumption for Population III stars, for instance, this is not valid for all objects. As such, in this project, I examined a more general scenario, in which there is no obvious velocity hierarchy; additionally, I examined the opposite scenario, in which the escape velocity of the capturing object is much smaller than the DM dispersion velocity. Such would be the case when examining exoplanets, for instance; this is an extremely important question to consider especially given the rise of new data from the James Webb Space Telescope. After many careful derivations, both by hand and using Mathematica, I was unable to completely validate these new expressions, as shown in the figure on the right; note once again that the approximation is valid wherever the region is purple. In sum, this project needs further work to find and fix the existing errors before actually validating and using the results. However, once these issues are resolved, these more general expressions will be useful, especially when examining possible constraints on DM properties taken from observations of exoplanets.



Research Fellow: **Zack Pelland (2023)** **Concentration:** **Neuroscience**

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

Title of Project: **Investigation of the Effects of Head Impacts on the Gut Microbiome Among Collegiate Football Players**

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

Project Summary:

The gut microbiome is the community of microbes (and their genomes) that live within our gastrointestinal (GI) tracts. An enormous amount of information is held in these gut microbes as they contain an estimated 150 times more genes than the entire human genome. Additionally, the gut and the brain are extraordinarily connected: up to 600 million neurons innervate our GI tracts, roughly equal to the number of neurons in our spinal cords. This vast network between the gut and the brain allows for extensive, bidirectional communication between the brain, the gut, and other peripheral systems. Recent research demonstrates a link between changes in the gut microbiome and many health conditions which is likely due to the connection between the gut and the whole body—this includes psychological and neurological conditions such as depression, anxiety, Alzheimer's disease, and, importantly, traumatic brain injuries (TBIs). TBIs occur when there is blunt trauma between the brain and cranium which either direct collisions or indirect jerking can cause, so TBIs are co during high-impact activities such as American Football. Few human studies have been published that investigate the link between TBIs and the gut microbiome. However, in animal models, inducing moderate TBIs consistently leads to changes in the gut microbiome, and the magnitude of these changes correlates with the severity of the brain injury.

To investigate links between head impacts and the composition of the human gut microbiome, we are carrying out a longitudinal study that will analyze both. During the fall 2022 football season, approximately 15 Colgate University varsity football players will collect daily stool samples for microbiome analysis, have their head impact data tracked by on-field impact monitors, take cognitive and balance assessments, and take daily assessments that monitor factors that confound with brain injuries and/or the gut microbiome such as stress, sleep, diet, and physical activity. The daily stool samples we collect will allow us to profile the gut bacterial community on any given day, and the on-field head impact monitors will record the number, location, and severity of head impacts sustained during practices and games. We will analyze these data for patterns such as correlations between head trauma and changes in participants' gut microbiomes. For example, participants' gut microbiomes might consistently change in the days following a heavy dose of head trauma and subsequently return to baseline when participants do not experience any head trauma.

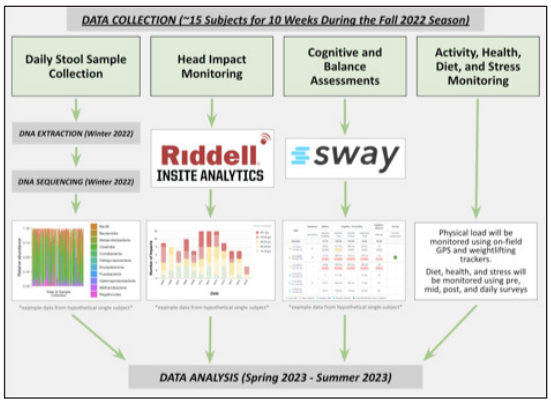


Figure I: Outline of Methods

As we begin to understand the relationship between head impacts and the gut microbiome, these data may eventually be able to be used to diagnose and determine the severity of concussions. Notably, a better understanding of the mechanisms underlying this relationship may allow for the development of more effective ways to prevent and treat brain injuries.

Research Fellow: **Facundo Pérez (2024)** **Concentration:** **Astronomy/Physics**

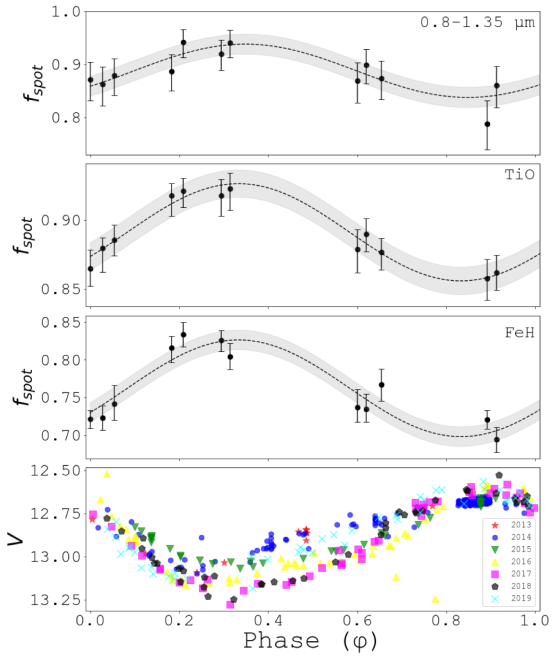
Faculty Mentor: **Jeff Bary** **Department:** **Physics and Astronomy**

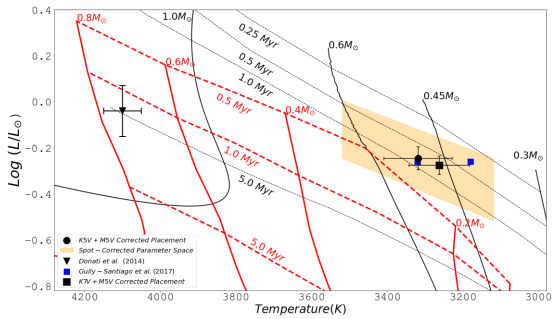
Title of Project: **Correlating Changs in Spot Filling Factors with Stellar Rotation**

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

Project Summary:

Using a multi-epoch near-infrared spectroscopic dataset of three heavily-spotted T Tauri star systems we use empirical composite spectral models to constrain spot filling factors and temperatures. Empirical composite models are created through a weighted sum of two IRTF Spectral Library dwarf standard spectra, a cooler one for the spots and a hotter one for the photosphere, and then fit to each observed stellar spectra using a Markov-Chain Monte-Carlo algorithm. Fits to individual epochs reveal clear variations in filling factors that are correlated with photometric variability. Covering over one full stellar enables us to calculate the total spot coverage of the stars. Knowing this, we revise the HR diagram placement of our sample and obtain new mass and age estimates using traditional unspotted and new spotted evolutionary models. Our results suggest that a failure to account for spots results in mass and age spreads as large as a factor of two. Additionally, analysis of American Association of Variable Star Observers (AAVSO) photometric data reveals evidence for spot evolution on timescales as short as a few years.





Research Fellows: **Jim Perry (2024)** — **Concentrations: Computer Science; Russian & Eurasian Studies**

Will Russel (2024) — **Concentration: Molecular Biology**

Faculty Mentor: **Ahmet Ay** — **Departments: Biology; Math**

Title of Project: **Undernutrition Outcomes in Ethiopian Schoolchildren: A machine learning based risk factor analysis utilizing epidemiological survey data**

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

Project Summary:

Undernutrition is a significant global health problem that threatens the development of children, fostering a vicious cycle of adverse health outcomes that span through generations in affected populations. Amid global declines in undernutrition prevalence, Ethiopia is one of the few regions in Africa where undernutrition continues to be a major public health threat. Thus, the need to implement more effective interventions is of great urgency. Machine learning (ML) has been recognized as a valuable tool in epidemiology as recent studies suggest that ML models may provide more comprehensive analysis than traditional statistical methods. While these studies have examined the feasibility of using ML to classify undernutrition status, researchers have yet to fully explore the potential of feature selection or association rule learning ML methods in relation to risk factor identification. Therefore, we used feature selection and association rule learning in conjunction with traditional logistic regression to identify undernutrition risk factors in the overall population; this same analysis was completed on sex, residency, and age population subsets.

Our results uncovered several interesting benefits of using machine learning analysis to complement traditional logistic regression. We observed increasing age, being female, and having received vaccinations as statistically significant factors associated with undernutrition. Feature selection also identified having a clean school latrine, a larger family, and engaging in nail maintenance as potentially important factors. Association rule learning showed how the co-occurrence of animals with non-hygienic variables was associated with increased odds of undernutrition, demonstrating the ability of this method to discern trends in the data that are otherwise hidden when using traditional logistic regression. Subset analysis revealed that populations of different age, residence, and sex are faced with different significant factors. Our observations suggest the benefits of using feature selection and association rule learning ML methods alongside traditional statistical techniques to better identify risk and protective factors for undernutrition in school-aged children. We also demonstrate the need to analyze different subsections of a population to explore the more complex interactions that determine one's risk for undernutrition. We posit that future research should explore the efficacy of these ML methods in other study populations.

Research Fellow: **Robert Pfeifer (2025)** **Concentration: Undeclared**

Faculty Mentor: **Barry Shain** **Department: Political Science**

Title of Project: **Researching "Revolutionary-era American Pamphlet Literature in Context: a Documentary History, 1764-1776," and "Recent Scholarship Exploring The Federalist, 1787-1788,"**

Funding Source: **SOSC Division**

Project Summary:

The years preceding the commencement of the American Revolutionary War for Independence are widely believed to have consisted of continually escalating tensions between, on the one hand, the colonists who are pigeonholed as a united group of progressive, pro-democratic activists who loathed the British monarchy and were determined to escape its rule and, on the other hand, the colonial puppet governments and the British Empire that were dedicated to enforcing its domination. However, the reality of the situation was considerably more complicated on both sides than the fervent diametrical opposition, which has acquired near mythological status.

The residents of Great Britain's thirteen North American colonies held diverse opinions about the legitimacy of the monarchy and expressed a wide range of beliefs as to what might constitute a successful and equitable relationship with the Crown. These opinions and beliefs were expressed by influential writers and personalities, including, most importantly, the Founding Fathers, who had little if any interest in espousing a united anti-royal position that would place them in armed conflict with those whom many had until recently perceived as benevolent overseers. We researched pamphlets and other primary sources which documented how well-respected individual colonists regularly appealed to the King, expressed their dislike of the British parliament, and even aspired to replicate the British system of government in North America.

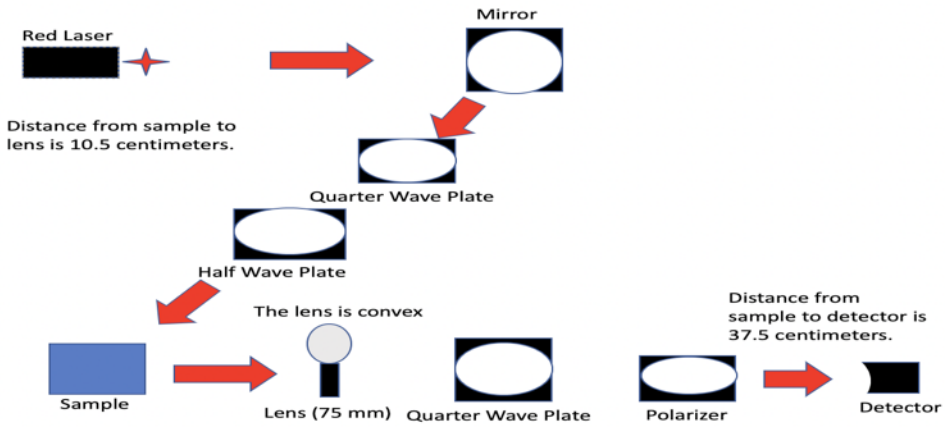
The goal was and continues to be to examine primary documents, especially in the form of the then popular pamphlet literature, in order to coherently present a more accurate and nuanced explanation of American history during the period preceding the American Revolutionary War.

I cataloged pamphlets by British and American authors, both supportive of and against the American colonies. Most of the pamphlets we researched are not available digitally, so much of my work was to format pamphlets so that Professor Shain could edit and eventually build them into a book that tackles the subject in depth. I put pdf scans we found through optical character recognition scans that transcribed them onto word documents and edited them, correcting the flaws to make textual replicas of the original documents. This overall goal of the project is more extensive than could be completed over the summer, and I hope to continue working on it with Professor Shain. I am gratified that the research I was able to undertake over the summer contributed to the creation of newly available resources to help analyze this critical and fascinating period of American history.

Research Fellow: Gabe Pickard (2025) **Concentration:** Undeclared
Faculty Mentors: Enrique Galvez **Department:** Physics and Astronomy
Rebecca Metzler **Department:** Physics and Astronomy
Title of Project: Exploring the structure and composition of the Atlantic Salmon Fish Scale
Funding Source: Volgenau-Wiley Endowed Research Fellowship
Project Summary:

Organisms go through the process of biomineralization which entails the creation of minerals by using the materials found in their respective environment. These biominerals can aid in functions such as protection, motion, cutting and grinding, buoyancy, gravity sensing, and storage. A common biomineral fish use are their scales, which protects them from predators and disease. In our project, we explored the Atlantic Salmon's fish scale which is cycloid: a smooth scale with an outer edge. We wanted to determine the structure and composition of the scale through infrared spectroscopy and polarization of light. When we put it under the infrared spectrometer, we found that the composition of the fish scale was made up of minerals and organics such as hydroxyapatite and collagen.

Polarized light is produced by manipulating the electric field component of the incoming light so that it propagates through space in a specific orientation. We created an optical setup that consisted of our biomineral in question, a red laser beam, a mirror, a convex lens, a quarter wave plate, two half wave plates, a polarizer, a detector, and a light meter. The specific setup looks like this:



We used the set-up to shine polarized light on the biomineral and examine the light that reflected off it. By taking data from the light meter, we were able to compose a Mueller matrix, which specifies how the material changes the polarization. We found that the fish scale changes circularized polarized light in a complex way. We hope to obtain more data in the future to see how the fish scale changes the other forms of polarized light.

Research Fellow: **Miriya Pinkerman (2023)** **Concentration: Physics**
Faculty Mentor: **Ken Segall** **Department: Physics and Astronomy**
Title of Project: **Time Delay in Neural Synapse Learning Circuit with Josephson Junctions**
Funding Source: **NASC Division**
Project Summary:

Many learning circuits incorporate non-linear superconducting quantum devices called Josephson Junctions. The Non-linear nature of JJs enables these neuromorphic computers to process electrical information similar to those within neural networks. This abstract will provide an overview for the research conducted with a learning circuit (containing Josephson Junctions).

Josephson Junctions enable the circuit to provide a neuron-synaptic response when the niobium circuitry is brought to its critical temperature of 9 Kelvin. At this temperature, the niobium wires become superconducting and the magnetic field of the wire changes. By using this change in field and Single Flux Quantum (SFQ) pulses an initial neuron firing can be created. Through the use of Josephson Junctions, part of the circuit imitates an axon. The SFQ pulse reaches other parts of the circuit through the axon or Josephson Transmission Line (JTL) splitters. The bottom JTL and top JTL splitters allow for the pulses to arrive at the circuit separately and thus display synaptic responses to the learning gate. WR Spice simulations were conducted to measure pulsing on a portion of Will Friend's circuit (Fig. 1). In this system the delays in pulses for the top JTL and bottom JTL were measured to determine whether there was a direct proportion of pulses from the input to that of the different JTLs near the learning gate (Fig. 2). After noticing a consistent pulse to pulse pattern, simulations were run on the full circuit and compared with the simulations of a clipped circuit.

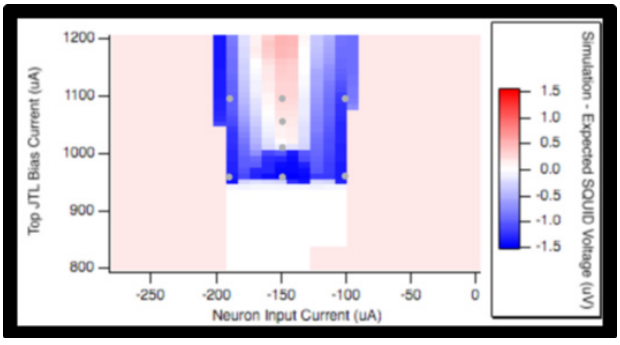


Fig. 1: Shows points in which learning measurements that were completed in order to determine whether learning occurred in the SFQ. The graph above is a simulation of Neuron Input v. Top JTL Bias [1].

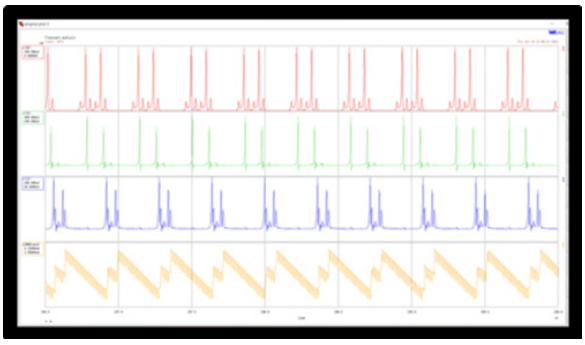


Fig. 2: Displays the result of transient for a Top JTL pulses, Bottom JTL pulses, and learning current with a neuron input current of -150 uA and a Top JTL current of 950 uA.

1. W. Friend, Spike Timing Dependence in Josephson Junction Neuron-Synapse System, thesis, 2021.

Research Fellow: Emma Pizer (2023) **Concentrations:** Computer Science; Mathematics
Faculty Mentor: Georgiana Haldeman **Department:** Computer Science
Title of Project: Code Tracing Visualization Tool for Teaching Time Complexity Analysis of For-Loops to Novice Programmers
Funding Source: Tom and Liz Brackett Endowed Fund for Diversity, Equity, and Inclusion in Computer Science

Project Summary:

It is important that students not only learn to write code that is correct, but also efficient. Therefore, time complexity analysis is an important part in the framework of computer science. Despite this, many introductory courses lack the space or time in their curriculum to teach the intricacies of time complexity analysis. As a result, students often hold fundamental misconceptions about how time complexity analysis works. In particular, many students develop misconceptions related to the analysis of for-loops. Luckily, studies have shown that requiring students to carefully trace code execution step-by-step improves the chances of students analyzing code and computing time complexity successfully. Therefore, we designed a proposal for a code tracing visualization tool for teaching time complexity analysis of for-loops to novice programmers.

Through research, we discovered that very few visualization tools for teaching time complexity analysis exist, and of those, even fewer are geared towards the comprehension level and learning goals of the novice programmer. We then proceeded to brainstorm and create our proposed visualization tool, which is designed as an extension to Visual Studio Code, a popular programming environment for programmers of all abilities. The proposed visualization tool takes a program as input from the user and illustrates the time complexity analysis of the program through the process of tracing. Specifically, the visualization tool focuses on the depiction of for-loop tracing for time complexity analysis using a table, where each column represents a loop variable, and each row represents one iteration of the loop (see Figure 2). As the user navigates through the tracing process via forward and backward buttons, the proposed visualization tool tabulates the program operations in the order that they happen during the execution of the loop. As such, the current line of code being executed is highlighted, while the table information is updated. At the end of the tracing process, the operations in the table are summed in a step-by-step visual process to arrive at the final time complexity of the inputted program. Overall, our proposed visualization tool enables novice programmers to observe the process of time complexity analysis for basic program structures, such as for-loops, while utilizing and enhancing code-tracing skills and limiting the cognitive load to ensure a manageable learning curve for adaptation.

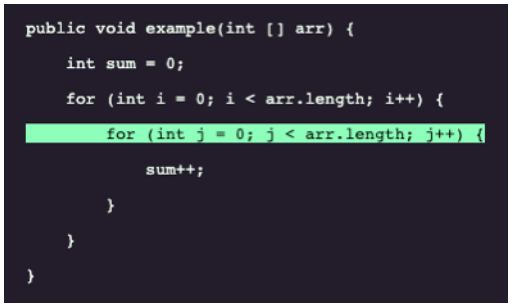


Figure 1. The student's inputted program, with the current line of the tracing execution highlighted.

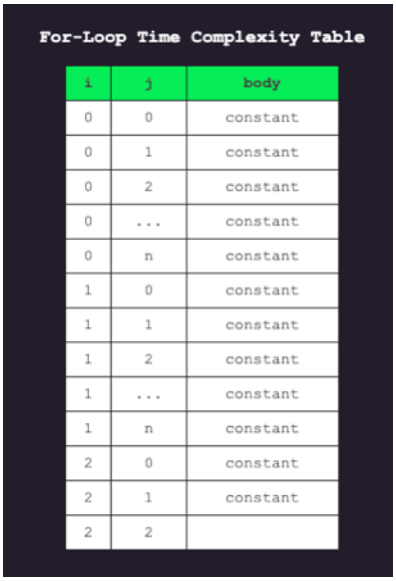
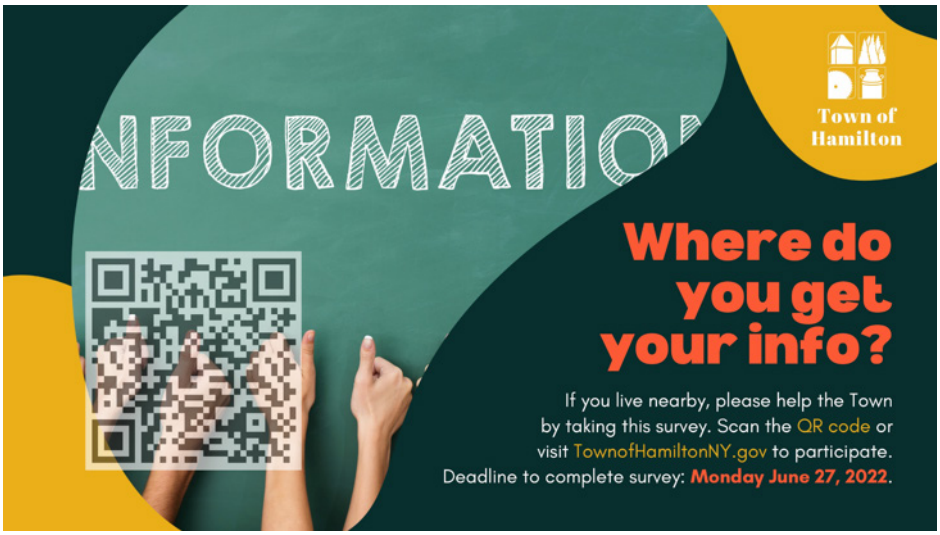


Figure 2. Visualization of the table, which documents the variable values of the for-loops and the operations performed.

Research Fellow: **Jason Qian (2024)** **Concentration:** **Environmental Geography**
Faculty Mentor: **Julie Dudrick** **Department:** **Upstate Institute**
Title of Project: **Town of Hamilton and People's Access to Information about the Town**
Funding Source: **Upstate Institute**
Project Summary:

During the summer of 2022, I conducted research for the Town of Hamilton to gather data about how people in or around the Town of Hamilton get access to news as well as information about the town. The results of my research will help the Town officials better understand the best ways to communicate with the residents in this town with various identities and backgrounds.

During the study, I first went through a series of literature, looking at previous studies that focused on similar topics about people's access to information. Based on the literature and with help from the Town Clerk, I devised a six-page questionnaire to serve as the basis of my data collection project. Using a list of property owners in the Town of Hamilton and a list of residents, we mailed approximately 2,000 surveys to Town residents. We also hung flyers and posters at different commercial properties around the Town, and set up survey pick-up and drop-off points at various places in the Town. In addition, we distributed the online Qualtrics version of the survey through Facebook, the Town website, as well as other media platforms such as NextDoor Hamilton.



I was able to gather approximately 400 responses across various distribution channels. The data demonstrate an overwhelming preference for paper-based forms of accessing information due to the high proportion of residents over 65 years of age. The study also reveals a stark difference between residents inside the Village of Hamilton and residents living outside in terms of their access to internet and internet-based information. Strong preference for newspapers and newsletters was reported. Recommendations for the Town were made based on the survey, and they include an expanded source of traditional, paper-based forms of communication for the residents.

Research Fellow: Geddy Rerko (2023) **Concentration:** Biology

Faculty Mentor: Ana Jimenez **Department:** Biology

Title of Project: Thermal relations in sled dogs after exercise and across seasons.

Funding Source: NASC Division

Project Summary:

Canine athletes, like sporting dogs, have a higher cardiovascular and thermoregulatory demand that requires them to have a greater internal temperature regulation. Here, we measured internal body temperature (Tear) and heat dissipation rates using thermal imaging in sled dogs (N=17) before and after exercise. Using linear regressions, we found that nose temperature scaled negatively with body mass in control measurements ($y = -0.2357x + 32.9339$, $R = 0.4882$, $p = 0.0468$), suggesting smaller sled dogs have warmer noses, which may challenge heat dissipation. Mouth temperature scaled positively with body mass during 15 and 30 mins of recovery from exercise (15: $y = 0.2856x + 22.7665$, $R = 0.6864$, $p = 0.0023$; 30: $y = 0.2179x + 25.2454$, $R = 0.4733$, $p = 0.0550$), likely due to the fact that larger dogs have more muscle mass, thus more potential for heat production. There was a significantly negative correlation between nose length and mouth and eye temperature right after exercise (mouth: $y = -2.2502x + 43.1896$, $R = 0.6161$, $p = 0.0110$; eye:$y = -1.7461x + 39.0360$, $R = 0.6398$, $p = 0.0076$), so that larger noses lead to decreases in mouth and eye temperature probably due to nasal turbinates.

Research Fellow: Riley Rice (2024) **Concentration:** Political Science
Faculty Mentor: Julie Dudrick **Department:** Upstate Institute
Title of Project: Centennial Farms - Cornell Cooperative Extension Madison County
Funding Source: Upstate Institute
Project Summary:

The goal of this project was to investigate the farms in Madison County which are over 100 years old or older. Cornell Cooperative Extension is the agricultural and community outreach arm of Cornell University, and an extension office is open in every county in New York State. This project was conducted by first defining the term centennial farm. The definition used during this project is "A farm which has been in continuous operation for 100 years or more, owned by the same family, positioned on the same land or registered under the same name, or has had periods in which operation ceased but has still accumulated over 100 years of operation." Once this definition was established, the next step was to identify as many centennial farms as possible. A detailed spreadsheet was created to catalog the information of each centennial farm. Following their identification, farmers were contacted, and interviews were conducted in order to learn more about the history of each farm. An article was written using the transcript of each interview which incorporated quotes from each farmer to tell the story of their farm and learn about the past and present challenges they have faced during the last century or more. Furthermore, a recommendation was then made to Cornell Cooperative Extension as to how their Centennial Farm Award should be changed in order to best represent and celebrate the centennial farms of Madison County.

Seven major trends were noticed in concerns farmers had about their industry. These concerns were generational change, farm equipment, the labor market, zoning laws, dairy quotas, federal assistance, and Cornell Cooperative Extension. Understanding these trends will allow Cooperative Extension to better assist farmers in combating these challenges. The recommendations for alterations to the Centennial Farm Award included increasing the number of awards given out each year as well as creating permanent road signs which would be displayed by the road at the farm of each recipient. These more substantial awards may also help connect or reconnect CCEMC to these farms by ensuring that each farmer or farm family understands that Extension recognizes and celebrates the challenges they have faced and the perseverance they have shown. The potential increase in award recipients and the potential introduction of signs would most likely cause CCEMC to incur a high cost that it does not incur today. However, these changes would help to create a more meaningful award for CCE, the award recipients, and the broader Madison County community.

This project was significant in many ways. First, it highlighted the difficulty in contacting many of Madison County's older farmers. Second, it displayed the difficulty of discerning the number of centennial farms within the county. Third, it helped to highlight some of the family histories of centennial farm families in Madison County. Fourth, it helped to catalog some of the trends in concerns amongst many of the county's oldest farmers or farm families. Fifth, it revealed many common problems centennial farmers share regarding the current agricultural landscape. Finally, it showed a need for the Centennial Farm Award to be amended or reformed to celebrate agriculture's legacy in Madison County better. This research project has laid the groundwork for so many other potential projects in the future. Madison County's centennial farms are a core part of its agrarian heritage, and CCEMC should continue to celebrate their endurance at every opportunity

Research Fellow: Mary Ring (2023) **Concentration:** Computer Science
Faculty Mentor: Georgiana Haldeman **Department:** Computer Science
Title of Project: Educational Memory Visualization Tool for Introductory CS Courses
Funding Source: NASC Division

Project Summary:

During a program's execution, the program accesses the computer's memory. This interaction is hidden from the programmer so additional tools are necessary to reveal this process to novice programmers. Visualization tools are helpful in clarifying common misconceptions regarding a program's memory usage. Our goal was to create a visualization tool that helped distinguish aspects of memory usage. We began by researching existing visualization tools to understand their strengths and weaknesses. We found that many existing tools do not cater to the learning goals of novice programmers, and are often too complex in their representation of memory. Additionally, many tools that are aimed at students are discontinued or not publicly available. Thus, we began a design for a memory visualization tool that focused specifically on the introductory concept of primitive and reference variable types. We aimed to create a tool that could accurately and effectively depict aspects of memory usage. Additionally, we planned to implement the visualization tool as a VSCode extension which would allow it to be accessible to all.

To create a tool that fulfilled our goals, we decided to use an analogy. Analogies are widely used by CS educators. We began with an analogy that represents the US Postal System. In this analogy, we represented primitive types as envelopes, reference types as package slips, and reference data as packages. This showed that envelopes or primitive types are small and can be accessed directly, while packages are larger and can only be accessed by presenting a package slip. This allows us to visually represent different variable types, the different ways of accessing these variables, and the different places within memory where these types are stored. After presenting our analogy to CS educators and students, we received some feedback that caused us to rethink our design. We are currently in the process of testing several analogies among CS educators and students to inform what design resonates the best with these groups.

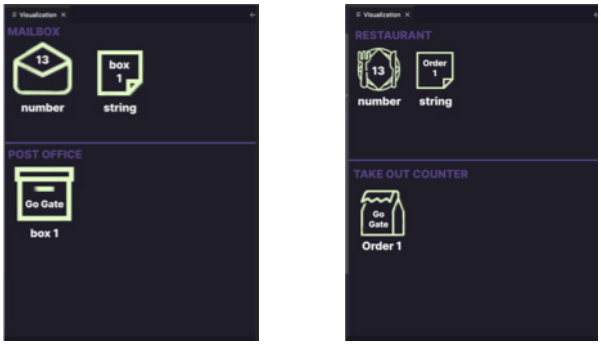


Figure 1. Two of the four design options (Left: Postal System Analogy, Right: Restaurant Analogy).

Our future work consists of fully implementing and testing the effectiveness of our chosen analogy. Once we have ensured the effectiveness of our product, we have plans for future design iterations that would add features such as customizable levels of complexity and auditory and visual feedback.

Research Fellow: **Natalie Ringel (2023)** **Concentration:** **English**

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

Title of Project: **(Dis)ability in the Outdoors: Increasing Accessibility to the Adirondacks**

Funding Source: **Upstate Institute**

Project Summary:

The ability to fully engage with the outdoors plays an especially critical role for me in navigating my challenges living with a visual disability. When I was twelve years old, I was diagnosed with a rare form of Retinitis Pigmentosa (RP), a degenerative retinal disease which eventually leads to blindness. As an avid outdoors person, continuing to spend time in nature while living with RP offers a safe space for healing, reflection and growth, while also instilling a sense of agency. Although my visual disability certainly creates some challenges, the inherent multi-sensory experience of outdoor recreation encourages me to continue to explore outdoor spaces with a sense of confidence and independence I desire as a disabled individual.

While learning how to best navigate outdoor spaces to have these fulfilling experiences, I am increasingly aware of the barriers to accessing the outdoors, especially for people with disabilities. Driven by my understanding of nature's ability to comfort and inspire, I was drawn to working at the Paul Smith College's Visitor Interpretive Center (VIC) in order to increase accessibility and equity for those visiting the Adirondack Park. As a summer fellow of the Upstate Institute Field School, I partnered with Paul Smith's VIC to increase Adirondack Park accessibility through physical landscape changes and educational programming reform.

Working with the VIC staff, my internship this summer targeted the systemic ableism prevalent in outdoor spaces in hopes of eliminating these barriers to better facilitate a positive outdoor experience for all visitors. Stemming from the VIC's greater mission of offering accessible outdoor experiences through education, recreation, research and arts, my work this summer aimed to increase accessibility and appreciation for this beautiful natural resource.

I helped the VIC build and plant a scent garden outside of the classroom area in order to educate visitors on native flora and fauna and allow those with visual disabilities to experience Adirondack ecology in an alternative way. I also developed a multi-sensory guided exploration of Barnum Brook Trail. One of the most popular Adirondack trails for young families and visitors with disabilities, my project focused on educating hikers on Adirondack ecology through valuing all senses as ways to absorb and enjoy one's environment in an accessible and fulfilling way.

As an Upstate Institute fellow, I have had the opportunity to bring my passion for the outdoors into an area of work that has the ability to build positive and lasting reform. By working with Paul Smith's College VIC as a community partner, I feel that I now better understand the barriers to accessing the outdoors for visitors with disabilities, and am grateful to have worked on projects which begin to bring down those barriers.

Research Fellow: **Jorge Rochet (2025)** **Concentration:** **Undeclared**

Faculty Mentor: **April Sweeney** **Department:** **Theater**

Title of Project: **Rewilding: A Micro Festival of Works by Romina Paula in Two Parts: Laboratory #1 & #2**

Funding Source: **AHUM Division**

Project Summary:

This theater-based summer program was divided into two separate projects. During the first two weeks we got to meet and work with Argentine playwright, Romina Paula. She traveled to New York City to specifically start crafting a new play. The purpose of this was to see how the city influenced her writing. I also got the chance to work with actors close to Romina, such as Denise Groesman, Josefina Scaro and Ben Becher. After those two weeks of cultural exchange, we moved on to the second project. I took part in the production of FAUNA, one of Romina's plays. It was fascinating to work without her in the same space where we had previously worked together. You could say there was an air of Romina Paula still floating in the room, which sparked our creativity even more.

The first project was more "organic", as Prof. Sweeney would say. I assisted Romina and the actors with whatever they needed during the process of brainstorming and creating the first drafts. I got the chance to help April (Prof. Sweeney) with translating the first draft from Spanish to English. I enjoyed the arduous work of translating. It was amazing to dive deep into the meaning of each word that Romina had carefully thought of. I learned that to be a good translator, you have to carefully study the meaning and purpose behind each idea, instead of going word by word directly translating. It was very rewarding when the actors read our version out loud.

Romina's creative process was one I had witnessed before. She already had Denise, Josefina, and Ben in the space without having written anything. She wrote in relation to the actors' identities and the space. She absorbed every little thought and filtered it into her piece. For example, one day she and Denise, who is also Argentinian, came back completely disturbed by the amount of plastic in New York City. They specifically expressed how disturbing it was to see a fresh cucumber wrapped in plastic at a supermarket. After this experience, trash became a very present element throughout the play, or the first few drafts.

The second part of the project was more stringent than the first part. However, I loved witnessing the beginning processes of creating FAUNA. As an aspiring actor, it was enriching to see how the actors prepared for their roles and how they deeply connected with their characters. I truly feel that I absorbed a lot of knowledge from this experience. This experience prepared me for future experiences in the acting field.

Being constantly in conversation with a group of creatives inspired me like never before. Ideas were constantly popping in my head. I even kept a notebook and a pen at all times because I would get random ideas for different projects that I am working with on my own. The way I view the Arts and theater making has changed because of this experience. We were simply creating. My first year of college I was confused with how to express myself as an artist. Now I understand that it is all about creating your own work. I learned that if you work hard on a project out of pure enjoyment, you will see your craft succeed. I am so grateful for Professor Sweenet. She gifted me the great opportunity of connecting with amazing people with whom I share my love and passions for theater. I appreciate the technical skills that I acquired, but I will forever treasure the lessons taught by all the amazing professionals I met.

Research Fellow: Ryan Ruan (2024) **Concentration:** Physics

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

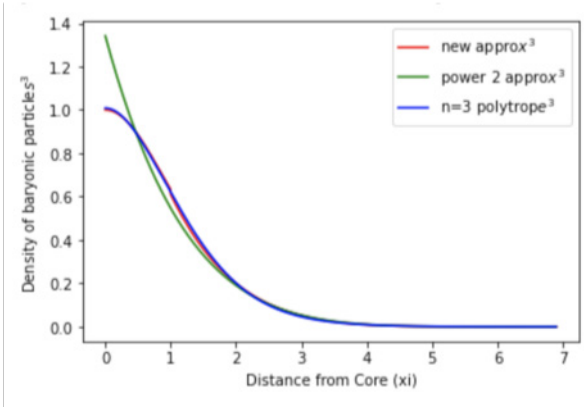
Title of Project: Modification of Dark Matter Single Collision Capturing Rate based on hypothetical Pop III star

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

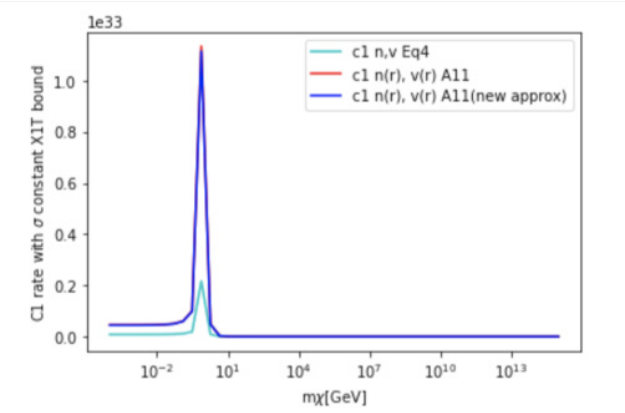
Project Summary:

As previous works show, Pop III star can be a very good capturer of Dark Matters(DM), and the conventional practice of calculating the single collision capturing rate of DM is based on the assumption of the uniformly distributed density Pop III stars for simplicity (which is not the case). This work examined the result of this simplification and compared it to a more precise calculation, and the result shows that the difference is significant. A method with improved precision can be used to modify, but the result is still not satisfying enough, and future research could focus on a better numerical solution.

There are mainly three possible approaches. The first method uses Chandrasekhar's Approximation for polytropes with xi smaller than 1, which includes the denser areas, and the second method uses a direct second-order approximation to the polytropes, and the third method is a combination of those methods, using Chandrasekhar's Approximation for the first part, and the second order approximation for the xi larger than 1. Although this method is the most precise one, it is highly complicated, and it will give a very complex numerical solution. In the figure on the right, the blue curve is the analytical solution for the Pop III star, and the green curve is the second-order approximation. The first part of the red curve is Chandrasekhar's Approximation, and the entire red curve is the result of the third method.



With different approaches, we can get different results for a single capturing rate, thus for the total capturing rate. In this part, we assume a Pop III star with 1000 solar mass, and the cross-section with X1T bound to show the relationship between those methods. The blue curve indicates the result of the third method, and the cyan curve plots the result of the original practice which is different from reality, which is plotted as the red line that is almost overlapping the blue line.



The blue curve can serve as a very good approximation, but still need more work on its simplification. The cyan curve has some difference from reality, and more investigation on the blue curve is required.

Research Fellows: Will Russel (2024) — **Concentration:** Molecular Biology
Dong Wang (2023) — **Concentrations:** Computer Science; Applied Math

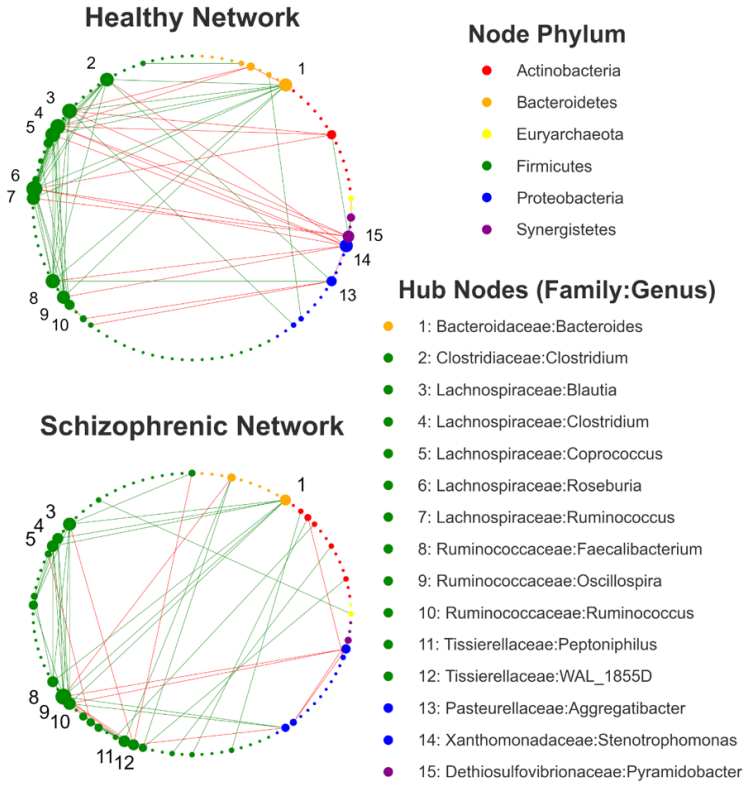
Faculty Mentor: Ahmet Ay — **Department:** Biology; Math

Title of Project: Predicting Schizophrenia from Human Gut Microbiome

Funding Source: Michael J. Wolk '60 Heart Foundation

Project Summary:

The human gut microbiome is communities of microorganisms (such as bacteria, viruses, fungi) living in our intestines. It is usually composed of thousands of, if not more species in any individual. It is an integral part of our bodies as it impacts intestinal functions and the digestive system. Recent findings have supported an association between deviations in gut microbiome composition and schizophrenia by virtue of the gut-brain axis, which states that there exists a bidirectional interaction between the digestive system and the central nervous system. However, the extent to which the gut microbiota contributes to schizophrenia remains unclear. Moreover, studies have yet to explore variations in ecological associations among bacterial types in schizophrenic subjects, which can reveal differences in community interactions and gut stability. We examined the dataset collected by Nguyen et al. (2021) to investigate the similarities and differences in gut microbial constituents between 48 schizophrenic subjects and 48 matched healthy comparison cases. We re-analyzed alpha- and beta-diversity differences and completed modified differential abundance analyses and confirmed the findings of Nguyen et al. (2021) that there was little variation in alpha-diversity but significant differences in beta-diversity between schizophrenic and non-schizophrenic subjects. We also conducted mediation analysis, developed a machine learning (ML) model to predict schizophrenia, and completed network analysis to examine community-level interactions among bacterial taxa. Our study offers new insights, suggesting that the gut microbiome mediates the effects between schizophrenia and smoking status, BMI, anxiety score, and depression score. Our differential abundance and network analysis findings suggest that the differential abundance of Lachnospiraceae and Ruminococcaceae taxa fosters a decrease in stabilizing competitive interactions in the gut microbiome of schizophrenic subjects. Loss of this competition may promote ecological instability and dysbiosis, altering gut-brain axis interactions in schizophrenic subjects.



Research Fellow: **Leslie Sanchez-Gonzalez (2025)** **Concentration:** **Undeclared**

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

Title of Project: **Zebrafish Neuromasts Regeneration post full Ablation?**

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

Project Summary:

The zebrafish lateral line is a sensory organ system, necessary for the detection of water flow and balance in the fish. Sensory organs called neuromast, can be found along the zebrafish lateral line. These are made out of mantle cells, sensory cells, and hair cells, the latter of which are also found in humans. Hair cells in all species degrade over time and are susceptible to various kinds of damage, but unlike zebrafish, which regenerate their hair cells, human loss of hair cells is permanent and eventually leads to hearing loss. Thus, the zebrafish lateral line is a model of great interest for human hearing loss.

Since it is known that zebrafish can specifically regenerate their hair cells, the question if an entire neuromast can regenerate was raised. A study by Sánchez et. al (2016) did just this. Sanchez suggested that zebrafish are also able to regenerate their whole neuromasts after a complete electroablation via the role of interneuromast cells (INCs). These cells lie between neuromasts and are reported to serve as lateral line progenitors, and Sánchez claims that the 2 INCs on either side of an ablated neuromast are able to regenerate a new one. However, Sánchez' electroablation method is less precise than ours, and, given the potential that regeneration is correlated with the extent of damage, we sought to test if our cell-specific ablations using a Zeiss 710 Laser Scanning Confocal Microscope would lead to the same results.

Using a confocal microscope, full neuromast ablations were performed on 6 day old zebrafish. The fish were observed 72 hours post ablations for regeneration. Out of 18 total neuromasts ablated across 6 fish, 0 regenerated. Based on this data, 6 day old zebrafish, when ablated, have no regeneration of their neuromasts 72 hours post ablations. Based on this data and data from Sánchez et. al (2016), it can be suggested that regeneration may be dependent on the extent of the damage, given our cell-specific ablations did not lead to regeneration. Thus further research can be directed towards determining if further damage affects interneuronmast cells and their ability to regenerate a neuromast.

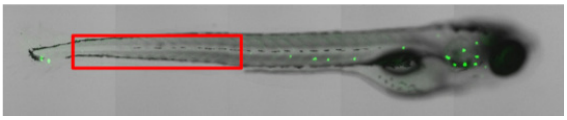


Figure 1: No neuromast regeneration seen 72 hours post a full ablation. The above shows a full-body scan of a zebrafish taken 72 hours post ablation using our Zeiss 710 Scanning Confocal Microscope. The green fluorescence marks the hair cells in neuromasts, and the red box shows the area along which we fully ablated neuromasts.

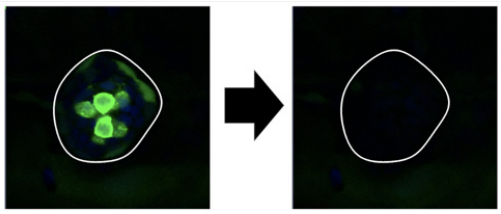


Figure 2: The Zeiss 710 Laser Scanning Confocal Microscope successfully ablates all cells in a neuromast. The above shows a before and after scan of a full neuromast ablation in a 6 dpf zebrafish. The green fluorescence indicates hair and mantle cells, and the blue indicates support cells. All zebrafish neuromasts in this study were fully ablated in the same fashion.

Research Fellows: Leslie Sanchez-Gonzalez (2025) — **Concentration:** Undeclared
Eva Wiener (2023) — **Concentration:** Neuroscience

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

Title of Project: Early Development of Cavefish and Surface Fish Lateral Lines

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

Project Summary:

The fish species *Astyanax mexicanus* comes in two forms, surface fish and cavefish. 1.5 million years ago, some members of the species, now called cavefish, were trapped in caves throughout Mexico and independently evolved, losing their pigment and eyes but gaining more sensitive taste buds and lateral lines. The lateral line is made up of sensory organs called neuromasts that allow fish to detect water movement, and they contain support cells, mantle cells, and hair cells, the latter of which are also found in the human inner ear. While humans cannot regenerate their hair cells, leading to hearing loss over time, several fish species—including surface, cavefish, and zebrafish—can. While the development of the zebrafish lateral line has been heavily researched, that of cavefish and surface fish has not. Yoshizawa et. al (2010) found that adult cavefish have a greater number of neuromasts, each with a greater number of hair cells, than adult surface fish; prior work from our lab shows that there is a size and hair cell difference by 7 days post fertilization (dpf) between the two morphs, but no research has been conducted to examine differences earlier in development. Further, Sapède et. al (2002) has claimed that the *Asytanax* lateral line initially develops like the zebrafish's on the midline by 53 hours post fertilization (hpf), but begins to migrate to the stomach by 72 hpf, results that we were able to investigate in the process of determining differences in development. Thus, we were interested in determining critical moments in neuromast differentiation between surface and cavefish by examining early time points in larval development, which gives us the information to then explore the mechanisms that might lead to those early differences of the *Astyanax* lateral line.

We raised surface and cavefish to about 2 dpf, then fixed 3 of each in a 4% paraformaldehyde solution. We then stained them with SOX-2 and HCS-1, which are markers for support and hair cells, respectively, along with DAPI, which marks cell nuclei. Using a Zeiss 710 Laser Scanning Confocal Microscope and Zen software, we took tile scans of the tail and z-stacks of neuromasts, which allowed us to count individual cells in each neuromast as well as to assess the area of each one. We found that, at about 2 dpf, surface fish neuromasts had significantly larger areas ($p < 0.01$), as well as that they had significantly more support cells ($p < 0.0001$). Given that, by 7 dpf, our lab has previously found that cavefish have larger neuromasts with more hair cells, these results indicate that the increase in cavefish neuromast cell count occurs somewhere in between 2 dpf and 7 dpf. Thus, we hope to conduct further experiments at intermediate time points to determine the exact moment of differentiation, which will then allow us to explore the mechanisms behind this difference. Further, through viewing full-body images of the fish, we also found that, at 2 dpf, both cavefish and surface fish have fully formed neuromasts on the ventral sides of their bodies, which differs from zebrafish, whose lateral lines form on their midlines at the same time point. This suggests that the mechanism of lateral line deposition differs in Astyanax from zebrafish, and more work can be done to discover the pathways behind this phenomenon.

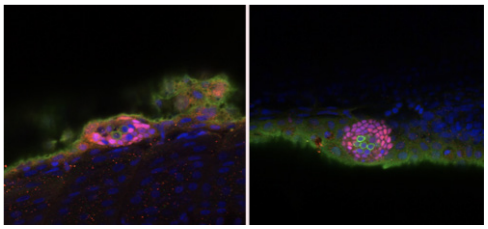


Figure 1: The surface fish neuromast is larger and has a considerably greater number of support and hair cells than the cavefish. The above z-stacks show a comparison of cavefish (left) and surface fish (right) neuromasts at ~2 dpf. Hair cells can be visualized in green, support in red, and cell nuclei in blue. Surface fish have a greater number of support cells per neuromast (unpairedt-test, $p < 0.0001$) and greater neuromast areas (unpaired t-test, $p < 0.01$).

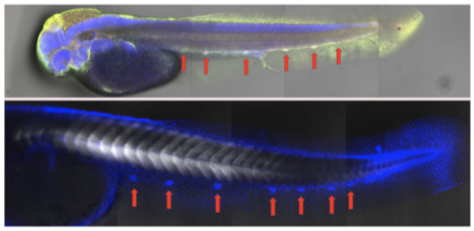


Figure 2: ~ 2 dpf cavefish and surface fish both have neuromasts fully formed on the ventral sides of their bodies. This differs from zebrafish, in which the lateral line initially develops on the midline. The top image is a z-stack of an ~2 dpf cavefish, and the bottom an ~2 dpf surface fish. Hair cells can be visualized in green, support in red, and cell nuclei in blue, and the red arrows indicate each neuromast.

Research Fellow: **Lily Schaeffer (2023)** **Concentration:** **Biology**

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

Title of Project: **Community Perceptions of Substance Use in Chenango County through the Lens of Qualitative Data**

Funding Source: **Upstate Institute**

Project Summary:

This qualitative data project investigated community members perceptions of underage drinking, smoking, marijuana, and prescription drug use in Chenango County. The project was facilitated by Drug Free Chenango Coalition and was in support of the data and evaluation components of the Strategic Prevention Framework on which all New York State Coalitions operate. Previous research has demonstrated a need for youth substance abuse prevention efforts in Chenango County, and the qualitative data collected in this project will be essential to inform future prevention strategies. Data were collected in the form of key informant interviews and parent/youth focus groups. Key informant interviews were conducted with representatives from 12 sectors: youth, parents, business, media, school, youth-serving organizations, law enforcement, religious or fraternal organizations, civic or volunteer groups, healthcare professionals, state or local agencies, and other local organizations. Focus groups were conducted in a conversational manner with three to ten parent or youth participants. This data project is valuable because qualitative data on youth substance use will aid DFCC by tapping into local knowledge and cultural norms to implement the most suitable prevention strategies for this community specifically. In addition, the project gives agency to community members in implementing community solutions.

(SAMHSA Model, CADCA, 2022)

To perform this research it was essential to become familiar with the CADCA grant, as well as the logic models pertaining to substance use in Chenango County. Recruiting and community outreach strategies were used to identify key informant interviews and focus group participants. These included coalition meeting attendance, email/phone outreach, and flier creation and distribution. Interviews and focus groups were conducted using an interview/focus group guide, and recorded confidentiality. Data was analyzed by coding transcripts by theme and then finding parallels between data.

The results of the data analysis found several common threads among interviewees and focus group conversation data. Risk factors for youth substance use identified were: a lack of mental health resources, childhood trauma, single-parent households, boredom, lack of community engagement, and lack of suitable adult mentors. Protective factors for youth substance use identified were: engaging in after-school activities, parents with negative attitudes towards substance use, suitable adult mentors present, and strong connection to peers. The qualitative data collected in this project will be a resource to use in conjunction with quantitative data to inform substance use prevention strategies for youth in Chenango County.

Research Fellow: Sarah Shelton (2023) **Concentration:** Educational Studies
Faculty Mentor: Julie Dudrick **Department:** Upstate Institute
Title of Project: Creating an I/DD Accessible Survey
Funding Source: Upstate Institute
Project Summary:

People with intellectual disabilities are the experts on their needs and experiences, but they are often assumed incapable of sharing their opinions via surveys. Most surveys about intellectual disability are given to the disabled individual's caretaker, preventing the disabled individual from sharing a true experience. This summer, in collaboration with Pathfinder Village, I created an intellectual disability-friendly survey to ask people with Down Syndrome about their lives during the COVID-19 pandemic.

While very few surveys for intellectually disabled people exist, research exists regarding the accommodations that they should have. Hasnain et al. (2014) suggested that surveys use clear and concise language, keep the recall periods for the survey material short, and have the survey reviewed by intellectually disabled people. Further, McSweeney and Williams (2019) stated that visual cues may help individuals think of talking points.

In my survey, I was inspired by Picture Exchange Communication Systems (PECS) that use pictures and one-word descriptions to substitute language. Wanting to support different forms of knowledge and communication, the survey had three different sections: word association between feelings and words related to COVID, an objective section, and a free writing section. All sections had a progress bar that measured the survey participant's process. The survey was reviewed by a group of five people, and edits were made based on their comments and spaces where they seemed confused. Individuals took the survey on an iPad so that they could touch their answers. Finally, all of the surveys were given by me.

Overall, the survey was extremely successful. Some respondents even expressed their experience better through the survey than they did verbally. At the same time, I learned a few things that would be beneficial to apply to future surveys. First, the word association section unintentionally used female icons for positive emotions and male icons for negative emotions. Because of this, one of the residents indicated that they only chose positive emotions because they were women. Second, all participants may have had subject bias because I was the main researcher and executor of the survey. Finally, for the free writing section, it may be beneficial to have individuals draw rather than type as some individuals could not manually type. Hopefully, in the future, my survey format will be used to proliferate the opinions of intellectually disabled people.

Research Fellow: Anya Sokolowski (2025) **Concentration:** Undeclared
Faculty Mentor: Graham Hodges **Departments:** History; Africana and Latin American Studies

Title of Project: Survivors of the Underground Railroad
Funding Source: SOSC Division
Project Summary:

This summer research project aimed to discover more about the lives of enslaved people in the United States after escaping from slavery, as well as the lives of their descendants, around the time of the Civil War. Many of these formerly enslaved people escaped through mechanisms supported by the Underground Railroad, a network of safe houses and people who gave money, food, clothing, and shelter to freedom seekers. Many of those who escaped slavery before the Emancipation Proclamation was enacted in 1863 journeyed to northern states and other Free states that had already abolished slavery, and the populations of these states had higher proportions of people with sympathetic views toward abolitionism movements. Those who were freed in 1863 by the Emancipation faced less pressure to move North, so some chose to remain settled in the states and counties that they had been enslaved in.
The research for this project was conducted through the use of both historical and genealogical source material, accessed through the Colgate University library databases. The formerly enslaved people and family members that this project is researching recorded personal written narratives about their experiences of slavery and freedom. These narratives are the most valuable piece in being able to discover more about the authors and their descendants. Especially in southern states, enslaved people were systematically stripped of their personal agency through the process of denying them education and basic literacy. As a result of this, millions of those who were enslaved in the United States did not have the resources available to share their experiences with others. The narratives were accessed through the University of North Carolina's North American Slave Narratives in Documenting the American South, a collection of primary sources that historically illustrate life in the southern states. In each narrative, biographical information about the author such as birth place and year, settlement, marital status, occupation, and record of children was noted in order to search for their descendants. This information was input into the Ancestry.com advanced search, accessed through Colgate University Libraries (CUL). America's Historical Newspapers, also accessed through CUL, were also used to look for records of descendants. The main primary sources that were used were federal census records, death certificates and gravestones, city directories, and obituaries.

Much of my research was centered around Levi Branham and his family. He was from Georgia, and he was freed by the Emancipation in 1863. He learned to read and write while enslaved, but many of the other authors of these narratives did not become literate until they were freed. Being educated gave Branham an advantage, as he was able to work as a teacher after he was freed. Several of his descendants also worked as teachers, and more of them also worked jobs that were higher paid and required more skills. Trends from this research show that those who were not educated had much fewer opportunities for upwards social mobility, and they worked jobs that paid significantly lower salaries. Other trends that persisted throughout this research include religion, specifically Christianity. Those authors with heavier emphasis on faith in their narratives had descendants who were more active church members or officials. Looking at these trends helps us understand how the Underground Railroad opened up opportunities for free people and their descendants in the United States after the Civil War.

Research Fellow: Stuart Sopko (2024) **Concentration:** Geography

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

Title of Project: Telling the Story of Oneida: From Free Love to Fine Silver

Funding Source: Upstate Institute

Project Summary:

The Oneida Community was a Perfectionist utopian society in Central New York known for radical social practices such as Complex Marriage and Male Continence. The community members lived together in the 93,000 Mansion House that they constructed in the 1860s in Oneida, NY, which stands today as a museum, residence, and hotel, which is where my research project was mainly conducted. The Community transitioned into a joint-stock company in 1880 and grew into Oneida Limited, which was one of the largest and best-known tableware manufacturers in the world until it went bankrupt in the early 2000s. The community has received significant academic and literary attention, but the history of the company has not, so I created an oral history project to collect some of this history first-hand via interviews with old Oneida Limited employees. My research project aims to utilize those interviews, as well as information from written sources and objects from the Mansion House's collection, to inform an exhibit that highlights the history of Oneida Limited and its legacy today. The exhibit is broken down into four themes that each highlight a different aspect of the company; innovation, community, tradition, and OCQ (Oneida Community Quality). Innovation focuses on the manufacturing side of the company and its renowned quality and beauty of not only its silverware but also its advertisements which helped to make the company a household name. Community aims to tell about the unique family atmosphere surrounding the company which was a product of the development of the town of Sherill where many of the employees lived and socialized, often using Company-sponsored recreation facilities such as the Oneida Community Golf Course. Tradition tells the story of Oneida Limited's roots in the Oneida Community and how ideals such as fairness and family have been able to carry on through the generations. Finally, OCQ highlights the high standard of quality that Oneida Community members and Oneida Limited employees both held themselves to in all aspects of life but specifically their work. The physical exhibit is organized into four shelves, each of which houses a theme, and each shelf contains descriptive label copy panels, objects and photos from the collections, and quote cards that directly quote the oral history interviews, along with object description cards. The exhibit aims to generally inform the public on the history of Oneida Limited, as well as attract attention to and potential participants in the oral history project. It is on display in the Madison County Courthouse near the Department of Motor Vehicles through the fall, and it will hopefully move to another location after that.

Research Fellow: **Luke Stayton (2024)** **Concentration:** **Physics**
Faculty Mentor: **Jonathan Levine** **Department:** **Physics and Astronomy**
Title of Project: **Initial Deployment of SDR to Investigate the VHF Radio Band**
Funding Source: **Justus '43 and Jayne Schlichting Student Research Fund**
Project Summary:

Abstract: Software Defined Radio (SDR) is one of the more recent developments in the wide world of the radio wave spectrum. The concept of creating software that can replace conventional radio hardware is one that has created a new path forward in the field of radio technology. Potential applications for this technology range from personal usage, in amatuer radio, all the way to commercial and military usage.

The goal of this project was to explore the central New York radio spectrum with SDR. Using an antenna and an RTL-SDR dongle to receive incoming signals, and MATLAB/Simulink to process the data, frequencies in the VHF (Very High Frequency, 30-300 MHz) spectrum were found and analyzed. With just code and a small amount of hardware, a large variety of radio sources can be heard; in this project specifically, we focused on listening to FM radio stations, automated weather observing systems (AWOS), and signals from car key fobs. One of the advantages of SDR is its ability to cover a broad range of frequencies, both AM and FM. A car radio, for example, can easily receive FM stations between 88 and 108 MHz; it would be unable to obtain, much less decode, AM-transmitted weather reports from an airport's AWOS. A simple dongle and antenna plugged into your personal computer can do both and much more.

Shown below is a time-domain plot of one signal picked up by the SDR. The figure below shows an audio clip of an automated weather report at an airport in central New York.

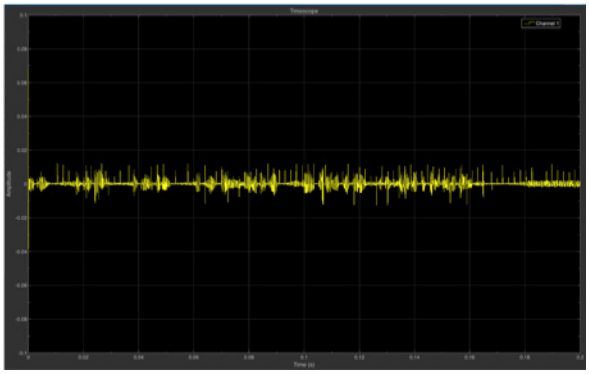


Fig. 1 - A clip saved from the continuous AWOS broadcast at Ithaca Tompkins International Airport. This message plays a few times every minute, containing live updates on aviation-relevant information such as temperature, visibility, sky conditions, cloud ceiling height, and dew point.

Further potential projects with software defined radio could attempt to receive signals higher in the radio spectrum, such as GPS satellite broadcasts at 1.5 GHz, or to take advantage of the SDR's ability to transmit data as well as receive it, in order to communicate with devices in its vicinity.

Research Fellow: Rebecca Sweigart (2023) **Concentrations: Art and Art History; Film and Media Studies**

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

Title of Project: Chenango Canal Association: The Project on the Summit

Funding Source: Upstate Institute

Project Summary:

This summer I worked with the Chenango Canal Association as a Field School Fellow through the Upstate Institute. The Chenango Canal Association works to protect and preserve the Chenango Canal as a public, recreational, and historic park for the surrounding communities. They are a 501(c)3 volunteer organization. Between themselves, college students, and other local volunteers, they keep the towpath trail clear of brush and the canal open to the public. This summer I developed a promotional video and short historical documentary for the association in order to reach out to the community for volunteers, as well as to raise awareness about the organization and the resource they protect.

Prior to my summer project, I was oblivious to the Chenango Canal's location, importance, and even existence. I had been in Hamilton for three years up to this point and had no idea what the Chenango Canal was. As it turns out, my summer apartment on Lebanon Street sits right where the canal once was. I have been able to explore the 5-mile summit of the Chenango Canal on which the association focuses its time and energy, as well as to meet the people that keep the organization going. They graciously invited me to their board meetings and I was also able to chat one on one with a majority of the board members about their personal experiences with the canal.

Currently approaching the end of the summer, I have finalized a promotional video for the Chenango Canal Association, conducted historical research and interviews, and am constructing a historical documentary on the history of the canal and the association. In the past, the Chenango Canal Association has had difficulties creating or commissioning a completely successful video on the canal. My goal this summer has been to do everything I can to make sure they have videos to share. These videos aim to increase volunteerism, monetary donations, as well as overall awareness. As a bonus, my work has enabled the organization itself as it redoubles its efforts on behalf of the Chenango Canal.

This is my second summer as an Upstate Fellow and my last as a Colgate student. Overall, I am glad to have spent it with the Chenango Canal Association. I've had video editing internships and other opportunities to build my portfolio in the past. However, this summer I've been able to not just work in post-production, but also to research, direct, interview, film, and script-write. All of these experiences are priceless and I am so grateful for the opportunity. As a double major in art and art history and film and media studies, looking towards post-production and art director work in less than a year, I feel much more prepared thanks to the work I have been able to do with Upstate and the surrounding community organizations.

Research Fellow: **Aleksia Taci (2025)** **Concentration:** **Undeclared**
Faculty Mentor: **Meredyth Winter** **Department:** **Art & Art History**
Title of Project: **The Sultan's Silks: Archaeological Textiles from Medieval Iranian Tombs**
Funding Source: **AHUM Division**
Project Summary:

This summer I joined Professor Meredyth Winter in researching and analyzing the archeological textiles dating back to the 10th-12th century from the city of Rayy, Iran. The 6 weeks of working under Professor Winter allowed me to build my background knowledge regarding the excavation of the Rayy textiles in the 1930s by archeologist Eric Schmidt, the reasons why they are shrouded in controversy, and why this research could reveal a lot more about the culture they came from.

Found inside graves and the rubble of the citadel, these garments were not in their best condition, especially after the raids that preceded the formal excavation. In addition to that, record-keeping during the time of the digging was not the most precise, hence, museums and researchers lack significant information regarding these textiles. Our goal was to make use of this existing knowledge while adding from our own analysis in order to achieve a thorough understanding of the Rayy textiles.

I worked with Schmidt's original excavation daybooks and the Philadelphia Museum of Art's cataloging of these textiles to create a comprehensive database that detailed the garment fragments as listed under the Museum and connected them to the archeologist's findings. The links created allowed me to plot the find spots to drawn maps of the two tomb towers where the textiles were excavated from, resulting in a better imaging of where these garments had come from.

With Professor Winter we further consolidated the Museum's database by conducting a close analysis of each fragment. Under her instructions and continuously broadening my own knowledge of textile weaving, we took measurements and identified various weaving techniques that were added to the growing information regarding the Rayy textiles. In the process I became familiar with the way Museums catalog their objects, as well as the techniques used in the conservation of these archeological textiles.

These 6 weeks only allowed me to scratch at the surface of the research of the Rayy textiles, helping with the database that can support further research. However, there is much more hidden under the history of their usage; their life before they became burying shrouds, perhaps a life of being traded from a different country, a history of different owners. With the new skills I have acquired, I hope that in the future I may be able to map out the Rayy textiles' life instead of just the location in which they were last found.

Research Fellow: **Ilyas Talwar (2024)** **Concentration:** **History**

Faculty Mentor: **David Robinson** **Departments:** **Asian Studies; History**

Title of Project: **In the Shadow of the Fall: Reanalyzing the Role of the Visigoths in the Last Century of the Western Roman Empire, 395-451 CE**

Funding Source: **Center for Freedom and Western Civilization**

Project Summary:

Between 395 and 451 CE, the Western Roman Court and the Visigoths oscillated between confrontation and cooperation as the former tried to hold its own against an unyielding tide of invasions and the latter sought to settle and consolidate as a people. During this period the Visigoths, initially the target of Western Roman campaigns, invaded Italy twice, sacking Rome in 410 CE. Eventually through military victories and negotiations the various generals who dominated the Western Court were able to leverage the Visigoths as allies before settling them in Roman territory in 418 CE. Over the following decades the Western Court used military campaigns and diplomacy to try and limit the Visigoths' territorial expansion. However, these decades also saw several instances of cooperation with the Western Court and the Visigoths collaborating to defeat various other groups such as the Vandals, Alans, Suebi and, most famously, the Huns in 451.

Using Roman and Byzantine histories, poems, and modern sources, this paper explores the interactions between the Western Roman Court and the Visigoths in the aforementioned fifty-six year period to demonstrate that the Visigoths were not always a driver of the Empire's demise when compared to other groups such as the Vandals. Moreover, it shows that a focus on the fall of the Western Empire obscures the complexity of the relationship between the two sides as the Visigoths were not always trying to destroy the Western Empire but instead to leverage its resources and legitimacy for their own advantage. Additionally, many instances of Roman success and clever policy-making making are overshadowed by the fall of the Western Empire in 476 CE. Ultimately, this paper concludes the role of the Visigoths in the fall of the Western Empire was not as large or detrimental as previously assumed. Although the Visigoths are an important part of the history of the late Roman Empire some of their most important contributions to the historical narrative were as allies with, not opponents of, the Western Empire.

Research Fellow: **Catherine Wang (2023)** **Concentration: Environmental Studies**

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

Title of Project: **Working as an Upstate Institute Summer School Fellow with the Ausable River Association**

Funding Source: **Upstate Institute**

Project Summary:

Though the majority of the Upstate Institute's work takes place in the greater Hamilton region, I had the pleasure of working in the Adirondacks this summer with a non-profit organization called the Ausable River Association. The Ausable River Association (AsRA) is located in Wilmington, NY, and is dedicated to helping the local community protect the bodies of water found in the Ausable watershed. The watershed is composed of the Ausable River, dozens of lakes, and over 70 streams, and also encompasses a wide range of diverse flora and fauna. Moreover, the region is a hotspot for human recreation as many people travel from afar to swim, boat, paddle, train, and fish. Given how closely a healthy environment was tied to the integrity of the community, it was very clear to me how much people valued having an organization that focused on preserving the environment and rectifying the specific issues that impact the region. Year-round threats like the overuse of road salt, rising temperatures due to climate change, eroding banks and sedimentation, and invasive species entering bodies of water were major concerns and consequently, AsRA took great measures to address these issues. The work that AsRA completes is all-encompassing, hands-on, driven by science, and constantly expanding to take on new projects. As a Field School Fellow with the Upstate Institute, I was able to gain experience in many different projects, work with various types of organizations, and meet many like-minded individuals that were all eager to help conserve the environment.

While I participated in an array of projects that ranged from field days spent electrofishing or gathering environmental DNA to conduct fish surveys to interviewing anglers and encouraging them to adopt invasive species prevention methods, the vast majority of my work was based on water quality monitoring. In particular, each month I helped monitor 12 lakes in the watershed by collecting bottom and/or top samples to analyze nutrient content and chlorophyll levels, and using a YSI DSS pro handheld sonde to record parameters like pH, temperature, specific conductivity, and dissolved oxygen. I also monitored 30 streams on a biweekly basis using the same YSI to record the same parameters. This is all measured in the hopes of creating a long-term database that can be used in the future to help stakeholders make informed decisions regarding issues the region may be facing and document long-term trends. Working mostly outdoors, being able to contribute to this database, and immersing myself in the issues that this one local community faced were both fulfilling and impactful work. I truly enjoyed my time working with the Upstate Institute and AsRA.

Using an integrated sampler to take a surface sample of a lake

Research Fellow: Haobo Wang (2022) **Concentrations: Geography; Geology**

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

Title of Project: Parking Area Utility Study In Downtown Oneida City

Funding Source: Upstate Institute

Project Summary:

Street parking and parking lot utilization studies are crucial for urban planning as they show multiple important aspects of the social-economic activities of the focused area. Peak-trough parking hours information, as well as day-to-day variation, could also be a helpful resource for both drivers and local business owners to adjust their visit/operation plans.

This summer, Oneida City Planning Department hosted me as a Field School Fellow to complete a new parking inventory research project. The goal of the project is to help them gain more knowledge on parking lots and street parking occupancy in the business district. Last year, the City of Oneida was successful in obtaining funding through the New York State Downtown Revitalization Initiative (DRI). This award will provide the city with $10 million of funding in order to help communities boost their post-COVID economies. The “background-level” parking area utilization rate will help inform the Planning Department on which areas are the most crowded and thus may require new lots to be built as new businesses settle in after the revitalization process.

My field research involves 1. counting all the street parking spots in the downtown area and labeling them, 2. surveying the parking spots every hour and keeping track of the plate number of the cars occupying each spot, 3. plotting the occupancy number versus time of the day to know the peak hours, and 4. mapping the downtown area parking occupancy by color-labeling parking areas using ArcGIS Pro.

For the first half of the project, I took surveys along the streets every hour, then trasported the raw data into excel sheets for temporal analysis. The second half of the research consists of calculating the average occupancy rate for a given time of the day across the weekdays. Then, I joined the occupancy data to polygons created in ArcGIS Pro indicating parking areas and color-coded. The final product of my research included a report write-up of occupancy summary of the studied areas, as well as multiple maps visualizing the parking area usage, which would be helpful for the planning council as well as for citizens to get familiar with parking availability in the downtown area.

Research Fellow: **Eli Watson (2024)** **Concentration:** **History**

Faculty Mentor: **Susan Woolley** **Departments:** **Educational Studies; LGBTQ Studies**

Title of Project: **Artifacts of Safe Space in Schools**

Funding Source: **SOSC Division**

Project Summary:

Adults and young people aim to create "safe space" for gender and sexual diversity in K-12 schools in a number of ways – sometimes drawing on strategies of recognition and visibility, at other times identifying physical spaces as safe or marking people as safe allies. Professor Woolley's research traces discourses of safe space, allies, and supporting LGBTQ students in the interactions and material life of K-12 education. Drawing on two sets of qualitative data, we examine how notions of "safe space" emerge in student and teacher dialogues, classrooms and broader school environments, and material artifacts. Professor Woolley's research over the past 10+ years includes a three-year ethnographic study in a California urban public high school and an interview-based study with New York teachers, administrators, and education policy makers about LGBTQ students in K-12 public education.

I have been coding this data with the program MAXQDA. Working with a number of "codes" Professor Woolley and I created to do with safe space in schools, including "school environment," "classroom environment," "potentially undermining," "reactive construction," "proactive construction," "language use," "curricular representation," "visual representation," and more, I coded numerous transcribed interviews and classroom lessons. I noted instances indicative of safe or potentially unsafe space, such as when, where, and how safe space had or had not been manifested. Interacting with the data, when I observed certain patterns of safe or unsafe space emerging for which there had not previously been a code, I created new codes for that data. This data will continue to be coded for future analysis, with my work continuing in the Fall 2022 semester.

Research Fellow: Tate Wright (2023) **Concentration:** Classics
Faculty Mentor: Naomi Rood **Department:** Classics
Title of Project: Bucolic Notions of Unrequited Love
Funding Source: Center for Freedom and Western Civilization
Project Summary:

Bucolic poetry is an ancient literary tradition that arose during the Hellenistic Period (Hunter p.218) (the era beginning with Alexander the Great's death in 323 BCE (Gutzwiller p.3)) and was created by the Sicilian poet Theocritus (Plaistowe/Masom p.10). This style of poetry is known for its themes of pastoralism, meaning that it often portrays shepherds and similar workers in the countryside and how the rural lifestyle contrasts with that of the urban (Hunter p.5-7). What makes Bucolic poetry unique though, was that it relies on themes of music, love and how they each lend themselves to the rural lifestyle (Hunter p.5-7). This focus on love as a literary theme likely stems from the changes in philosophical thought during the Hellentistic Period (Gutzwiller p.6), but is also rooted in the nature of the shepherd's lifestyle and how they lived at the intersection of the human and natural worlds (Hunter p.16).

Wherever there is a story of love, there is an immense gamble on the part of the lover as to whether or not their beloved will return their feelings. With love being such a ubiquitous theme in Bucolic poetry, there are several stories that feature an individual expressing his love for another who doesn't return the romantic feelings. Three of the most prominent poets to portray this theme were Theocritus, Vergil and Longus, with each poet bringing his own perspective to the nature of spurned love. This paper aims to analyze how each of these poets portray unrequited love in his own light while deepening the same literary tradition. In Theocritus' writing, for example, there are a multitude of solutions for coping with unrequited love, but Theocritus seemingly advocated for paths that weren't self-destructive. Furthermore, Theocritus claims that there are paths of coping that allow for the spurned lover to healthily move on from their beloved or even convince the beloved to love them. In Vergil's poetry however, there is a much more tragic tone, since the most satisfactory end to a tale of unrequited love features the lover moving on from wallowing in his own self pity, but admitting that he still holds on to the beloved who abandoned him. Lastly, Longus has the most stereotypically romantic outlook of the three authors. In Longus' writing, while unrequited love can still result in death, that is only the case in instances where a third party attempts to infiltrate a relationship preordained by the gods, which is otherwise a matter of self discovery more than winning over the beloved.

What each of these interpretations share, though, is the pain that stems from unrequited love, a toll so great that it makes characters at least consider suicide in each of the three authors' writings. Moreover, each of the authors use scenes that compare the state of nature to the state of the lover or beloved, each demonstrating the depth of what love has done to each character, making the theme of love extend beyond the scope of mere human concern.

Research Fellow: David Xiu (2024) **Concentrations:** English; Philosophy
Faculty Mentor: Julie Dudrick **Department:** Upstate Institute
Title of Project: Modern United Way: The Response to Our Changing World
Funding Source: Upstate Institute
Project Summary:

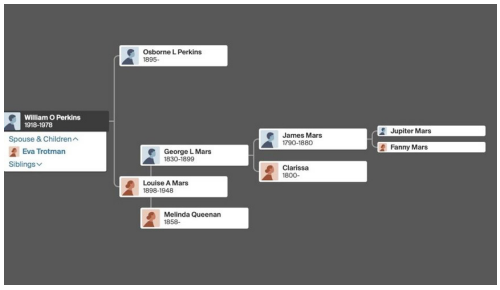
This summer I had the great opportunity to work with Chenango United Way. Their work includes improving education in local communities, helping people achieve financial stability, and promoting healthy lives. Currently, Chenango United Way is building affiliation with United Way of Madison County and United Way of Delaware & Otsego Counties. The work I did this summer is closely related to the ongoing establishment of this affiliation, including implementing modern United Way self-assessment to United Way of Madison County and United Way of Delaware & Otsego Counties, assisting in the daily work of the Chenango United Way, and engaging in a mid-year site visits to organizations receiving funding from the United Way.

My main project is to conduct a Modern United Way self-assessment for the United Way of Madison County and United Way of Delaware & Otsego Counties. This project includes designing the self-assessment survey through the instruction by United Way WorldWide, distributing surveys through an online platform, and producing a survey report after collecting and analyzing distributed surveys. The self-assessment survey is essential for local United Way organizations to identify current problems and draft future business plans. The span of this project spread over seven weeks. Therefore, I also participated in other United Way projects while working on the main project. By participating in their daily work, I have gained a more comprehensive understanding of the operation of small local philanthropy. I organized various data tables, witnessed the ongoing merger between three United Ways, and participated in online meetings. These daily tasks provided me with a more comprehensive view of the work of the United Way.

The opportunity to work at Chenango United Way this summer has given me knowledge of the operation of philanthropy and non-profit organizations in the local community. The professional and friendly working environment gave me opportunities to have conversations with core staff members of local non-profits. As a student enrolled in a liberal art college, and as an English and Philosophy double major, I not only have precious knowledge written in books but also the opportunity to learn the world comprehensively through different dimensions. This summer at Chenango United Way I work alone with these inspirational people who devote themselves to helping those who are worse off. To end, I will borrow a quote from Immanuel Kant: “Without sensibility no object would be given to us, and without understanding none would be thought. Thoughts without content are empty, intuitions without concepts are blind”. What I learned this summer is beyond theoretical knowledge; it is a ten weeks experience of an intellectual journey.

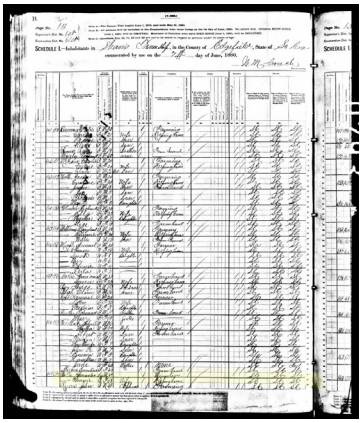
Research Fellow: Allison Yetter (2023) **Concentration:** History
Faculty Mentor: Graham Hodges **Departments:** History; Africana and Latin American Studies
Title of Project: Survivors of the Underground Railroad
Funding Source: SOSC Division
Project Summary:

The focus of my research this summer was African Americans who escaped slavery through the Underground Railroad. This was not an actual railroad, but rather the name given to the network of abolitionists who established safe houses and aid to those who were fleeing enslavement. Through the use of the University of North Carolina at Chapel Hill's collection of North American Slave Narratives, I was able to access biographies and autobiographies of those that escaped slavery and lived as free people. From there, I collectected information on their lineage and where their descendants lived. In this way, a large portion of my research was dedicated to genealogical work surrounding these figures. I did encounter some limitations, and after reading fifty-four biographies, I found that only seven of them had enough information to search for their descendants on ancestrylibrary.com. Many of these biographies did not mention the subject's children, or if they did, oftentimes their birth dates and names were not included. By using the information I found, I was able to compile information on their lineage and retrieve their family trees.



James Mars Family Tree

This research made me appreciate the nuance that each individual brought to a broader historical development. There has often been an oversimplified conception of the institution of American slavery, and my research disproved a lot of common misconceptions surrounding the topic. I read about people suffering from the bonds of slavery in states ranging from Connecticut to Maryland to Alabama, contradicting the common narrative that slavery existed solely in the Deep South. The reality was that slavery existed throughout the country, not solely in the South. Furthermore, I read about people who had mostly White lineage that were enslaved, an aspect of this subject that has not often been discussed. Because there was a pervasive issue of slaveowners commiting sexual violence and rape towards enslaved women, there were children born into slavery that had light hair and eyes. For example, Louisa Picquet, an enslaved woman that became free, stated that she and her children appeared White, but they were classified as Black because their ancestors had been enslaved. Another one of my main takeaways from this research was the financial turmoil Black Americans faced, even after escaping slavery. Due to limited employment opportunities for Black Americans and even fewer jobs that paid well, many of the people I researched had a difficult time supporting themselves and their families. For example, James Mars, a man that was enslaved in Connecticut but ran away to freedom, labored well into his seventies. Despite having many children, none of them could support their father economically. He relied primarily on revenue from his autobiography sales. Fanny McCray, another formerly enslaved person from Ohio, struggled to make ends meet on her family farm. The struggles of Black Americans extended far beyond slavery.


1880 United States Federal Census for Alexander Bettis. Retrieved from ancestry.com

In closing, this research emphasized the various complexities of American slavery. There has often been an emphasis on the litigation and politics surrounding American slavery as a whole, but my research was focused on the personal side of the issue. Many of the people I studied mentioned that the separation of families was the most painful part of enslavement. Oftentimes, discussion of this topic has been reduced to what was occurring in Washington D.C. rather than the people that were impacted. Their priorities and struggles were mainly family and survival. Furthermore, I am more aware of the limitations of historical research and how we only have access to a certain number of perspectives. I am looking forward to incorporating what I have learned into my future historical pursuits.

Research Fellow: **Bella Yu (2024)** **Concentration:** **Molecular Biology**
Faculty Mentor: **Priscilla Van Wynsberghe** **Department:** **Biology**
Title of Project: **Gustatory Receptors LITE-1 and GUR-3 Affect Circadian Clock Genes in *C. elegans***
Funding Source: **Oberheim Memorial Fund**

Project Summary:

Caenorhabditis elegans, abbreviated as *C. elegans*, are microscopic, transparent, terrestrial roundworms often used in scientific research as model organisms in order to better understand biological processes potentially similar in humans. They are often used as model organisms because 40% of their genome is homologous in humans. In other words, the organism has genes similar in evolutionary origin to human genes, indicating that they may function similarly. In addition, a model organism is used because the human genome is very complex and intricate, while the genome of *C. elegans* may be simpler. For instance, the roundworms may have fewer copies of a specific gene in their genome than humans. Both humans and *C. elegans* function with circadian rhythms; circadian rhythms involve natural processes that follow a 24-hour cycle. Environmental cues are taken into the organism by signaling like on a receptor on a cell's membrane. Light or temperature are examples of these environmental cues. These cues signal the genes involving circadian rhythm, known as oscillator genes or clock genes, to either turn on and/or off in a cyclic fashion over 24 hours. This oscillation leads to a physical, mental, or behavioral change in the organism.

This research focused on the effects of two receptors, LITE-1 and GUR-3, on their circadian rhythms in *C. elegans*. This is important because the circadian clock genes in *C. elegans*, LIN-42 and KIN-20, are homologous to Period (PER) protein in mammals. These genes are important to behavioral and developmental characteristics and changes in mammals. The effects of LIN-42 and KIN-20 on behavior and development were, thus, explored in this research. LIN-42 is a period protein that inhibits LET-7, which is a microRNA essential for development in the Larval 4 (L4) stage of development in *C. elegans*. Therefore the goal of this study was to investigate potential relationships between the gustatory, or taste, receptors LITE-1 and GUR-3 and LIN-42, directly and indirectly, and LET-7.

In order to understand on a molecular level what effects these receptors had on development, shown with LET-7 levels and LIN-42 levels, levels of LET-7 microRNA and LIN-42 mRNA were measured using quantitative PCR. Mutant strains of worms were reproduced and used to compare to a control worm strain N2. Many mutants were used, having defects in LITE-1, GUR-3, and/or LIN-42. The worms in populations of each respective strain, were grown and collected at the L4 stage for RNA extraction twice. Then, qPCR was used to compare the amounts of LET-7 miRNA and LIN-42 mRNA for each strain. As a result, GUR-3 appears to inhibit LET-7 miRNA expression while LITE-1 promotes it. In addition, GUR-3 and LITE-1 have an impact on LIN-42 mRNA levels, however, the impact is not yet clear. More research and repetition is needed to further understand these results. We plan on repeating these miRNA and mRNA quantifications with more samples. Also, a Western Blot using LITE-1 and GUR-3 mutants could be used to analyze LIN-42 protein levels in order to understand whether the receptors have more of an impact at the transcriptional or translational level.

In addition, a Chemotaxis Assay was performed to measure hydrogen peroxide avoidance as a behavioral phenotype. We were comparing the avoidance and recognition of the environmental cue, hydrogen peroxide, in worms with functional receptors and worms with non-functional receptors. Overall, this assay did not show consistent significant results. Thus, we plan on chemotaxis assay repetition in the future with more worms and possibly a more accurate assay.

Research Fellow: Krelyn Zacarias (2025) **Concentration:** Undeclared
Faculty Mentor: Beth Parks **Department:** Physics and Astronomy
Title of Project: Measuring Insulation within Buildings
Funding Source: NASC Division
Project Summary:

During the summer, I was part of a team researching insulation inside buildings. One of the largest energy uses in the U.S. is heating and cooling within buildings. With proper insulation, the amount of energy used decreases. To find out if a building has proper insulation, the R-value, or thermal resistance of a wall, has to be measured. Since there are no easy-to-use tools to measure R-values, homeowners have to locate and hire an energy contractor, which may be difficult, time-consuming, and expensive. My group's goal is to develop an inexpensive tool to measure the R-value.

The method we used to measure the R-value is based on the relationship shown in Figure 1. The equation can be used if there is a constant difference in temperature between the inside and outside (Figure 2). With that equation, we can find the unknown R-value. There were two test structures that we developed and researched this summer. To start simple, we used a Styrofoam House. It was a rectangular prism whose dimensions were (8ft x 4ft x 2ft) and was composed of R-10 polystyrene (Figure 2). After confirming that our equipment yielded the expected R-value for this structure, we used the Model House. The Model House was our way of imitating a house, which included studs, insulation, and a layer of plywood 0.5 in thick outside of the polystyrene insulation. To measure the R-value, we used thermometers, thermocouples, and heat flux transducers.

$$\frac{\Delta T_{Insulation}}{\Delta T_{Total}} = \frac{R_{Insulation}}{R_{Total}}$$

Figure 1. R-value equation

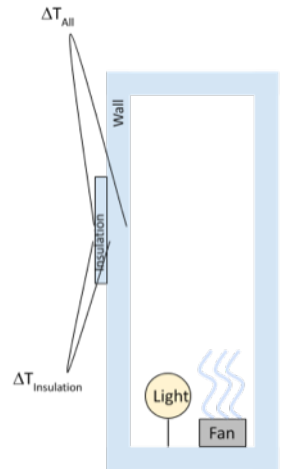


Figure 2. Styrofoam House

My part of the research consisted in making sure the temperatures inside and outside the Styrofoam and Model house were consistent. I placed many data-logging thermometers at different locations inside and outside the structure. It was important that the temperatures measured by the different thermometers should not be drastically different (example: 6°C); they should be less than 1°C. If they were drastically different, we started to seek out ways to make that difference in temperature decrease. Many of the outcomes came out to be either 1) increasing fan size, 2) increasing the voltage in the light bulb, or 3) moving the light bulb to point in a direction that is not on the thermometer.

In addition to researching the Styrofoam and Model House, we looked back at data from Spring 2022. To analyze the Spring 2022 data, I created a Matlab Script that was able to obtain the minimum values between different thermometers at every minute. In addition, the Matlab Script was capable of plotting the whole worth of data, or one day specifically, including the minimum temperature values.

With all of that research, some of the hands-on research was on constructing and organizing the Styrofoam and Model House, but also constructing a functioning thermostat that can turn off or on the light bulbs (our heating system) when needed. Hopefully, in the future, more research can be done on the Model House and complicating it more to imitate it more like a real house.

Research Fellow: **Jessica Zehner (2023)** **Concentration:** **Geology**

Faculty Mentor: **Alison Koleszar** **Department:** **Geology**

Title of Project: **Fieldwork and Laboratory Research Investigating Pre-Contact Eruption Dynamics on Augustine Volcano**

Funding Source: **NASC Division**

Project Summary:

Augustine Volcano is an intermediate arc volcano in Alaska's Cook Inlet, located 280 km southwest of Anchorage, and is part of the 4000 km long Aleutian Volcanic arc, which accounts for the vast majority of Alaska's 50 modernly active volcanoes (post-1741). Augustine is one of Alaska's most active and well known volcanoes, with recorded eruptions in 1883, 1935, 1964, 1976, 1986, and 2006 . Despite this high modern activity, tephra deposits from pre-contact eruptions (pre-1741) indicate that Augustine hosted even larger and more explosive eruptions in the past . Our research team is investigating what may have changed at Augustine Volcano to result in this difference in explosivity. This summer we traveled to Augustine to collect samples on two eruptions, "Tephra B" (390 y.p.b.) and "Tephra M" (750 y.p.b.). While there, we also collected samples from "Tephra C" (1000-1200 y.p.b.) . The deposits from Tephra C have become the focus of my research, and I will continue to investigate this eruption more thoroughly for my senior thesis.

We flew by sea plane from Homer, Alaska to Augustine Volcano where we camped and traveled daily to different field sites with colleagues and research partners from Western Washington University and the Alaska Volcano Observatory (AVO). Our primary field tasks were to dig out, describe, and sample a variety of outcrops of tephra from previous eruptions. The goal of this sampling was to collect tephra for our projects, as well as add to the existing characterizations of Augustine's deposits (e.g., Waitt & Beget (2009) and previous mapping by scientists at AVO).

Back at Colgate, our focus was preparing samples for geochemical analysis: cleaning and sieving samples, drying samples in the oven, identifying and describing the different components present in each sample. This componentry allows us to correlate our samples with other published works on Augustine (e.g. Power et al. (2010) , Benage et al. (2021) , Tappen et al. (2006)2). We also prepared samples for XRF analysis at Hamilton College by chipping, grinding, precisely weighing, and fusing samples. We will use the XRF data to compare and correlate samples across field sites.
For my independent research project, I am studying the evolution of Eruption C at Augustine to investigate changes in magma storage, mixing, source and explosivity throughout the eruption. I am especially interested in how these processes were changing immediately prior to and following the eruption of the tephra's middle lithic-rich layer. I hypothesize that I will observe an increase in clast size, vesiculation, and/or silica content that correlates with increased explosivity. The results from this research could provide key information about the eruption dynamics of intermediate arc volcanoes more broadly, which are some of the most common and threatening volcanoes on the planet.

[1] Coombs, M. L., Bull, K. F., Vallance, J. W., Schneider, D. J., Thoms, E. E., Wessels, R. L., & McGimsey, R. G. (2006). Timing, distribution, and volume of proximal products of the 2006 eruption of Augustine Volcano. *The*, 145-186.

[2] Tappen, C. M., Webster, J. D., Mandeville, C. W., & Roderick, D. (2009). Petrology and geochemistry of ca. 2100–1000 aBP magmas of Augustine volcano, Alaska, based on analysis of prehistoric pumiceous tephra. *Journal of Volcanology and Geothermal Research*, *183*(1-2), 42-62.

[3] Waitt, R. B., & Begét, J. E. (2009). *Volcanic processes and geology of Augustine Volcano, Alaska* (p. 78). US Geological Survey.

[4] Power, J.A., Coombs, M.L., and Freymueller, J.T., eds. (2010). The 2006 eruption of Augustine Volcano, Alaska: U.S. Geological Survey Professional Paper 1769, 667 p., 1 plate, scale 1:20,000, and data files.

[5] Benage, M. C., Wright, H., & Coombs, M. L. (2021). Eruption of compositionally heterogeneous andesites from a complex storage region during the 2006 eruption of Augustine Volcano. *Bulletin of Volcanology*, *83*(3), 1-23.

Research Fellow: Ruilin Zhang (2024) **Concentration: History**

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

Title of Project: Rejuvenating Local History

Funding Source: Upstate Institute

Project Summary:

Founded in 1876, the Oneida County History Center is a public non-profit organization located in the historical district of downtown Utica. It cares for a growing collection of over 250,000 documents and books, tens of thousands of images (photographs, paintings, slides, drawings, etc.), and thousands of artifacts from the city of Utica and surrounding Oneida County. As an area rich in its remarkable cultural & historical heritage, Oneida County was the stage for many significant events in the United States. The mission of Oneida County History Center (OCHC) is to protect and preserve the past of Oneida County and the Central New York region for present and future generations, and continue to make history alive today. The History Center seeks to make this rich heritage readily available to researchers, families, and students, enhancing the community's knowledge of and appreciation for its history.

One of the most important exhibitions at the Center is the Oneida County Historical Hall of Fame & Living Legends. As the oldest permanent exhibition in the museum, the Historical Hall of Fame first started in 1946, and a Living Legend category was added in 2000. Each year three to five new members are inducted into both categories and they are celebrated with an awards dinner and recognized in the permanent exhibit at the History Center. Inductees include world-renowned inventors, prominent politicians, nationally exhibited artists, and much more, all with strong connections to Oneida County. The goal of the Hall of Fame is to honor and record the historical contributions of Oneida County citizens to its community.

The development of virtual opportunities to engage with the public is stronger than ever in many museums, following the challenges of COVID-19. Therefore, my project Rejuvenating Local History focused on the design and implementation of a new interactive, digital component to the Historical Hall of Fame Gallery. With abundant primary and secondary sources ranging from videos to family genealogy files based on the biography of each individual figure from the Historical Hall of Fame, I had the opportunity to create a virtual exhibit that can be accessed through the history center website with three major steps: 1) Researching the biography of each inductee, categorizing individuals based on their living periods, and brainstorming the structure, theme, and layout of the virtual exhibition on the website. 2) Constructing a timeline with groups of inductees from different time periods; Grouping inductees with portraits & photographs based on occupations (soldiers, artists, writers) 3) Building website pages for external sources (lectures, archives, podcasts); Setting up QR codes for self-guided audio tours; Designing interactive message boards for visitors.

My project included many interactive elements in the virtual exhibition that aim to appeal to visitors of all ages and go beyond reading text panels. The implementation of self-guided activities as part of my project includes various forms of media I developed, such as podcasts, interview videos, and other related museum exhibitions. These programs not only enriched the content of the Hall of Fame exhibition but could also be reused by the OCHC for future inductees. The project will help the History Center to share its knowledge with a larger audience via the internet and attract new visitors to experience Oneida County's history from a new perspective. This project highlights the OCHC's relevance to the Upstate community as an educational institution and provides access to its great resources. I also assisted other museum board members to collect this year's nominations for the Hall of Fame and the Living Legends from the public by writing and editing the biography for each nominee, contacting local businesses to plan for this year's award ceremony venues in the fall, and create multiple social posts for museum summer events such as kids story hours, documentary filming, and a family scavenger hunt. My project will reinvigorate the Historical Hall of Fame Gallery and enable the audience to engage with the history of these significant individuals. Sharing Oneida County's history is important to the community to take pride in their shared heritage and cherish the cultural bonds among us.

Research Fellow: **Angela Zheng (2023)** **Concentrations:** **Educational Studies; Religion**

Faculty Mentor: **Sally Bonet** **Department:** **Educational Studies**

Title of Project: **Global Citizenship Development in Secondary Schools: A Case Study of The United States**

Funding Source: **SOSC Division**

Project Summary:

This summer, I conducted self-initiated research under the supervision of Professor Sally Bonet of the Educational Studies Department at Colgate University. The research investigated how American secondary schools effectively develop students' global citizenship. Specifically, I looked into the ways in which high schools help students develop a global perspective through social studies classes, world language classes, and extracurricular programs.

According to leading international organizations such as UNESCO, Asia Society, and OECD, the idea of Global Citizenship (or Global Competence) emphasizes a sense of belonging to a global community that implicates the development of individuals with intercultural knowledge and skills. Global citizens are also able to understand and appreciate different cultures. The theoretical framework of the present study is based on the synthesis of the Global Citizenship/Global Competence theories developed by Asia Society, UNESCO, and OECD. Based on the theoretical framework, I interviewed 14 Colgate students (current and alumni), including seven Caucasian American students, five international students, one Mexican American student, and one African American student. I interviewed research participants' experiences in high school and whether they are confident in being global citizens through high school courses. Going beyond their high school academic experiences, I also investigated students' extracurricular experiences to get a fuller picture of their global perspective development in high school.

The research yields mainly three types of students' attitudes toward their high schools' performance in developing them into competent global citizens: First, the school took students' global development seriously and was effective in developing them into global citizens. Second, the school did not take students' global development seriously and should be improved. Third, the school did not make global development a priority, but the school should not be blamed for the lack of global cultivation. Among all participants, over half expressed dissatisfaction with their schools' performance in global citizenship development. The research revealed three tensions exist in American high schools that may account for students' dissatisfaction: the tension between conservative religious or political environment and critical thinking development; the tension between low diversity and effective intercultural communication, and the tension between academic priority (getting good scores in AP tests, getting graduated, etc.) and in-class global/multicultural education.

To alleviate the aforementioned tensions, I concluded with the following possible suggestions based on the research. First, the school could encourage teachers (especially world language teachers) to bring critical global ideas into classes. In this way, despite the textbooks not including global issues, teachers may initiate the discussion in class to remedy global or intercultural knowledge that is beyond the textbooks but is undoubtedly critical to students' education. Second, teachers can intentionally create open spaces in class to allow students, who might possess more knowledge about the globe than teachers, to initiate meaningful discussions. Finally, since day students are mostly local Americans while boarding students are usually international students, high schools could try to mix day and boarding students better. This procedure creates more opportunities for different groups of students to engage in informal intercultural communication that is not hindered by the restriction imposed by the conservative environment.

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: **190**

Distribution of Students by Concentration (students with double majors are included twice)

Anthropology	6
Applied Math	2
Art and Art History	4
Arts and Humanities	1
Asian Studies	1
Astrogeophysics	3
Astronomy/Physics	5
Biochemistry	16
Biology	9
Chemistry	8
Classics	1
Computer Science	14
Computer Science/Mathematics	1
Economics	6
Educational Studies	2
English	8
Environmental Biology	4
Environmental Geography	4
Environmental Geology	2
Environmental Studies	6
Film and Media Studies	3
Geography	5
Geology	12
History	6
International Relations	4
Mathematical Economics	1
Mathematics	6
Molecular Biology	10
Natural Sciences	2
Neuroscience	3
Peace and Conflict Studies	3
Philosophy	6
Physics	13
Political Science	8
Psychological Science	2
Religion	1
Russian and Eurasian Studies	2
Sociology	4
Spanish	1
Undeclared	26
Women's Studies	1

Arts and Humanities	**22**
Art and Art History	4
Art and Humanities	1
Classics	1
English	8
Philosophy	6
Religion	1
Spanish	1
Natural Sciences and Mathematics	**107**
Applied Math	2
Astrogeophysics	3
Astronomy/Physics	5
Biochemistry	16
Biology	9
Chemistry	8
Computer Science	14
Computer Science/Mathmatics	1
Geology	12
Mathematical Economics	1
Mathematics	6
Molecular Biology	10
Natural Sciences	2
Neuroscience	3
Physical Science	0
Physics	13
Psychological Science	2
Social Sciences	**41**
Anthropology	6
Economics	6
Educational Studies	2
Geography	5
History	6
International Relations	4
Political Science	8
Sociology	4
University Studies	**26**
Asian Studies	1
Environmental Biology	4
Environmental Geography	4
Environmental Geology	2
Environmental Studies	6
Film and Media Studies	3
Peace and Conflict Studies	3
Russian and Eurasian Studies	2
Women's Studies	1
Undeclared	**26**

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	2
Classics	1
East Asian Languages and Literatures	2
English	4
Philosophy	1
Religion	1
Theater	2
Natural Sciences and Mathematics	**129**
Biology	24
Chemistry	30
Computer Science	6
Geology	24
Mathematics	10
Neuroscience	2
Physics and Astronomy	33
Social Sciences	**31**
Economics	1
Educational Studies	4
Geography	5
History	6
Political Science	9
Sociology and Anthropology	6
University Studies	**15**
African and Latin American Studies	3
Asian Studies	1
LGBTQ Studies	1
Environmental Studies	7
Peace and Conflict Studies	2
University Studies	1
Other	**39**
Center for Freedom and Western Civilization	8
Lampert Institute for Civic and Global Affairs	5
Upstate Institute	26

Distribution of Students by Funding Source

Internal	**129**
Center for Freedom and Western Civilization	8
Division of the Arts and Humanities	9
Division of Natural Sciences and Mathematics	63
Division of Social Sciences	16
Division of University Studies	2
Lampert Institute for Civic and Global Affairs	5
Upstate Institute	26
Endowed	**54**
Alexander V. Wasson Fund to Support American History	1
Bob Linsley/James McLelland Fund	1
Byron R. Hanke Endowed Fund- Enviornmental Studies	2
Doug Rankin ’53 Endowment-Appalachian Research	2
Doug Rankin ’53 Endowment-Geology Research	3
Endowed Fund for Peace Research	3
Hackett-Rathmell 1968 Memorial Fund	2
Holden Endowment Fund	1
J. Curtiss Taylor ’54 Endowed Student Research Fund	1
Justus ’43 and Jayne Schlichting Student Research Fund	9
Michael J. Wolk ’60 Heart Foundation	12
Miller-Cochran Fund	1
Mind, Brain and Behavoir Scholars Award	1
Norma Vergo Prize	2
Oberheim Memorial Fund	2
Picker Interdisciplinary Science Institute	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	3
External	**19**
Beckman Scholar Program	1
NASA New York Space Grant	3
National Institutes of Health (NIH) Area Grant	2
National Science Foundation Grant	13

Total Number of Participating Faculty:	**72**

(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	8
Art and Art History	2
Classics	1
East Asian Languages and Literatures	1
English	1
Philosophy	1
Religion	1
Theater	1
Natural Sciences and Mathematics	**41**
Biology	8
Chemistry	10
Computer Science	3
Geology	7
Mathematics	3
Neuroscience	1
Physics and Astronomy	9
Social Sciences	**20**
Economics	1
Educational Studies	3
Geography	4
History	3
Political Science	5
Sociology and Anthropology	4
University Studies	**8**
African and Latin American Studies	1
Asian Studies	1
LGBTQ Studies	1
Environmental Studies	2
Peace and Conflict Studies	2
University Studies	1
Other	**14**
Center for Freedom and Western Civilization	8
Lampert Institute for Civic and Global Affairs	5
Upstate Institute	1

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	8
Division of the Arts and Humanities	4
Division of Natural Sciences and Mathematics	29
Division of Social Sciences	10
Division of University Studies	1
Lampert Institute for Civic and Global Affairs	5
Upstate Institute	1
Endowed	**43**
Alexander V. Wasson Fund to Support American History	1
Bob Linsley/James McLelland Fund	1
Byron R. Hanke Endowed Fund- Enviornmental Studies	1
Doug Rankin ’53 Endowment-Appalachian Research	1
Doug Rankin ’53 Endowment-Geology Research	3
Endowed Fund for Peace Research	3
Hackett-Rathmell 1968 Memorial Fund	2
Holden Endowment Fund	1
J. Curtiss Taylor ’54 Endowed Student Research Fund	1
Justus ’43 and Jayne Schlichting Student Research Fund	7
Michael J. Wolk ’60 Heart Foundation	5
Miller-Cochran Fund	1
Mind, Brain and Behavoir Scholars Award	1
Norma Vergo Prize	2
Oberheim Memorial Fund	2
Picker Interdisciplinary Science Institute	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	3
External	**11**
Beckman Scholar Program	1
NASA New York Space Grant	2
National Institutes of Health (NIH) Area Grant	1
National Science Foundation Grant	7

COLGATE