Colgate University Summer Undergraduate Research Directory

Volume 25
2018

Cover photo: View of the summer research poster session from above in the atrium of the Ho Science Center. *Photo by Thomas Balonek.*

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Summer Undergraduate
Research Directory

Volume 25
2018

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

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List of Participants

DIVISION OF THE ARTS AND HUMANITIES (AHUM)

Department of Art and Art History

Name: Paul Jung 2020 (Mathematical Economics)
Mentor: Penny Lane (Art and Art History)
Title: *Documentary Film Production*
Funding: AHUM Division

Name: Allison "Ally" Shahidi 2019 (Physics)
Mentor: Robert "Bob" McVaugh (Art and Art History)
Title: *Documenting Colgate's Architectural Legacy*
Funding: AHUM Division; Career Services

Name: Alexandra "Alex" Weimer 2020 (English)
Mentor: Margaretha Haughwout (Art and Art History)
Title: *Eco-Arts in New York State*
Funding: AHUM Division

Department of the Classics

Name: Beth Caruana 2021 (Mathematics)
Mentor: Robert Garland (Classics)
Title: *Colgate in World History, Bicentennial Visualization Lab Project*
Funding: AHUM Division

Name: Julian Danetiu 2019 (Environmental Biology)
Mentor: Rebecca Ammerman (Classics)
Title: *Environmental Archaeology at Paestum, Italy (Summer of 2018)*
Funding: AHUM Division

Department of East Asian Languages and Literatures

Name: Sifan "Sophie" Chen 2020 (Art and Art History)
Mentor: Jing Wang (East Asian Languages and Literatures)
Title: *Reframing Hegel: Chinese and Western World Outlooks Juxtaposed*
Funding: AHUM Division

Name: Zhelun Zhou 2020 (History; Philosophy and Religion)
Mentor: John Crespi (East Asian Languages and Literatures)
Title: *"The Great Wall" and "Wolf Warrior 2": China Soft Power in its Recent Films*
Funding: J. Curtiss Taylor '54 Endowed Student Research Fund

Department of English

Name: Jonathan Abbott 2019 (English)
Mentor: Christina "CJ" Hauser (English)
Title: *Researching and Crafting Fiction on Closed Communities*
Funding: J. Curtiss Taylor '54 Endowed Student Research Fund

Name: Daniel Dougherty 2021 (Astrogeophysics)
Mentor: Christina "CJ" Hauser (English)
Title: *Science Fact vs. Science Fiction*
Funding: AHUM Division

Name: Heather Fredrick 2020 (International Relations)
Mentor: Jennifer Brice (English)
Title: *Living Writers*
Funding: AHUM Division

Name: Kimberly "Kim" Ravold 2019 (English)
Mentor: Jennifer Brice (English)
Title: *Living Writers*
Funding: AHUM Division

Department of Romance Languages and Literatures

Name: Amanda Gastel 2019 (French; Psychology)
Mentor: John Gallucci (Romance Languages and Literatures)
Title: *Translation from the French: Madame De La Tour du Pin in Upstate New York*
Funding: AHUM Division

Name: Christina Towse 2019 (French)
Mentor: John Gallucci (Romance Languages and Literatures)
Title: *Translation from the French: Madame De La Tour du Pin in Upstate New York*
Funding: AHUM Division

DIVISION OF NATURAL SCIENCES AND MATHEMATICS (NASC)

Department of Biology

Name: Katherine "Katie" Anderson 2021 (Undeclared)
Mentor: Ana Jimenez (Biology)
Title: *Oxidative Stress in Resident Birds*
Funding: NASC Division

Name: Peter "Pete" Baker 2020 (Biochemistry)
Mentor: Rajinikanth "Raj" Mohan (Biology)
Title: *Identifying Novel Regulatory Machinery of Immunity in Plants*
Funding: NASC Division

Name: Skyler Berardi 2019 (Biology)
Mentor: Timothy "Tim" McCay (Biology; Environmental Studies)
Title: *Crazy Worm Invasion*
Funding: Picker Interdisciplinary Science Institute

Name: Andrew Blum 2021 (Undeclared)
Mentor: Engda Hagos (Biology)
Title: *Krüppel-Like Factor 4 Regulates Glycolytic Metabolism and The Cellular Response to Metabolic Stress*
Funding: Michael J. Wolk '60 Heart Foundation

Name: Warren Carter 2020 (Molecular Biology)
Mentor: Geoffrey "Geoff" Holm (Biology)
Title: *Mechanisms and Functional Consequences of Reovirus Innate Immune Responses*
Funding: National Institutes of Health (NIH) Area Grant

Name: Ravendra Dhanraj 2019 (Neuroscience)
Mentor: Frank Frey (Biology; Environmental Studies)
Title: *To what extent does public awareness of epilepsy and attitudes towards people with epilepsy impact the access to antiepileptic treatments in Joanna and New Amsterdam, Guyana*
Funding: Lampert Institute for Civic and Global Affairs

Name: Taylor Flaherty 2020 (Molecular Biology)
Mentor: Priscilla Van Wynsberghe (Biology)
Title: *Molecular Analysis of Development in C. elegans*
Funding: NASC Division

Name: Rebecca Gowen 2019 (Molecular Biology)
Mentor: Krista Ingram (Biology)
Title: *Role of the Circadian Clock in Seasonal Affective Disorder*
Funding: Beckman Scholar Program

Name: Christine Horn 2019 (Biology)
Mentor: Frank Frey (Biology; Environmental Studies)
Title: *Volatile Organic Compound Expression in Response to Herbivory in Tomatoes*
Funding: Beckman Scholar Program

Name: Daniel "Danny" Jaris 2019 (Biology)
Mentor: Krista Ingram (Biology)
Title: *Facial Recognition on Harbor Seals in Harpswell, Maine*
Funding: NASC Division

Name: Emelei Klein 2019 (Molecular Biology)
Mentor: Jason Meyers (Biology; Neuroscience)
Title: *Control of Stem and Progenitor Cell Fate in Zebrafish Sensory Systems*
Funding: Michael J. Wolk '60 Heart Foundation

Name: Chelsey Koren 2019 (Biology)
Mentor: Frank Frey (Biology; Environmental Studies)
Title: *Assessing Antibacterial Activity of Traditional Medicinal Plants used by Haudenosaunee Peoples of New York State*
Funding: NASC Division

Name: Esther Lee 2020 (Molecular Biology)
Mentor: Jason Meyers (Biology; Neuroscience)
Title: *Control of Stem and Progenitor Cell Fate in Zebrafish Sensory Systems*
Funding: Michael J. Wolk '60 Heart Foundation

Name: Levan Mekerishvili 2020 (Molecular Biology)
Mentor: Jason Meyers (Biology; Neuroscience)
Title: *Control of Stem and Progenitor Cell Fate in Zebrafish Sensory Systems*
Funding: NASC Division

Name: Mostafa Mohamed 2021 (Undeclared)
Mentor: Timothy "Tim" McCay (Biology; Environmental Studies)
Title: *Studying Invasion by Exotic Crazy-Worms and Distributions of Native Earthworm Species in the Northeast*
Funding: NASC Division

Name: Julieanne Montaquila 2021 (Biology)
Mentor: Timothy "Tim" McCay (Biology; Environmental Studies)
Title: *Studying Invasion by Exotic Crazy-Worms and Distributions of Native Earthworm Species in the Northeast*
Funding: Picker Interdisciplinary Science Institute

Name: Erin O'Connor 2019 (Biology; Spanish)
Mentor: Ana Jimenez (Biology)
Title: *Oxidative Stress in Resident Birds*
Funding: Oberheim Memorial Fund

Name: Marisa Olavarria 2019 (Environmental Studies)
Mentor: James "Eddie" Watkins (Biology)
Title: *Role of Plant Functional Traits in Structuring Epiphytic and Terrestrial Fern Communities*
Funding: Science and Math Initiative-SMI (NASC Division)

Name: Allison "Alli" Reiner—St. Lawrence University 2020 (Biology; Statistics)
Mentor: Mahita Kadmiel (Biology)
Title: *The Sex-Biased Eyes: Sexual Dimorphism in Corneal Gene Expression*
Funding: New York Six Liberal Arts Consortium

Name: Carolyn Robb 2020 (Molecular Biology)
Mentor: Priscilla Van Wynsberghe (Biology)
Title: *Molecular Analysis of Development in C. elegans*
Funding: NASC Division

Name: Michael Sakirsky 2021 (Undeclared)
Mentor: Priscilla Van Wynsberghe (Biology)
Title: *Molecular Analysis of Development in C. elegans*
Funding: NASC Division

Name: Sarah Sampson 2019 (Molecular Biology)
Mentor: Geoffrey "Geoff" Holm (Biology)
Title: *Mechanisms and Functional Consequences of Reovirus Innate Immune Responses*
Funding: National Institutes of Health (NIH) Area Grant

Name: Kayla Schacher 2020 (Molecular Biology)
Mentor: Geoffrey "Geoff" Holm (Biology)
Title: *Effects of Reovirus Infection on Cellular Metabolism*
Funding: Michael J. Wolk '60 Heart Foundation

Name: Abagail "Abby" Sotomayor 2020 (Environmental Studies; Biology)
Mentor: James "Eddie" Watkins (Biology)
Title: *Role of Plant Functional Traits in Structuring Epiphytic and Terrestrial Fern Communities*
Funding: NASC Division

Name: Araven Tiroumalechetty 2019 (Physics; Molecular Biology)
Mentor: Rajinikanth "Raj" Mohan (Biology)
Title: *Identification of Novel Genes Involved in Effector Triggered Immunity (ETI) via Programmed Cell Death in Arabidopsis*
Funding: NASC Division

Name: Kailey Tobin 2019 (Biology)
Mentor: Ana Jimenez (Biology)
Title: *Oxidative Stress in Resident Birds*
Funding: Oberheim Memorial Fund

Name: Zachary "Zach" Walsh 2018 (Biochemistry)
Mentor: Engda Hagos (Biology)
Title: *Investigating the Influence of KLF4 on the Etabolic Profile of Mouse Embryonic Fibroblasts and Human Colorectal Cancer Cells*
Funding: Michael J. Wolk '60 Heart Foundation

Name: Jacob Watts 2021 (Biology)
Mentor: James "Eddie" Watkins (Biology)
Title: *Role of Plant Functional Traits in Structuring Epiphytic and Terrestrial Fern Communities*
Funding: NASC Division

Name: Emma Wellington 2019 (Asian Studies; Neuroscience)
Mentor: Frank Frey (Biology; Environmental Studies)
Title: *Fluctuating Asymmetry as a Result of Temperature Stress in Glycine Max*
Funding: NASC Division

Department of Chemistry

Name: Vincent "Vinny" Betti 2021 (Biochemistry)
Mentor: Jacob Goldberg (Chemistry)
Title: *Novel Unnatural Amino Acids to Study the Role of Hydrogen Bonding in Proteins*
Funding: Michael J. Wolk '60 Heart Foundation

Name: Matthew Bousquet 2020 (Chemistry)
Mentor: Jason Keith (Chemistry)
Title: *Applications of Density Functional Theory to Electronic Structure, Spectroscopy and Mechanism*
Funding: American Chemical Society Petroleum Research Fund

Name: Nora Burner 2020 (Chemistry)
Mentor: Ephraim Woods (Chemistry)
Title: *Reactive Transients in Atmospheric Photochemistry*
Funding: National Science Foundation Grant

Name: John Buttner 2019 (Chemistry)
Mentor: Anthony Chianese (Chemistry)
Title: *Bifunctional Catalysts for the Hydrogenation and Dehydrogenation of Polar Bonds*
Funding: Justus '43 and Jayne Schlichting Student Research Fund

Name: Harrison Chen 2019 (Chemistry)
Mentor: Jason Keith (Chemistry)
Title: *Applications of Density Functional Theory to Electronic Structure, Spectroscopy and Mechanism*
Funding: American Chemical Society Petroleum Research Fund

Name: Oliver Harris 2019 (Chemistry)
Mentor: Jason Keith (Chemistry)
Title: *Applications of Density Functional Theory to Electronic Structure, Spectroscopy and Mechanism*
Funding: American Chemical Society Petroleum Research Fund

Name: Tianyi "Mike" He 2019 (Philosophy; Chemistry)
Mentor: Anthony Chianese (Chemistry)
Title: *Bifunctional Catalysts for the Hydrogenation and Dehydrogenation of Polar Bonds*
Funding: National Science Foundation Grant

Name: Ezra Hornik 2019 (Chemistry)
Mentor: Ernie Nolen (Chemistry)
Title: *Towards the Synthesis of a Tn Antigen Mimic via Stereoselective Oxime Cyclization*
Funding: National Institutes of Health (NIH) Area Grant

Name: Kendra Jeans 2020 (Biochemistry)
Mentor: Ernie Nolen (Chemistry)
Title: *Esterification of Galactose Heptenitol and an L-Serine Analog for the Synthesis of a Tn Antigen Mimic*
Funding: National Institutes of Health (NIH) Area Grant

Name: Ryan Kiel 2019 (Biochemistry)
Mentor: Jacob Goldberg (Chemistry)
Title: *Novel Unnatural Amino Acids to Study the Role of Hydrogen Bonding in Proteins*
Funding: Miller-Cochran Fund

Name: Linh Le 2018 (Chemistry; Physics)
Mentor: Anthony Chianese (Chemistry)
Title: *Bifunctional Catalysts for the Hydrogenation and Dehydrogenation of Polar Bonds*
Funding: National Science Foundation Grant

Name: William "Will" Leiter 2020 (Chemistry)
Mentor: Ephraim Woods (Chemistry)
Title: *Reactive Transients in Atmospheric Photochemistry*
Funding: National Science Foundation Grant

Name: Brynn Lewis 2020 (Biochemistry)
Mentor: Ernie Nolen (Chemistry)
Title: *Synthesis of Glyco Amino Acids for Biomedical Studies*
Funding: National Institutes of Health (NIH) Area Grant

Name: Madeline "Maddie" Loffredo 2019 (Chemistry)
Mentor: Jacob Goldberg (Chemistry)
Title: *Novel Unnatural Amino Acids to Study the Role of Hydrogen Bonding in Proteins*
Funding: NASC Division

Name: Markus Miranda 2019 (Chemistry)
Mentor: Jason Keith (Chemistry)
Title: *Applications of Density Functional Theory to Electronic Structure, Spectroscopy and Mechanism*
Funding: American Chemical Society Petroleum Research Fund

Name: Akosua "Pomaa" Ofosuhene 2018 (Biochemistry)
Mentor: Ephraim Woods (Chemistry)
Title: *Reactive Transients in Atmospheric Photochemistry*
Funding: NASC Division

Name: John Pham 2020 (Mathematics; Chemistry)
Mentor: Anthony Chianese (Chemistry)
Title: *Ruthenium Catalysts for Ester Hydrogenation*
Funding: NASC Division

Name: Sara Robinson 2020 (Chemistry)
Mentor: G. Rick Geier (Chemistry)
Title: *Investigation of the Synthesis of N-Confused Ferrocenylporphyrin*
Funding: Warren Anderson Fund

Name: Valerie Rome 2021 (Biochemistry)
Mentor: G. Rick Geier (Chemistry)
Title: *Investigation of Reaction Conditions for the Synthesis of BOPHY*
Funding: NASC Division

Name: Sam Schlichting 2019 (Biochemistry)
Mentor: Jacob Goldberg (Chemistry)
Title: *Novel Unnatural Amino Acids to Study the Role of Hydrogen Bonding in Proteins*
Funding: NASC Division

Name: Veronica Switzer-Poplar 2019 (Biochemistry)
Mentor: Ephraim Woods (Chemistry)
Title: *Reactive Transients in Atmospheric Photochemistry*
Funding: NASC Division

Name: Katie Wasurick 2019 (Chemistry)
Mentor: G. Rick Geier (Chemistry)
Title: *Investigation of the Distribution of Porphyrinoid Products in a Two-Step, One-Flask Reaction of Pyrrole, Pentafluorobenzaldehyde, and Acetone*
Funding: NASC Division

Name: Leah Weisburn 2020 (Mathematics)
Mentor: Jason Keith (Chemistry)
Title: *Applications of Density Functional Theory to Electronic Structure, Spectroscopy and Mechanism*
Funding: American Chemical Society Petroleum Research Fund

Department of Computer Science

Name: George Armstrong 2018 (Mathematics)
Mentor: Michael Hay (Computer Science)
Title: *DPComp: Realistic Data Mining Under Differential Privacy*
Funding: National Science Foundation Grant

Name: Yesu Carter 2019 (Japanese; Computer Science)
Mentor: Joel Sommers (Computer Science)
Title: *Design of A Web Application For Food Allergens And Dietary Restrictions*
Funding: Science and Math Initiative-SMI (NASC Division)

Name: Rupika Chakraverti 2020 (Computer Science)
Mentor: Michael Hay (Computer Science)
Title: *DPComp: Realistic Data Mining Under Differential Privacy*
Funding: National Science Foundation Grant

Name: Priyadarshinee "Priya" Dhawka 2019 (Computer Science; German)
Mentor: Joel Sommers (Computer Science)
Title: *Design of a Web Application for Food Allergens and Dietary Restrictions*
Funding: NASC Division

Name: Ethan Dorow 2020 (Computer Science)
Mentor: Michael Hay (Computer Science)
Title: *DPComp: Realistic Data Mining Under Differential Privacy*
Funding: National Science Foundation Grant

Name: Muhammad Yasoob Ullah Khalid 2021 (Computer Science)
Mentor: Aaron Gember-Jacobson (Computer Science)
Title: *Deanonymization and Proximity Detection Using Wi-Fi*
Funding: Holden Endowment Fund

Name: Zhongwen "Kevin" Lian 2020 (Computer Science)
Mentor: Michael Hay (Computer Science)
Title: *DPComp: Realistic Data Mining Under Differential Privacy*
Funding: National Science Foundation Grant

Name: Liam Peng 2020 (Computer Science)
Mentor: Madeline E. Smith (Computer Science)
Title: *Eye Tracking Based Nystagmus Compensating System*
Funding: Holden Endowment Fund

Name: Margaret "Maggie" Reed 2020 (Computer Science)
Mentor: Madeline E. Smith (Computer Science)
Title: *Design of a Smartwatch App for Long-Distance Affective Communication*
Funding: NASC Division

Name: Ruchit Shrestha 2020 (Mathematics; Computer Science)
Mentor: Aaron Gember-Jacobson (Computer Science)
Title: *Finding Errors in Computer Network Configurations*
Funding: NASC Division

Name: Xinni "Ginni" Song 2020 (Music; Computer Science)
Mentor: Michael Hay (Computer Science)
Title: *DPComp: Realistic Data Mining Under Differential Privacy*
Funding: National Science Foundation Grant

Name: Xiaolin "Owen" Sun 2020 (Mathematical Economics)
Mentor: Aaron Gember-Jacobson (Computer Science)
Title: *Finding Errors in Computer Network Configurations*
Funding: National Science Foundation Grant

Name: Abiy Tekle 2020 (Computer Science)
Mentor: Madeline E. Smith (Computer Science)
Title: *Design of a Smartwatch App for Long-Distance Affective Communication*
Funding: NASC Division

Name: Cindy Vo 2020 (Psychology; Computer Science)
Mentor: Madeline E. Smith (Computer Science)
Funding: Research Council

Name: Xianghong "Paul" Wu 2021 (Computer Science)
Mentor: Madeline E. Smith (Computer Science)
Title: *Design of a Smartwatch App for Long-Distance Affective Communication*
Funding: NASC Division

Name: Xiyu "Cici" Wu 2021 (Educational Studies)
Mentor: Sandra Jackson (Computer Science)
Title: *New Architectures for Low-Power Complex Processing*
Funding: NASC Division

Name: Yuyou "Pomelo" Wu 2021 (Psychology)
Mentor: Elodie Fourquet (Computer Science)
Title: *Representing Depth for 2D Images Perception Experiments*
Funding: Picker Interdisciplinary Science Institute

Department of Geology

Name: Victoria Arnold 2019 (Geology)
Mentor: William Peck (Geology)
Title: *Natural Carbon Sequestration in Adirondack Mine Wastes*
Funding: Doug Rankin '53 Endowment-Geology Research

Name: Sean Corrigan 2018 (Astrogeophysics)
Mentor: Joseph "Joe" Levy (Geology)
Title: *Exploration Science: Mapping Antarctica and Mars and Simulating Titan Geological Processes*
Funding: NASA / New York Space Grant

Name: Julia Dottinger 2018 (Natural Sciences)
Mentor: Karen Harpp (Geology)
Title: *Virtual Galapagos Project*
Funding: NASC Division; National Science Foundation Grant

Name: Isabel Dove 2019 (Geology)
Mentor: Amy Leventer (Geology)
Title: *Polar Marine Diatoms and Antarctic Paleoclimate*
Funding: Bob Linsley/James McLelland Fund

Name: Margaret "Maggie" Dunn 2019 (Geography)
Mentor: Amy Leventer (Geology)
Title: *Aquaculture as a Possibility in Food Deserts*
Funding: Lampert Institute for Civic and Global Affairs

Name: Devin Ferri 2021 (Peace and Conflict Studies)
Mentor: Karen Harpp (Geology)
Title: *Virtual Galapagos Project*
Funding: Doug Rankin '53 Endowment-Geology Research;
Hackett-Rathmell 1968 Memorial Fund

Name: Adrian Heath 2019 (Geology)
Mentor: Joseph “Joe” Levy (Geology)
Title: *Exploration Science: Mapping Antarctica and Mars and Simulating Titan Geological Processes*
Funding: NASA / New York Space Grant

Name: Chelsea Jacques 2019 (Geology)
Mentor: Joseph “Joe” Levy (Geology)
Title: *Exploration Science: Mapping Antarctica and Mars and Simulating Titan Geological Processes*
Funding: NASA / New York Space Grant

Name: Meaghan Kendall 2021 (Natural Sciences)
Mentor: Amy Leventer (Geology)
Title: *Polar Marine Diatoms and Antarctic Paleoclimate*
Funding: Norma Vergo Prize

Name: Natalie Kozlowski 2019 (Environmental Geology)
Mentor: Amy Leventer (Geology)
Title: *Polar Marine Radiolarians and Antarctic Paleoclimate*
Funding: Hackett-Rathmell 1968 Memorial Fund

Name: Mark LaPan 2019 (Geology)
Mentor: William Peck (Geology)
Title: *Contact Metamorphism and Ore Formation During Intrusion of Adirondack Anorthosite*
Funding: Doug Rankin ’53 Endowment-Geology Research

Name: Patrick Matulka 2019 (Astrogeophysics)
Mentor: Joseph “Joe” Levy (Geology)
Title: *Exploration Science: Mapping Antarctica & Mars and Simulating Titan Geological Processes*
Funding: NASA / New York Space Grant

Name: Faith McDonald 2019 (Geology)
Mentor: William Peck (Geology)
Title: *Natural Carbon Sequestration in Adirondack Mine Wastes*
Funding: Doug Rankin ’53 Endowment-Appalachian Research

Name: Rachel Meyne 2021 (Undeclared)
Mentor: Amy Leventer (Geology)
Title: *Polar Marine Diatoms and Antarctic Paleoclimate*
Funding: Norma Vergo Prize

Name: Hayley Pearson 2019 (Geology)
Mentor: Joseph “Joe” Levy (Geology)
Title: *Exploration Science: Mapping Antarctica & Mars and Simulating Titan Geological Processes*
Funding: NASA / New York Space Grant

Name: Marie Pugliese 2020 (Biology)
Mentor: Karen Harpp (Geology)
Title: *Virtual Galapagos Project*
Funding: Doug Rankin ’53 Endowment-Geology Research; Norma Vergo Prize

Name: Kaitlin “Katie” Stansbury 2019 (Natural Sciences)
Mentor: Amy Leventer (Geology)
Title: *Polar Marine Diatoms and Antarctic Paleoclimate*
Funding: Bob Linsley/James McLelland Fund; Norma Vergo Prize

Name: Michelle Tebolt 2019 (Astrogeophysics)
Mentor: Joseph “Joe” Levy (Geology)
Title: *Exploration Science: Mapping Antarctica & Mars and Simulating Titan Geological Processes*
Funding: NASA / New York Space Grant

Name: Samuel “Sam” Timothy 2019 (Geology)
Mentor: William Peck (Geology)
Title: *Contact Metamorphism and Ore Formation During Intrusion of Adirondack Anorthosite*
Funding: Doug Rankin ’53 Endowment-Geology Research

Name: Jordan Tockstein 2020 (Astrogeophysics; Applied Math)
Mentor: Aubreya Adams (Geology)
Title: *Field Work: Earthquakes and Subduction On- and Off-shore of the Alaskan Peninsula*
Funding: National Science Foundation Grant

Name: Jordan Tockstein 2020 (Astrogeophysics; Applied Math)
Mentor: Aubreya Adams (Geology)
Title: *Field Work: Earthquakes and Subduction On- and Off-shore of the Alaskan Peninsula*
Funding: Doug Rankin ’53 Endowment-Appalachian Research

Name: Emily Weaver 2020 (Environmental Geology)
Mentor: Karen Harpp (Geology)
Title: *Virtual Galapagos Project*
Funding: Doug Rankin ’53 Endowment-Geology Research; National Science Foundation Grant

Name: Katherine “Katie” Weber 2020 (Molecular Biology)
Mentor: Karen Harpp (Geology)
Title: *Virtual Galapagos Project*
Funding: Doug Rankin ’53 Endowment-Appalachian Research; National Science Foundation Grant

Department of Neuroscience

Name: Rachel Dansereau 2020 (Neuroscience)
Mentor: Jason Meyers (Biology; Neuroscience)
Title: *Signaling Coordinating Sensory Cell Progenitor and Stem Cell Fate*
Funding: Science and Math Initiative-SMI (NASC Division)

Name: Allison “Ally” DePuyt 2020 (Neuroscience)
Mentor: Jun Yoshino (Neuroscience; Psychological and Brain Sciences)
Title: *Effects of Anti-Depressants on Nitric Oxide Released from Glial Cells*
Funding: NASC Division

Name: Marlene Lawston 2020 (Molecular Biology)
Mentor: Jason Meyers (Biology; Neuroscience)
Title: *Cavefish: A New Model Organism for the Study of Progenitor Cells*
Funding: Beckman Scholar Program

Name: Erin Santos 2020 (Neuroscience)
Mentor: Jun Yoshino (Neuroscience; Psychological and Brain Sciences)
Title: *Effects of Anti-Depressants on Nitric Oxide Released from Glial Cells*
Funding: NASC Division

Department of Physics and Astronomy

Name: Scott Adler 2019 (Physics)
Mentor: Beth Parks (Physics and Astronomy)
Title: *Developing Electronics for Monitoring Solar Cell Output*
Funding: Justus ’43 and Jayne Schlichting Student Research Fund

Name: Jocelyne Andrade 2019 (Astronomy/Physics)
Mentor: Jeffrey “Jeff” Bary (Physics and Astronomy)
Title: *Orbitally Modulated Accretion/Outflow Activity*
Funding: Justus ’43 and Jayne Schlichting Student Research Fund

Name: Aayam Bista 2020 (Physics)
Mentor: Enrique “Kiko” Galvez (Physics and Astronomy)
Title: *Engineering Liquid Crystal Optics*
Funding: Picker Interdisciplinary Science Institute

Name: Kaitlyn Eckart 2019 (Physics)
Mentor: Thomas Balonek (Physics and Astronomy)
Title: *Optical Variability of Quasars and Stars at the Colgate Observatory*
Funding: Justus ’43 and Jayne Schlichting Student Research Fund

Name: Amogh Gupta 2021 (Undeclared)
Mentor: Jonathan Levine (Physics and Astronomy)
Title: *Supporting the Development of a Spaceflight Dating Spectrometer*
Funding: Justus ’43 and Jayne Schlichting Student Research Fund

Name: Jin Won “Jin” Huh 2019 (Physics)
Mentor: Enrique “Kiko” Galvez (Physics and Astronomy)
Title: *Quantum Ghost Imaging*
Funding: NASC Division

Name: Laura Leonard 2019 (Physics)
Mentor: Cosmin Ilie (Physics and Astronomy)
Title: *Inflationary Physics with the Higgs Boson*
Funding: Justus ’43 and Jayne Schlichting Student Research Fund

Name: Rishi Lohar 2021 (Undeclared)
Mentor: Thomas Balonek (Physics and Astronomy)
Title: *Optical Variability of Quasars and Stars at the Colgate Observatory*
Funding: Justus ’43 and Jayne Schlichting Student Research Fund

Name: Justin Mailom 2020 (Japanese)
Mentor: Thomas Balonek (Physics and Astronomy)
Title: *Optical Variability of Quasars and Stars at the Colgate Observatory*
Funding: Justus ’43 and Jayne Schlichting Student Research Fund

Name: Anupama “Annie” Motee 2020 (Physics)
Mentor: Enrique “Kiko” Galvez (Physics and Astronomy)
Title: *Liquid Crystal Optics*
Funding: Justus ’43 and Jayne Schlichting Student Research Fund

Name: Cheeranjeev Purmessur 2020 (Physics)
Mentor: Beth Parks (Physics and Astronomy)
Title: *Measuring Building Insulation*
Funding: Justus ’43 and Jayne Schlichting Student Research Fund

Name: Yingsi Qin 2020 (Physics)
Mentor: Enrique “Kiko” Galvez (Physics and Astronomy)
Title: *Singularities in Optical Beams*
Funding: National Science Foundation Grant

Name: Lekshmi Rajagopal 2019 (Applied Math; Astronomy/Physics)
Mentor: Thomas Balonek (Physics and Astronomy)
Title: *Optical Variability of Quasars and Stars at the Colgate Observatory*
Funding: Justus ’43 and Jayne Schlichting Student Research Fund

Name: Eric Roels 2021 (Undeclared)
Mentor: Thomas Balonek (Physics and Astronomy)
Title: *Long Term Variability of Blazar OJ 287*
Funding: Justus ’43 and Jayne Schlichting Student Research Fund

Name: Lindsey Wiley 2020 (Mathematics; Physics)
Mentor: Beth Parks (Physics and Astronomy)
Title: *Analyzing Air Pollution Sources from Uganda*
Funding: Justus ’43 and Jayne Schlichting Student Research Fund

Name: Saiyang “Sylvan” Zhang 2019 (Astronomy/Physics; Applied Math)
Mentor: Walter Tangarite Garcia (Physics and Astronomy)
Title: *Phenomenology of Self-Interacting Dark Matter*
Funding: Justus ’43 and Jayne Schlichting Student Research Fund

Department of Psychological and Brain Sciences

Name: Kiana Billot-Vasquez 2020 (Neuroscience; Educational Studies)
Mentor: Spencer Kelly (Neuroscience; Psychological and Brain Sciences)
Title: *Dual Streams of Iconicity: Sound Symbolism and Iconic Gestures in Foreign Vocabulary Learning*
Funding: NASC Division

Name: MaKenna Cealie 2019 (Neuroscience)
Mentor: Wan-chun Liu (Psychological and Brain Sciences)
Title: *Identification of Potential Avian Hippocampal Subdivisions via Molecular Marker Genes*
Funding: NASC Division

Name: Mara Devia 2019 (Psychology)
Mentor: Spencer Kelly (Neuroscience; Psychological and Brain Sciences)
Title: *Dual Streams of Iconicity: Sound Symbolism and Iconic Gestures in Foreign Vocabulary Learning*
Funding: NASC Division

Name: Francesca Fernandez 2019 (Psychology)
Mentor: Caroline "Carrie" Keating (Psychological and Brain Sciences)
Title: *Neoteny in the Female Zebra Finch: Honest Signal or Masterful Manipulation?*
Funding: NASC Division

Name: Ada Gao 2019 (Psychology)
Mentor: Caroline "Carrie" Keating (Psychological and Brain Sciences)
Title: *Dialects of the Body: Concealing and Revealing Emotion and Power in US and Asian Cultures*
Funding: Science and Math Initiative-SMI (NASC Division)

Name: Caroline Hashagen 2019 (Psychology; Spanish)
Mentor: Jennifer Tomlinson (Psychological and Brain Sciences)
Title: *Understanding the Benefits of Shared Activities in Long-Term Relationships*
Funding: NASC Division

Name: Wentao Jiang 2021 (Undeclared)
Mentor: Julia Martinez (Psychological and Brain Sciences)
Title: *How Does Alcohol Play a Role in One's Identity Formation?*
Funding: NASC Division

Name: Yingyi "Wenny" Lin 2020 (Psychology)
Mentor: Caroline "Carrie" Keating (Psychological and Brain Sciences)
Title: *Dialects of the Body: Concealing and Revealing Emotion and Power in US and Asian Cultures*
Funding: NASC Division

Name: Grace Macdonald-Gagnon 2019 (Psychology)
Mentor: Julia Martinez (Psychological and Brain Sciences)
Title: *How Does Alcohol Play a Role in One's Identity Formation?*
Funding: NASC Division

Name: Iona MacKillop 2020 (Neuroscience)
Mentor: Ann Jane Tierney (Psychological and Brain Sciences)
Title: *The Effects of Serotonin and Serotonergic Ligands on Feeding and Satiety Behavior in Crayfish*
Funding: NASC Division

Name: Emma Meyer 2019 (Classical Studies; Psychology)
Mentor: Jennifer Tomlinson (Psychological and Brain Sciences)
Title: *Understanding the Benefits of Shared Activities in Long-Term Relationships*
Funding: NASC Division

Name: Abraham Rodriguez 2020 (Psychology)
Mentor: Julia Martinez (Psychological and Brain Sciences)
Title: *How Does Alcohol Play a Role in One's Identity Formation?*
Funding: NASC Division

Name: Gillian "Gill" Schutt 2020 (Neuroscience)
Mentor: Wan-chun Liu (Psychological and Brain Sciences)
Title: *Identify the Genetic and Behavioral Mechanisms of Communication Disorder*
Funding: NASC Division

Name: Carolyn Senneca 2020 (Neuroscience; English)
Mentor: Wan-chun Liu (Psychological and Brain Sciences)
Title: *Identify the Genetic and Behavioral Mechanisms of Communication Disorder*
Funding: NASC Division

Name: Jenna Taylor 2020 (Molecular Biology)
Mentor: Wan-chun Liu (Psychological and Brain Sciences)
Title: *Identification of Potential Avian Hippocampal Subdivisions via Molecular Marker Genes*
Funding: NASC Division

Name: Fanyi Zhang 2019 (French; Psychology)
Mentor: Jennifer Tomlinson (Psychological and Brain Sciences)
Title: *Understanding the Benefits of Shared Activities in Long-Term Relationships*
Funding: NASC Division

DIVISION OF SOCIAL SCIENCES (SOSC)

Department of Anthropology

Name: Seth Grimes 2019 (Anthropology; Psychology)
Mentor: Mary Moran (Anthropology; Africana and Latin American Studies)
Title: *The Modern Gladiators?: An Ethnography of the Lives of Combat Sports Competitors*
Funding: SOSC Division

Name: Olivia Miller 2020 (Anthropology)
Mentor: Elana Shever (Anthropology)
Title: *Making Mesozoic Meaning: People and Dinosaurs in the American West*
Funding: SOSC Division

Name: Trey Spadone 2020 (Anthropology)
Mentor: Elana Shever (Anthropology)
Title: *Exotic Specimens: Why Dinosaurs Will Never Go Out of Style*
Funding: SOSC Division

Department of Economics

Name: Payton Baker 2019 (Mathematical Economics; Computer Science)
Mentor: Erik Lillethun (Economics)
Title: *Machine Learning and its Economic Effects*
Funding: SOSC Division

Name: Leanne Fitzpatrick 2021 (Undeclared)
Mentor: Robert "Bob" Turner (Economics; Environmental Studies)
Title: *Contingent Choice Surveys of American National Parks*
Funding: SOSC Division

Name: Austin Movinski 2019 (Economics; Political Science)
Mentor: Richard "Rick" Klotz (Economics)
Title: *Who Benefits from Cleaning Up Ocean-Based Trade? The Impacts of Emissions Control Areas on Air Pollution and Transport Costs*
Funding: SOSC Division

Name: Justin Newman 2020 (Economics)
Mentor: Robert "Bob" Turner (Economics; Environmental Studies)
Title: *Contingent Choice Surveys of American National Parks*
Funding: SOSC Division

Name: Anh "Julie" Nguyen 2018 (Educational Studies; Mathematics)
Mentor: Margaret "Meg" Blume-Kohout (Economics)
Title: *Effects of the National Science and Mathematics Access to Retain Talent (SMART) Grant on STEM Degree Completion*
Funding: National Science Foundation Grant

Name: Ha "Jenny" Nguyen 2019 (Psychology; International Relations)
Mentor: Margaret "Meg" Blume-Kohout (Economics)
Title: *Effects of the National Science and Mathematics Access to Retain Talent (SMART) Grant on STEM Degree Completion*
Funding: National Science Foundation Grant

Name: Kheytsun Rinchhen 2019 (Environmental Economics; Geography)
Mentor: Robert "Bob" Turner (Economics; Environmental Studies)
Title: *Contingent Choice Surveys of American National Parks*
Funding: SOSC Division

Name: Jacob "Jake" Scott 2020 (Economics)
Mentor: Margaret "Meg" Blume-Kohout (Economics)
Title: *Incentivizing STEM Participation: Evidence from the SMART Grant Program*
Funding: National Science Foundation Grant

Name: Kexin "Tracy" Xu 2019 (Mathematical Economics; Psychology)
Mentor: Takao Kato (Economics)
Title: *Overjustification in the Chinese Work Place: Do Bonuses Motivate Work?*
Funding: Lampert Institute for Civic and Global Affairs

Name: Youhan "Carrie" Zhang 2020 (Economics)
Mentor: Takao Kato (Economics)
Title: *Regional Variations in China's One Child Policy*
Funding: Walter Broughton '63 Research Fund

Department of Educational Studies

Name: Edward "Ned" Campbell GR (MAT English)
Mentor: Margery "Meg" Gardner (Educational Studies)
Title: *An Evaluation of Colgate's Teacher Preparation Program*
Funding: SOSC Division

Name: Dylann McLaughlin 2018 (English)
Mentor: Margery "Meg" Gardner (Educational Studies)
Title: *An Evaluation of Colgate's Teacher Preparation Program*
Funding: SOSC Division

Name: Leiya Salis 2019 (Social Sciences)
Mentor: Sally Bonet (Educational Studies)
Title: *What's in a Citizen? An Exploratory Study of the Effectiveness of England's Approach to Citizenship Education*
Funding: Lampert Institute for Civic and Global Affairs

Department of Geography

Name: James Chaplin 2020 (Asian Studies)
Mentor: Daisaku "Dai" Yamamoto (Geography; Asian Studies)
Title: *Why do People Live in Disaster-Prone Houses? Machiya Preservation and Urban Sustainability in Kyoto*
Funding: SOSC Division

Name: Elena Forbath 2021 (Undeclared)
Mentor: Heather Kropp and Michael "Mike" Loranty (Geography)
Title: *Combing Drone Remote Sensing and Field Measurements to Understand Plant Function*
Funding: National Science Foundation Grant

Name: Chloe Mansell 2019 (Geography)
Mentor: Adam Burnett (Geography)
Title: *Oxygen and Hydrogen Isotopes in the Hydrologic Cycle*
Funding: SOSC Division

Name: Nicholas Quinn 2020 (Geography)
Mentor: Heather Kropp and Michael "Mike" Loranty (Geography)
Title: *Investigating the Relationship Between Leaf Temperature and Water Stress in Local Shrub Populations*
Funding: SOSC Division

Department of History

Name: Katherine "Kate" Bundy 2020 (History)
Mentor: Heather Roller (History)
Title: *"The Generation of Change, the Generation of Peace:" Student Movements as a Formidable Political Engine in Colombia*
Funding: Lampert Institute for Civic and Global Affairs

Name: Alara Burgess 2021 (Sociology; History)
Mentor: Graham Hodges (History; Africana and Latin American Studies)
Title: *Black Flight in the Americas, 1500s-1865*
Funding: SOSC Division

Name: Sarah Jones 2019 (History)
Mentor: Dan Bouk (History)
Title: *From a Resource to a Colleague: Improving Foster Parent Retention in Missouri*
Funding: Lampert Institute for Civic and Global Affairs

Name: Phuong "Alicia" Nguyen 2020 (International Relations)
Mentor: Jennifer Hull (History)
Title: *Colgate Bicentennial: Rewriting the History of International Students, 1924 -1969*
Funding: SOSC Division

Name: Annina "Anna" Pluff 2020 (History)
Mentor: Raymond "Ray" Douglas (History)
Title: *Re-education Camps in Postwar Vietnam: Understanding Lines of Internment*
Funding: Lampert Institute for Civic and Global Affairs

Name: Annalise Simons 2021 (International Relations)
Mentor: Jennifer Hull (History)
Title: *Colgate Bicentennial: Rewriting Colgate's History*
Funding: SOSC Division

Name: Erik "Liam" Tuveson 2020 (History)
Mentor: Graham Hodges (History; Africana and Latin American Studies)
Title: *Black Flight in the Americas, 1500s-1865*
Funding: SOSC Division

Department of Political Science

Name: Eric Benoit 2019 (International Relations)
Mentor: Robert Kraynak (Political Science; Center for Freedom and Western Civilization)
Title: *John Jay – Religious Liberty and the American Founding*
Funding: Center for Freedom and Western Civilization (James Madison Research Fund)

Name: William "Caio" Driver 2020 (International Relations)
Mentor: Edward "Ed" Fogarty (Political Science)
Title: *Forcing Germany's Hand: Principle and Pragmatism in German Foreign Relations with Turkey since the European Migration Crisis*
Funding: Lampert Institute for Civic and Global Affairs

Name: Alec Hufford 2018 (Religion)
Mentor: Robert Kraynak (Political Science; Center for Freedom and Western Civilization)
Title: *Weeping Over Jerusalem Together: Discerning the Catholic Way in Israel Anew*
Funding: Center for Freedom and Western Civilization (Stone Summer Research Fund)

Name: Linh "Christine" Le 2019 (Mathematical Economics; International Relations)
Mentor: Edward "Ed" Fogarty (Political Science)
Title: *Humanitarian Intervention in Failed and Fragile States Post-Cold War: What Works, What Doesn't?*
Funding: David Hubbell Colgate Dennis Fund

Name: Yunhee Oh 2020 (International Relations; Mathematical Economics)
Mentor: Edward "Ed" Fogarty (Political Science)
Title: *The Role of International Sports Festival in Dyadic Hostile Relations*
Funding: Lampert Institute for Civic and Global Affairs

Name: William "Max" Waller 2021 (Economics)
Mentor: Barry Shain (Political Science)
Title: *Researching "Revolutionary-era American Pamphlet Literature in Context: a Documentary History, 1764-1776"*
Funding: SOSC Division

Name: Douglas "Doug" Whelan 2019 (Political Science)
Mentor: Barry Shain (Political Science)
Title: *Researching "Revolutionary-era American Pamphlet Literature in Context: a Documentary History, 1764-1776"*
Funding: SOSC Division

Department of Sociology

Name: Olivia "Liv" Castro 2019 (Sociology)
Mentor: Carolyn Hsu (Sociology)
Title: *Enhancing the Quality of Life: Physical Exercise and Social Networks in the Elder Generation*
Funding: Walter Broughton '63 Research Fund

Name: Mylah Chandler 2019 (Sociology)
Mentor: Alicia Simmons (Sociology)
Title: *News Framing of Police Killings of Unarmed Blacks*
Funding: SOSC Division

Name: Susan "Susie" Ness 2019 (Sociology)
Mentor: Jacqueline Villarrubia (Sociology)
Title: *Social Determinants of Teen Pregnancy in Rural Northern Michigan*
Funding: Lampert Institute for Civic and Global Affairs

Name: Chau Nguyen 2019 (Educational Studies; Sociology)
Mentor: Janel Benson (Sociology)
Title: *Urban Development in a Transitional Economy: Understanding the Effects of City Transformation on Vietnam's Street Vendors*
Funding: Lampert Institute for Civic and Global Affairs

Name: Gillian Nissenbaum 2019 (Sociology)
Mentor: Alicia Simmons (Sociology)
Title: *News Framing of Police Killings of Unarmed Blacks*
Funding: SOSC Division

DIVISION OF UNIVERSITY STUDIES (UNST)

Department of Environmental Studies

Name: Peter Bertone 2020 (Physics)
Mentor: Linda Tseng (Physics; Environmental Studies)
Title: *Characterization of Local Natural Water and Municipal Wastewater*
Funding: UNST Division

Name: Jeremy Bonte 2020 (Physics)
Mentor: Linda Tseng (Physics; Environmental Studies)
Title: *Plastics Degradation and Plasticizers Leaching*
Funding: UNST Division

Name: Matthew "Matt" Chistolini 2021 (Undeclared)
Mentor: Linda Tseng (Physics; Environmental Studies)
Title: *Plastics Degradation and Plasticizers Leaching*
Funding: Research Council

Name: Vanessa Escobar Acosta 2019 (Environmental Studies; Spanish)
Mentor: Andrew "Andy" Pattison (Environmental Studies)
Title: *Administration and Perceptions of Water Resources in Northwest Honduras: Case Studies of a National Park, a Wildlife Reserve and a Botanical Garden in Comayagua, Yoro, and Atlántida, Honduras*
Funding: Lampert Institute for Civic and Global Affairs

Name: Sihyun "Si" Wei 2021 (Undeclared)
Mentor: Linda Tseng (Physics; Environmental Studies)
Title: *Characterization of Local Natural Water and Municipal Wastewater*
Funding: UNST Division

Department of Film and Media Studies

Name: Alden DeBouter 2019 (Anthropology)
Mentor: Mary Simonson (Film and Media Studies; Women's Studies)
Title: *Staging Cinema: Performance, Liveness, and the Transition to Sound*
Funding: UNST Division

Name: Vanessa Lizana 2020 (English)
Mentor: Mary Simonson (Film and Media Studies; Women's Studies)
Title: *Staging Cinema: Performance, Liveness, and the Transition to Sound*
Funding: UNST Division

CENTER FOR FREEDOM AND WESTERN CIVILIZATION

Name: Eric Benoit 2019 (International Relations)
Mentor: Robert Kraynak (Political Science; Center for Freedom and Western Civilization)
Title: *John Jay – Religious Liberty and the American Founding*
Funding: Center for Freedom and Western Civilization (James Madison Research Fund)

Name: Alec Hufford 2018 (Religion)
Mentor: Robert Kraynak (Political Science; Center for Freedom and Western Civilization)
Title: *Weeping Over Jerusalem Together: Discerning the Catholic Way in Israel Anew*
Funding: Center for Freedom and Western Civilization (Stone Summer Research Fund)

LAMPERT INSTITUTE FOR CIVIC AND GLOBAL AFFAIRS

Name: Katherine "Kate" Bundy 2020 (History)
Mentor: Heather Roller (History)
Title: *"The Generation of Change, the Generation of Peace:" Student Movements as a Formidable Political Engine in Colombia*
Funding: Lampert Institute for Civic and Global Affairs

Name: Ravendra Dhanraj 2019 (Neuroscience)
Mentor: Frank Frey (Biology; Environmental Studies)
Title: *To what extent does public awareness of epilepsy and attitudes towards people with epilepsy impact the access to antiepileptic treatments in Joanna and New Amsterdam, Guyana*
Funding: Lampert Institute for Civic and Global Affairs

Name: William “Caio” Driver 2020 (International Relations)
Mentor: Edward “Ed” Fogarty (Political Science)
Title: *Forcing Germany’s Hand: Principle and Pragmatism in German Foreign Relations with Turkey since the European Migration Crisis*
Funding: Lampert Institute for Civic and Global Affairs

Name: Margaret “Maggie” Dunn 2019 (Geography)
Mentor: Amy Leventer (Geology)
Title: *Aquaculture as a Possibility in Food Deserts*
Funding: Lampert Institute for Civic and Global Affairs

Name: Vanessa Escobar Acosta 2019 (Environmental Studies; Spanish)
Mentor: Andrew “Andy” Pattison (Environmental Studies)
Title: *Administration and Perceptions of Water Resources in Northwest Honduras: Case Studies of a National Park, a Wildlife Reserve and a Botanical Garden in Comayagua, Yoro, and Atlántida, Honduras*
Funding: Lampert Institute for Civic and Global Affairs

Name: Sarah Jones 2019 (History)
Mentor: Dan Bouk (History)
Title: *From a Resource to a Colleague: Improving Foster Parent Retention in Missouri*
Funding: Lampert Institute for Civic and Global Affairs

Name: Susan “Susie” Ness 2019 (Sociology)
Mentor: Jacqueline Villarrubia (Sociology)
Title: *Social Determinants of Teen Pregnancy in Rural Northern Michigan*
Funding: Lampert Institute for Civic and Global Affairs

Name: Chau Nguyen 2019 (Educational Studies; Sociology)
Mentor: Janel Benson (Sociology)
Title: *Urban Development in a Transitional Economy: Understanding the Effects of City Transformation on Vietnam’s Street Vendors*
Funding: Lampert Institute for Civic and Global Affairs

Name: Yunhee Oh 2020 (International Relations; Mathematical Economics)
Mentor: Edward “Ed” Fogarty (Political Science)
Title: *The Role of International Sports Festival in Dyadic Hostile Relations*
Funding: Lampert Institute for Civic and Global Affairs

Name: Annina “Anna” Pluff 2020 (History)
Mentor: Raymond “Ray” Douglas (History)
Title: *Re-education Camps in Postwar Vietnam: Understanding Lines of Internment*
Funding: Lampert Institute for Civic and Global Affairs

Name: Leiya Salis 2019 (Social Sciences)
Mentor: Sally Bonet (Educational Studies)
Title: *What’s in a Citizen? An Exploratory Study of the Effectiveness of England’s Approach to Citizenship Education*
Funding: Lampert Institute for Civic and Global Affairs

Name: Kexin “Tracy” Xu 2019 (Mathematical Economics; Psychology)
Mentor: Takao Kato (Economics)
Title: *Overjustification in the Chinese Work Place: Do Bonuses Motivate Work?*
Funding: Lampert Institute for Civic and Global Affairs

NEW YORK SIX LIBERAL ARTS CONSORTIUM

Name: Allison "Alli" Reiner—St. Lawrence University 2020 (Biology; Statistics)
Mentor: Mahita Kadmiel (Biology)
Title: *The Sex-Biased Eyes: Sexual Dimorphism in Corneal Gene Expression*
Funding: New York Six Liberal Arts Consortium

OTHER

Name: Caio Rodrigues Faria Brighenti 2020 (Peace and Conflict Studies; Computer Science)
Mentor: Joe Eakin (Vis Lab)
Title: *Virtual Galapagos Project*
Funding: Ho Tung Visualization Laboratory

Name: Samuel "Sam" Stuttard 2020 (Art and Art History)
Mentor: Joshua "Josh" Finnell (University Libraries)
Title: *3D Modeling Case-Geyer: A Pilot Project Immersive Technology Summer Institute 2018*
Funding: UNST Division

Name: Desmond Tuiyot 2020 (Japanese)
Mentor: Joe Eakin (Vis Lab)
Title: *Vis Lab Productions*
Funding: Ho Tung Visualization Laboratory

RESEARCH COUNCIL

Name: Matthew "Matt" Chistolini 2021 (Undeclared)
Mentor: Linda Tseng (Physics; Environmental Studies)
Title: *Plastics Degradation and Plasticizers Leaching*
Funding: Research Council

Name: Cindy Vo 2020 (Psychology; Computer Science)
Mentor: Madeline E. Smith (Computer Science)
Funding: Research Council

UPSTATE INSTITUTE

Name: Sarah Allen 2020 (Neuroscience)
Mentor: Julie Dudrick (Upstate Institute)
Title: *Hands-On Programming at the Utica Children's Museum*
Funding: Upstate Institute

Name: Louis Berkowitz 2020 (English; Political Science)
Mentor: Julie Dudrick (Upstate Institute)
Title: *Legal Aid Society of Mid-New York, Inc.: Consumer Bankruptcy Law Project*
Funding: Upstate Institute

Name: Erin Burke 2018 (History)
Mentor: Julie Dudrick (Upstate Institute)
Title: *National Abolition Hall of Fame: Assessing A Crusade for Social Reform*
Funding: Upstate Institute

Name: Claudia Buszta 2019 (Environmental Geography)
Mentor: Julie Dudrick (Upstate Institute)
Title: *Southern Madison Heritage Trust: Use of Aerial Photography Mapping to Establish Photographic Record of Land Trust Properties*
Funding: Upstate Institute

Name: Mackenzie Carroll 2019 (Economics; International Relations)
Mentor: Julie Dudrick (Upstate Institute)
Title: *Madison County Department of Health: Madison County's Healthy Workforce Initiative*
Funding: Upstate Institute

Name: Andrea De Hoyos 2020 (History)
Mentor: Julie Dudrick (Upstate Institute)
Title: *Fiver Children's Foundation: The Impact of A Public Speaking Curriculum on a Child's Self Confidence*
Funding: Upstate Institute

Name: Colleen Donlan 2018 (Political Science)
Mentor: Julie Dudrick (Upstate Institute)
Title: *ADK Action and the Keeseville "Farmacy": Good Health Begins at the Table*
Funding: Upstate Institute

Name: Miller Downer 2021 (Environmental Biology)
Mentor: Julie Dudrick (Upstate Institute)
Title: *Unpacking the Climate Smart Community Checklist with the Village and Town of Hamilton*
Funding: Upstate Institute

Name: Diana Flores 2020 (Peace and Conflict Studies; History)
Mentor: Julie Dudrick (Upstate Institute)
Title: *Mountain Lake PBS and "Promised Land": Original Opera and the Making of Rural Identity*
Funding: Upstate Institute

Name: Amanda Hauser 2019 (Neuroscience; Spanish)
Mentor: Julie Dudrick (Upstate Institute)
Title: *Assessing Transportation for the Madison County Rural Health Council and Madison County Emergency Management*
Funding: Upstate Institute

Name: Katrina Judicke 2020 (Psychology; Geography)
Mentor: Julie Dudrick (Upstate Institute)
Title: *Pathfinder Village: Employment Opportunities for People with Disabilities*
Funding: Upstate Institute

Name: Kayla Logar 2020 (Economics; Mathematics)
Mentor: Julie Dudrick (Upstate Institute)
Title: *Adirondack Foundation: A Survey of Gaps and Overlaps in Adirondack Philanthropy*
Funding: Upstate Institute

Name: Elizabeth "Lizzy" Moore 2020 (Peace and Conflict Studies; Geography)
Mentor: Julie Dudrick (Upstate Institute)
Title: *Agricultural Economic Development in Madison County: Marketing Techniques and Consumer Education for Farmers' Markets*
Funding: Upstate Institute

Name: Mackenzie Murphy 2018 (Neuroscience)
Mentor: Julie Dudrick (Upstate Institute)
Title: *End of Life Care with Hudson Headwaters Health Network*
Funding: Upstate Institute

Name: Revée Needham 2018 (Environmental Studies; Geography)
Mentor: Julie Dudrick (Upstate Institute)
Title: *Adirondack Council: The Future of Adirondack Forest Preserve Stewardship*
Funding: Upstate Institute

Name: Jolene Patrina 2019 (History)
Mentor: Julie Dudrick (Upstate Institute)
Title: *Oneida County History Center: The Mohawk Valley in the Great War*
Funding: Upstate Institute

Name: Madison Perez 2019 (Environmental Biology)
Mentor: Julie Dudrick (Upstate Institute)
Title: *Assessing the Effectiveness of the Adirondack Center for Loon Conservation's Educational Exhibits, Outreach, and Donor Satisfaction*
Funding: Upstate Institute

Name: Ashlea Raemer 2018 (Environmental Studies; Biology)
Mentor: Julie Dudrick (Upstate Institute)
Title: *Wildlife Conservation Society: Climate- and Wildlife-Friendly Farming in the Adirondacks*
Funding: Upstate Institute

Name: Emily "Emmy" Ritchey 2020 (English)
Mentor: Julie Dudrick (Upstate Institute)
Title: *Improving Administrative Processes and Strategic Planning at the Midtown Utica Community Center*
Funding: Upstate Institute

Name: Tuyen Phuong Ta Hoang 2020 (English)
Mentor: Julie Dudrick (Upstate Institute)
Title: *Friends of Rogers Environmental Education Center: Creating a Donor Profile for Effective Fundraising with a Nonprofit Organization*
Funding: Upstate Institute

Name: Alicia Violette 2019 (Biology)
Mentor: Julie Dudrick (Upstate Institute)
Title: *Madison County Council on Alcoholism and Substance Abuse, Inc: The Landscape of Substance Use and Abuse in Madison County*
Funding: Upstate Institute

Name: Qianhui “Eva” Wen 2021 (Undeclared)
Mentor: Julie Dudrick (Upstate Institute)
Title: *Abraham House: Promoting and Funding End of Life Care*
Funding: Upstate Institute

Name: Gabrielle “Gabby” Yates 2019 (Geography)
Mentor: Julie Dudrick (Upstate Institute)
Title: *Partnership for Community Development: Increased Walkability in the Hamilton Community*
Funding: Upstate Institute

Name: Shimiao Zuo 2021 (International Relations; Psychology)
Mentor: Julie Dudrick (Upstate Institute)
Title: *Mohawk Valley Resource Center for Refugee's Office of New Americans*
Funding: Upstate Institute

Research Summaries

Research Fellow: Jonathan Abbott (2019) **Concentration: English**

Faculty Mentor: Christina "CJ" Hauser **Department: English**

Title of Project: Researching and Crafting Fiction on Closed Communities

Project Summary:

My summer research at Colgate University was concerned with the literary fiction of isolation and closed communities. I split my ten weeks of work into two distinct five-week segments. The first of these halves was primarily dedicated to researching the literary techniques that prominent authors of the last century have used to depict isolated peoples in their writing. I took advantage of the second five weeks to explore themes of isolation in my own craft. I read seven novels all largely having to deal with isolation in different veins—some concerned with overt cases of closed communities, others shedding light on isolation in unexpected places. During the research segment of my work I also explored three works of nonfiction. Two of these works cover the rise and fall of the Rajneeshee people in the early 1980s; the third was a memoir written by Nansook Hong that chronicles the injustices and trauma she faced while living with the founder of the Unification Church's family, Reverend Sun Myung Moon. Upon completing these various works and synthesizing some of the common literary tactics I observed, I dove into my own craft. After the initial rough draft, three workshops with my advisor, three rounds of editing, and numerous drafts later, the result was a small novella that currently stands as my longest complete, polished work of fiction: *Liberty Roads*.

The largest obstacle I noticed the closed communities in my readings facing, whether it was the long-established North Korean dictatorship or the young and quickly growing Rajneeshees, was the issue of how to keep a political system of isolation afloat over a long period of time. Often times issues of sustainability became evident on a more micro scale: how do specific individuals maintain certain powers and freedoms they've held for so long? While this notion of sustainability and the nuances surrounding the possibility of collapse are intriguing in their own right, this really isn't a ground-breaking observation. More importantly, so often this overshadowing idea of sustainability and searching for signs of an inevitable downfall distract from the other subtle politics and cultural phenomena occurring within these microcosms. I wanted to write a story that would allow for these types of subtle interactions to flourish while removing the clouds of sustainability and inevitable collapse. The result was my creation of "Heidi's Haulers," a cult of elderly residents at an assisted-living facility in present-day, eastern Indiana. I refer to these residents as "the Midwestern darlings," a largely conservative contingent, very much riling against PC culture. These people view modest two-story homes as mansions, they yearn for the past, and we like to think they exist in small numbers on the fringe. The Haulers' wish is simple: they don't want things to progress forward; they want to turn back the clock to the "Golden era" of nostalgia and 1950s whiteness. In this sense, these people aren't really that interesting—they're cliché at best. My mission was to make them interesting—make the reader look at their story and realize that their hatred and misguidedness is vital to our understanding of where we're at as a nation, their experiences not ones to be ignored.

The narration in my story shifts multiple times between an omniscient third-person and multiple first-persons. This tactic is not only one that yields for a more dynamic story, but it's one that I believe creates layers of complexity in my story and demonstrates characters on multiple occasions fighting to reclaim their voice. It was my intention for this element of the story to mirror what many disenfranchised, rural, white, lower-middle-class Americans are feeling today. Furthermore, the shifting narration is a tactic I observed in Adam Johnson's *The Orphan Master's Son.* Rife with death, destruction, mountain lions, and eighty-year-olds collectively running through parks, I believe the novella to be quite satiric at times. My work approaches the boundaries of realism, it attempts to juggle themes of isolation, death, authority, and fear while still maintaining clarity, and it certainly takes some risks. However, I believe my work this summer has bolstered my understanding of those living amongst us who may feel the most alone and forgotten, and my craft and the respect I have for my art have most certainly been elevated.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): J. Curtiss Taylor '54 Endowed Student Research Fund

Research Fellow: Scott Adler (2019) **Concentration: Physics**

Faculty Mentor: Beth Parks **Department: Physics and Astronomy**

Title of Project: Developing Electronics for Monitoring Solar Cell Output

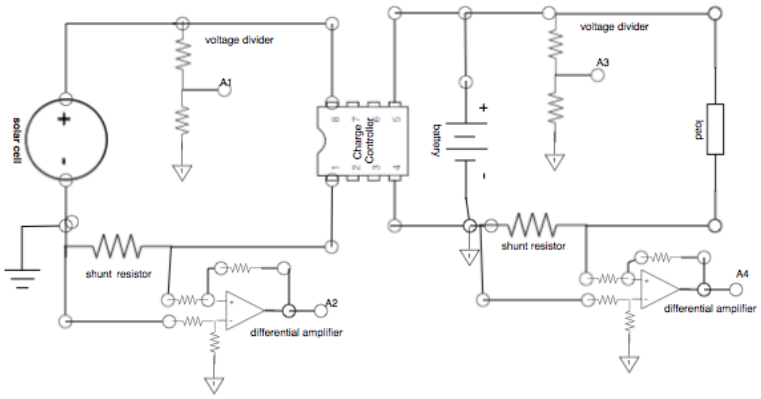
Project Summary:

Access to electricity, even on a small scale, greatly improves one's standard of living. In many developing countries, the majority of homes are not connected to the electrical grid. Having electricity allows people in developing countries to charge their cell phones at home instead of paying high fees for charging in town and illuminate lightbulbs in the evening as opposed to burning kerosene lamps, which have adverse respiratory health effects. Households in developing countries face two main challenges when upgrading to electricity: sourcing and affordability. A standalone solar power system is a viable solution, since it generates and stores electricity in isolation and is relatively inexpensive.

Solar tracking is a process whereby solar panels rotate throughout the day to follow the sun's trajectory. Solar tracking systems generate about 40% more energy than fixed solar systems. However, motor-based tracker systems are expensive and require service. Therefore, tracking systems can be advantageous in solar farms but are unsuitable for households in developing countries. My lab has developed an inexpensive tracking system that has the potential to significantly increase power production. The contraption is set up with a solar panel balancing on a stand (free to rotate) with a bag of rocks and a bucket of water as weights. At sunrise, the water outweighs the rocks, and the solar panel faces east. Throughout the day, a calibrated drip causes the bucket of water to get lighter. Thus, the solar panel follows the sun's trajectory, rotating west under the influence of gravity. This design has promise in developing countries where the labor required to build and set up the apparatus daily is cheap, unlike in First World countries where the cost of labor is expensive, making it impractical.


Solar cell tracker

The design was successfully tested at a Ugandan university and is ready to be tested under realistic conditions. A number of inexpensive and precise data loggers are necessary to carry out this testing. My contribution to the research project was developing electronics for monitoring solar cell output in order to test the novel solar tracking device in homes and businesses. I designed an electronics circuit controlled by an Arduino to measure and record data. A logger shield is stacked on top of the Arduino to maintain consistent timekeeping and timestamp every measurement (stored on a SD card). The circuit is programmed to record the date and time, voltage and current of the solar cell, and voltage and current of the battery. The voltages across the solar cell and battery are measured by assembling voltage dividers. Large resistors (on the order of 10^6 Ω) are used so that essentially no current flows along this path. The reduced voltage (between 0 and 5V) is read by an analog pin on the Arduino. The currents corresponding to the solar cell and battery are measured using shunt resistors followed by differential amplifiers and voltage amplifiers. Shunt resistors are low resistance precision resistors used to measure currents by reading the change in voltage across the shunt resistor. Using Ohm's law: V = IR (and knowing the resistance) a quick calculation yields the current. The solar power circuit is completed with a charge controller and rechargeable battery to store the energy.



Circuit diagram displaying electronics used to measure voltages and currents of the solar power system

My electronics monitoring system will be packaged in a durable waterproof box and transported to Uganda where testing will commence. Solar panels connected to the data logger will be given to a handful of Ugandan households who agree to take part in the research project in order to monitor how the tracker functions. Analysis of the results from this project will determine how much more energy the inexpensive solar tracking system generates compared to a fixed solar panel. Additionally, the data collected from the battery will be analyzed to understand how a typical Ugandan family uses electricity. This information will factor into a decision, concerning economic, environmental and social factors, to conclude whether these standalone solar systems are practical to implement in developing countries.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Justus '43 and Jayne Schlichting Student Research Fund

Research Fellow: Sarah Allen (2020) **Concentration: Neuroscience**

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

Title of Project: Hands-On Programming at the Utica Children's Museum

Project Summary:

Through the Upstate Institute Summer Field School, I was partnered with the Utica Children's museum, where I focused on developing new programming. The Children's Museum focuses on serving children primarily from the Utica community by providing them with a fun and engaging environment in which they can learn, explore, and express their creativity. Their mission statement highlights how the museum offers "an environment that supports children's natural curiosity to learn through hands-on, play-based exploration." The museum is under the management of Kids Oneida, an organization focused on providing support to families in the area. Their mission statement is, "to empower children, families and individuals who have high service needs and enabling them to live ways that are productive, healthy and meaningful." Together, these organizations provide services to children in need by providing a healthy learning environment.

I created a schedule of events for the months of September and October as well as smaller craft activities and individual events during the summer. I organized the museum's log of past events as well as supply lists and tutorials for craft activities. My work in planning and development involved researching what others had previously done for inspiration in addition to childhood development to determine what was appropriate for children of the museum's target age group.

Through this experience, I learned that the best way to foster learning in the children who attended the museum was to let children learn in a fun and hands-on manner. Because I thought this could be accomplished with hands-on craft activities and the reintroduction of Science Saturdays, where kids can take part in fun STEAM projects. I successfully proposed a complete schedule that incorporated these ideas for the fall. By developing these schedules, I helped to take some of the pressure off of other employees who don't have time to spend on programming. My hope is that this increased programming would help to increase museum attendance overall, provide children with more opportunities to learn in a fun and entertaining manner, and appeal to a greater number of children with various interests.

My time at the museum helped me to learn a great deal both about the work I was doing and the Utica community. I spoke with many community members who were grateful for the museum's presence and impressed by its growth in recent years. As someone from Upstate New York, I was glad to help my own community while developing business and management skills through observation and teamwork. The skills in leadership, management, and community building that I learned at the museum were an incredibly valuable component of my summer.

I also feel as though this experience has added to my academic experience at Colgate. I was able to apply research skills from the classroom in real world settings that could possibly be relevant to a future career. Though a career in a children's museum may not initially appear relevant to a neuroscience major, I believe many of the skills I developed at the museum could translate well into scientific research. The experience of looking at how childhood development can play into activities for children has caused me to consider studying developmental neuroscience to learn more about the biological basis for development. Overall, my time at the museum allowed me develop several valuable skills that I could utilize in any career field while gaining experience in applied research.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Upstate Institute

Research Fellow(s): Katherine "Katie" Anderson (2021) **Concentration: Undeclared**
Kailey Tobin (2019) **Concentration: Biology**

Faculty Mentor: Ana Jimenez **Department: Biology**

Title of Project: Oxidative Stress in Resident Birds

Project Summary:

Due to Anthropogenic Climate Change, global temperatures will increase and the instances of extreme weather events will increase as well. Therefore, the purpose of this research is to try to understand how year-long resident bird species in Upstate New York deal with both acute and chronic increases in temperature. The two species selected, the Black-Capped Chickadee and the Rock Pigeon, were chosen to not only understand how birds deal with temperature changes, but also to understand if there is a discrepancy in how organisms of different mass deal with environmental stressors. Physiologically, a measure of damage caused by an environmental stressor such as changes in temperatures outside of what the organism is used to is called oxidative stress. Oxidative stress occurs in the tissues of organisms when an increase in metabolism causes an imbalance between the organism's anti-oxidant capacity and the potentially harmful reactive oxygen species (ROS) produced by cellular respiration. When an endothermic organism, such as birds, is presented with temperatures outside of their thermal neutral zone, the organism will increase its metabolism in order to create the increased amount of energy it needs to perform the necessary processes, such as the building of heat shock proteins, to deal with the new temperatures. An already costly process, the upregulation of metabolism also means an increase in the creation of reactive oxygen species, which are a byproduct of cellular respiration, the processes required to produce ATP (cellular energy). These ROS are electronegative, which means they crave electrons and will damage molecules, such as DNA, lipids, and proteins to obtain them. To keep this damage at bay, organisms employ molecular safeguards in the form of enzymatic anti-oxidants. These anti-oxidants convert the (ROS) into the less harmful reactive oxygen species hydrogen peroxide or water, depending on the anti-oxidant. When balanced in concentration, these anti-oxidants keep the reactive oxygen species in check and prevent cellular and tissue damage. However, if an organism's metabolism is increased to deal with increased ambient temperatures, the organism must also be able to increase its enzymatic anti-oxidant capacity, otherwise the increased amount of reactive oxygen species will exist unchecked and cause damage.

To simulate increases in temperature, spring phenotype black-capped chickadees and rock pigeons were placed in the environmental chambers and subjected to one of six treatments. The treatments were subdivided into two groups, acute heat shock and chronic heat shock. This was done in order to simulate the consistent rise in global temperature created by Climate Change as well as to simulate the drastic and rapid temperature changes caused by the increase in frequency in temperature extremes. Within each group, there was a control, a heat shock group, and a heat shock and recovery group. The acute heat shock groups were heat shocked at 33^{o}C for 9 hours and the recovery group was then allowed to recover. The chronic groups were heat shocked for 6 hours per day at 33^{o} C for a total of five days and the recovery group was again allowed to recover. Brain and muscle tissues were collected from each bird and flash frozen in liquid nitrogen and then placed in a -80^{o}C freezer. These tissues were then measured for enzymatic anti-oxidant capacity as well as lipid peroxide concentration. For the enzymatic assays, the tissues were homogenized with 0.1 M PBS pH = 7.0 and then centrifuged at 14000 rpm for 20 minutes at 4^{o}C. The supernatants were then separated from the pellet and five chemical assays were run with them. The chemical assays measured Superoxide Dismutase, Catalase, and Glutathione Peroxidase concentrations as well as two ORAC assays that measured total anti-oxidant scavenging capacity for both hydroxyls and peroxyls. This was done using Cayman Chemical Assay kits, which required samples to be platted and then run through a plate reader at different absorbances. Absorbances were then transfigured into concentrations via a generated standard curve. For lipid peroxide concentrations (LPO) the tissue samples were homogenized with methanol and then centrifuged at 5000 rpm for 5 minutes at 4^{o}C. The supernatants were then separated from the pellet and assayed with the FOX cocktail. After 30 minutes, the plated samples were run through the plate reader at again; absorbance was converted into concentration via a generated standard curve. Black-Capped Chickadee tissue was also received from a collaborating lab who subjected the birds to cold shock instead of heat shock. The tissues received, liver, muscle, brain, and intestine, were subjected to the same chemical procedures detailed above.

While preliminary results appear very interesting, this project is ongoing and further experiments are needed to draw any conclusions.

Source of Support: ☐ AHUM Div. ☒ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Oberheim Memorial Fund

Research Fellow: Jocelyne Andrade (2019) **Concentration: Astronomy/Physics**

Faculty Mentor: Jeffrey "Jeff" Bary **Department: Physics and Astronomy**

Title of Project: Orbitally Modulated Accretion/Outflow Activity

Project Summary:

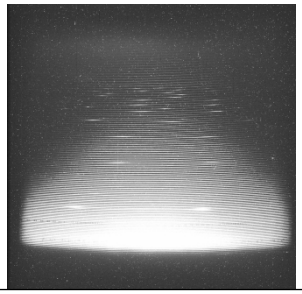
T Tauri stars (TTs) are young, variable, pre-main sequence stars with masses ranging from 0.5 – 2.0 solar masses and are less than 10^7 years old. Because of their young age, these stars have not begun fusing hydrogen in their cores, but we're able to see them because of the energy being created as they contract under gravity to their main sequence sizes. The subjects of this particular research project are DQ Tau, UZ Tau E, and V826 Tau. All three of these stars are T Tauri stars found in binary star systems — that is, they orbit another star. TTs are special in that, because they're young, most of these stars still have disks of gas and dust in orbit around them. From these *protoplanetary disks* new planets can form.

The goal of the project is to study the evolution of these protoplanetary disks through the analysis of light spectra. We reduced high-resolution optical (3,514 Å – 10,163 Å) and moderate-resolution near-infrared (0.9 μm – 2.46 μm) spectra of DQ Tau, UZ Tau E, and V826 Tau from two nights in 2014, two nights in 2015 and two nights in 2017. Data reduction was done using IRAF or xspectool in order to remove noise and atmospheric absorption features. From these reduced spectra, we took a look at emission lines that astronomers believe are indicators of magnetospheric accretion and other disk processes such as disk winds, inflows and outflows.

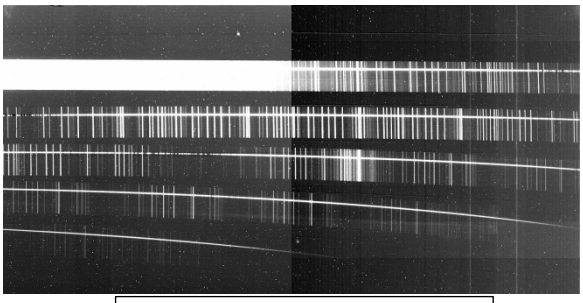
Once emission lines became more clearly identifiable, we were able to measure the equivalent widths — a proxy for measuring the area under a curve — in order to calculate the strength of the emission line. While we were able to compare relative strengths of particular emission lines across the different nights for each of the stars, work still has to be done to clean them up more. Eventually, the goal is to be able to extract mass accretion rates and material infall/outflow rates.

The final piece of this project focused on trying to gather more evidence for the occurrence of apastron flares from DQ Tau as well as trying to identify if this flaring activity exists at all on UZ Tau E and V826 Tau. This required producing plots of the emission features versus the star's orbital phase — the position of the star in its orbit with respect to a particular starting point. Again, without being able to further clean up the spectra to account for occulting processes like veiling, we were not able to fully determine if there was an apastron flare within our data for DQ Tau not could we point out flaring activity for the other two stars. More observations would be needed in order to fully identify flaring activity in the spectra of the stars, especially as a function of orbital phase.

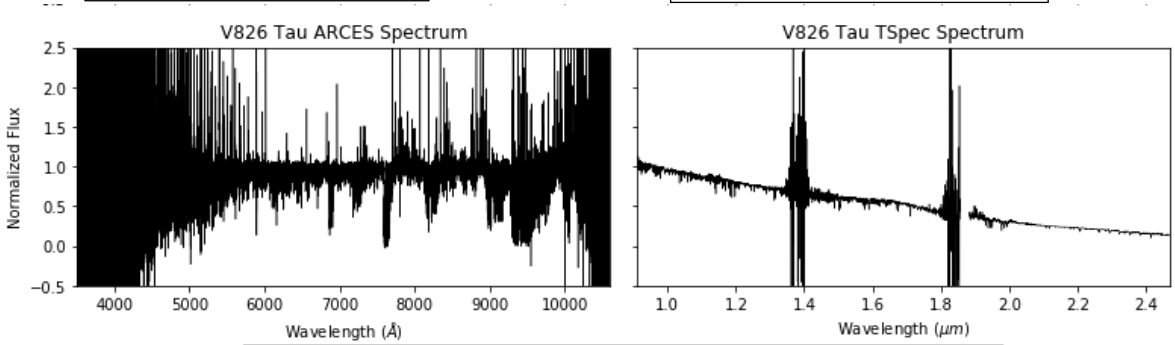
Other future work would include removing the effects of veiling from the spectra and modeling the emission features to gain a better sense of which processes are giving these light spectra their distinctive emission lines.



Raw, unreduced optical spectra.
There are 107 orders of information.



Raw, unreduced near infrared spectra.
There are 5 orders of information.



Optical (left) and infrared (right) spectra for V826 Tau before being treated for noise.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Justus '43 and Jayne Schlichting Student Research Fund

Research Fellow: George Armstrong (2018) **Concentration: Mathematics**

Faculty Mentor: Michael Hay **Department: Computer Science**

Title of Project: DPComp: Realistic Data Mining Under Differential Privacy

Project Summary:

Differential privacy provides a strong, quantifiable guarantee that individuals are unlikely to have their personal information leaked when aggregate information from a dataset is shared. The constraints of differential privacy require that specially designed algorithms are developed to release information with carefully constructed random perturbations to the results. These algorithms necessarily increase the errors in results and tend to be highly specialized. However, different algorithms can provide more accurate information at the same level of privacy. Our method, EMTree, is capable of producing similar results to the state of the art in differentially private histogram release. EMTree has a simpler proof of privacy and a more flexible framework that uses methods from the fields of statistics and artificial intelligence. As a result, EMTree demonstrates the potential to leverage more research from these areas and attract the interest of a broader community of researchers.

Histograms consist of two primary elements: bins that correspond to some subdomain of the data, and frequencies that are counts of the number of data points associated with each bin. In order for a histogram release procedure to be differentially private, each element must have noise added to the response. Even though the results are random, we can prioritize certain aspects of histograms that are desirable such that there is a high likelihood that the sampled histogram meets certain qualitative criteria. In general, histograms with a higher number of bins require that more noise is added to the frequency in each bin, thus deteriorating the quality of the results, even though the histogram has a high resolution. Additionally, histograms with a low resolution can tend to overgeneralize interesting patterns in the data. Thus, one goal of a good algorithm is to strike a balance between having a high resolution and not having to inject too much noise into the frequencies so that the most salient features of the data are preserved. Our method achieves this by a novel application of the exponential mechanism, a well-known privacy preserving technique.

In order to use the exponential mechanism in this context, our work draws from research on sampling from complex distributions, which is a widely studied problem in artificial intelligence. If formulated in the naïve way, the problem of sampling with the exponential mechanism is linear in the size of the support, which is intractable in this case. However, if we define the quality score for our exponential mechanism in a particular way, we can derive a Gibbs distribution over the possible sets of bins for our histograms. Then, this problem simplifies to running the belief propagation algorithm on a factor graph representing the distribution. We also propose a way to sample from distributions of histogram bins with an infinite support and provide criteria for setting the algorithm's parameters such that we can sample from this distribution in reasonable expected time.

The experimental results provided by using EMTree on real data are comparable to a state-of-the-art algorithm named PrivTree. We evaluate both methods by measuring the relative error in response to range queries on the released histogram and find that our method closely matches the state of the art. Additionally, we show that our method is robust with changes in its quality score, so histograms with various desired traits can easily be prioritized in the random generation step. Given the generalized nature and high performance of our approach, this work demonstrates the utility and potential for using the exponential mechanism in more sophisticated differential privacy settings.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): National Science Foundation Grant

Research Fellow(s): **Victoria Arnold (2019)** **Concentration: Geology**
Faith McDonald (2019) **Concentration: Geology**

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

Title of Project: Natural Carbon Sequestration in Adirondack Mine Wastes

Project Summary:

The Lewis Mine in the northeastern Adirondacks produces wollastonite, which is a mineral used by many industries to improve the strength of plastics or to replace the use of asbestos. Often after an area has been mined, the mining company leaves both the mined ore and waste rock in piles at the mine site. In many areas at the Lewis mine, we noticed cemented crusts on the top of old stockpiles of wollastonite ore that formed when the wollastonite waste rock weathered. Based on the composition of wollastonite ($CaSiO_3$), these crusts are likely formed by wollastonite and carbon dioxide combining to form calcite ($CaCO_3$) and quartz (SiO_2). One possible source for the carbon dioxide in this equation is the atmosphere, through a process called carbon sequestration, in which minerals draw carbon dioxide from the air and trap it into a solid, rather than gaseous, form. This process is important because carbon dioxide is a greenhouse gas that contributes to global climate change, and any process that can help remove some of the carbon dioxide in our atmosphere could help slow the effects of climate change. In this research project we sought to examine the weathering products from the Lewis Mine and consider their potential relationship to atmospheric carbon.

We collected multiple samples from the Lewis mine, some from pits we dug in the old ore stockpile berms and the rest were large cemented pieces of ore material that made up the crusts. After bringing the samples back to Colgate, we took pieces of the solid samples and mounted them in epoxy to create pucks for analysis on the SEM (scanning electron microscope). We covered the pucks in a thin film of carbon for imaging in the SEM. By using the SEM we were able to determine the mineralogy in the puck based on the elements in it. We also determined pH on samples taken from different depths within our berm pits by mixing the samples with RO (reverse osmosis) water and using a pH electrode. The main focus of our summer work was to determine the modal mineralogy of the crushed ore and cemented crust. This was done by X-ray diffraction and data processing using an Excel macro called Rock Jock. To prepare samples and collect data for this program, we first powdered between 3.5-5 g of sample of all our solid samples, all of the samples from one of our berm pits and a select few from our other pit. After powdering, we sieved the material through a #60 sized sieve and mixed 0.250 g of a corundum as an internal standard with 1 g of the powdered material. We then analyzed these samples using an X-ray diffractometer (XRD) which measures the d-spacings of the powder so that we could determine what specific minerals are in each sample. We then used the raw X-ray data and input it, along with standard files we created for wollastonite, garnet, and pyroxene, into Rock Jock. This program allows us to quantify the weight percent of each mineral in each sample.

This research is ongoing, but at this point we have some preliminary results. The pH of the samples from both the Lewis Berm Pit and the Crusher Berm transects are all neutral to mildly alkaline, usually with pH between 7 and 8, with no obvious trend between the top and bottom of the transects. The presence of calcite could explain these pH readings as carbonates are effective at neutralizing acids. Using the SEM, we observed evidence of quartz, garnet, and pyroxene, as well as wollastonite crystals surrounded by rinds of a silicon-rich material, possibly amorphous SiO_2 and a calcium-rich mineral, possibly calcite. These rinds could be evidence that the wollastonite is weathering into quartz and calcite, as predicted. Using Rock Jock, the well cemented chunks of rock typically have between 10-25% wollastonite, 40-70% garnet, and 15-20% pyroxene, while the less cemented pit samples have 30-60% wollastonite and less garnet and pyroxene proportionally, which could indicate that wollastonite has weathered away in the cemented samples.

In the future, this study will include deeper focus on the fines that make up the cements in the material as well as trying to quantify the amount of calcite present in the samples. We will also be investigating the stable isotope geochemistry of the carbon and oxygen in the calcite to determine if it contains atmospheric carbon.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Doug Rankin '53 Endowment-Appalachian Research;
Doug Rankin '53 Endowment-Geology Research

Research Fellow: Payton Baker (2019) **Concentration(s): Mathematical Economics; COSC**

Faculty Mentor: Erik Lillethun **Department: Economics**

Title of Project: Machine Learning and its Economic Effects

Project Summary:

My project this summer was to understand machine learning and its effects on the economy. The project started off with research into how machine learning works and the methods it takes to build the algorithms and how it has developed throughout the years. While initially methods were basic, the algorithms did build to become more complicated and involved Recurrent Neural Networks and Support Vector Machines. After understanding this process, I began research into economic reports about the current use of machine learning in the workplace environment. We began to understand the expectations and development of the algorithms and how firms were reacting to them. Using this information we began to look at where the machine learning algorithms were being deployed across the industry focusing on employment effects. Our regression model took many different looks over the course of the summer, initially trying to track jobs before using jobs as a component to industry effects that we needed to design our own algorithm to determine. Our initial results were that, excluding a few heavy data analytics industries such as finance and insurance, machine learning has a had a positive effect on employment.

With the coding of the algorithms, we started off attempting different experiments using different machine learning processes. After using a linear prediction model, we found that using a Recurrent Neural Network was the best process for understanding textual comprehension. Although originally we used numeric data sets to test the node structures and learning models within the nodes, all coded in Python in Anaconda's IDE. Our most effective example was using the Keras and Theanos packages run on a dataset provided by the Center for Disease Control to allow for predictive algorithms, using a recurrent neural network, to estimate if the person would have diabetes. Our model ended with a 77% success rate. When we switched the algorithm to text we had difficulties with the learning models due the complexity of the English language. Holding sentence structures, while being grammatically correct, required a depth of processor that I did not have and forced me to learn how to get an Amazon developer license to use proxy servers. When the time ended for algorithm work, we could divide stories into groupings with the algorithm able to identify the common structures for characters and locations, having a variety of grammatical tools to define them.

With respect to the economic side, two large problems arose while trying to collect the data. Foremost was that machine learning is a very cutting edge technology that is often being used in propriety uses and mostly is in its R&D phase. Firms are rare to announce their uses of the technology and the success of it. As such, most reports were high level consulting firms or previous economic reports that discussed automation scores. We had to translate the scattered data into firm use. We developed an algorithm that looked at skills used per industry using both OOS from the Census Bureau and from a McKinsey report looking at job skills used in industries vulnerable to automation. As our dependent variable was our automation score, we had to base it off of tasks in each industry taking into consideration time of task and its susceptibility to machine learning. After generating a score for each industry, we ran regression models with respect to each industry automation score while using industry output, gdp, population growth, and other macroeconomic and time control variables. Our initial results were that finance, insurance and management groups all had a slight negative correlation but none of the variables are statistically significant with the remaining industries having a slight positive coefficient that was not statistically significant. We began using two different processes in order to understand the beta coefficient better. The first is using a regression discontinuity using 2010 as a break date and looking, with a time after variable, to examine slopes and their rate after 2010 to see if there was an effect. Our second test is to pool our regression models so that our results will not be industry specific but rather would give a more accurate description whether machine learning is a substitutionary or complementary effect on industry employment. Our results are not complete in the writing of this paper and are being worked on beyond the scope of our initial project.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☒ SOSC Div. ☐ UNST Div.
☐ Other (specify):

Research Fellow: Peter "Pete" Baker (2020) **Concentration: Biochemistry**

Faculty Mentor: Rajinikanth "Raj" Mohan **Department: Biology**

Title of Project: Identifying Novel Regulatory Machinery of Immunity in Plants

Project Summary:

My summer research centered on an examination and characterization of a novel candidate gene, AP1, previously identified by Professor Mohan and believe to be involved in plant immune responses triggered by pathogen infections. The gene in question is believed to contribute to the programmed cell death (PCD) immune response of *Arabidopsis thaliana*. Plant immunity in comprised of two response mechanisms. The first mechanism is Pathogen Molecular Pattern (PAMP) Triggered Immunity, otherwise abbreviated as PTI. PTI relies on the extracellular recognition and detection of chemical structures common to pathogenic bacteria such as flagella, for example. However, some pathogens evolved to be able to disrupt or inhibit the PTI-Responses of plants thereby making these plant cells susceptible to infection yet again. In defense, plants evolved Effector Triggered Immunity (ETI) which is dependent on the – often intracellular – recognition of bacterial effector proteins intended to disrupt PTI. It is ETI responses that my work this summer centered on. Part of ETI associated responses in plant cells is PCD which protects the entire plant from pathogenic infection and disease by an "altruistic" sacrifice of a handful of initially infected cells. PCD is a very important defense mechanism present across many classes and kingdoms of life, serving as a mechanistic vanguard against disease, cell injury, and cancerous growth to name only a few examples.

In my research, multiple genotypes were used to examine the role of AP1. WT plants served as positive controls and baselines. TF57 is a suspected transcriptional activator of the AP1 so *tf57* mutants were used as negative controls. Mutated plants, containing t-DNA insertions (~5000 bp) within the AP1 disrupting its sequence and effective transcription were also treated with avirulent pathogen in an attempt to characterize as well as quantify the PCD of the wildtype and two mutants. Genetic analyses, genotyping PCR, cloning and genetic crossing, qPCR, and Western blotting were only some among the methods used in my research. My data confirmed induction of AP1 expression by avirulent pathogen treatments, Figure 1, as well as salicylic acid (SA) treatments. SA is a plant stress hormone commonly produced in response to pathogen detection on immune responses. In addition to qPCR and mRNA transcript analysis, ion leakage was performed to quantify the cell death as lysing cells release ions, increasing the conductivity of storage solutions.

While my obtained PCD phenotypes were inconclusive regarding differences of PCD in the *ap* genotype, I was able to use qPCR data to develop a preliminary mechanistic outline explaining the induction of AP1 in PCD responses, Figure 2.

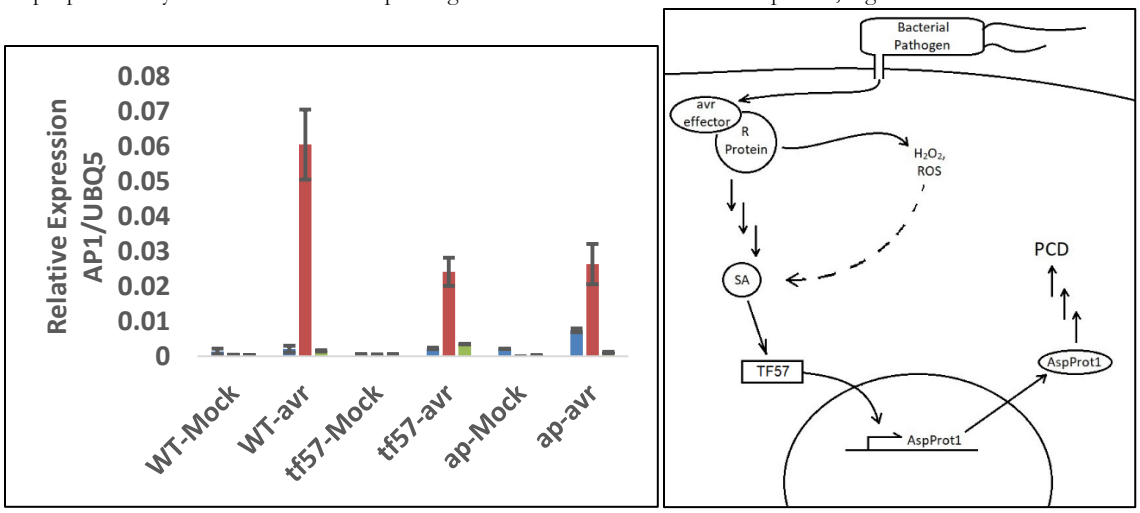


Figure 1. Relative levels of AP1 transcript following avirulent pathogen exposure in WT, *tf57* and ap1 genotypes. AP1 is greatest is WT as expected, in *tf57* mutant expression is reduced as TF57 is a suspected activator of AP1 transcription. AP1 expression in ap1 is still present due to potential heterogeneity of t-DNA insertion leading to a half knockout. The "avr" treatments were conducted by infiltrating true leaves with avrRpt2 (OD_{600}=0.02) suspended in 10mM $MgSO_4$. Mock treatments were infiltrations conducted in the same manner containing only 10mM $MgSO_4$. Relative expression level determined by comparison with UBQ5 – a constitutively expressed housekeeping gene.

Figure 2. The induction pathway of AP1 leading to PCD as an ETI response to avirulent pathogen exposure.

Source of Support: ☐ AHUM Div. ☒ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☐ Other (specify):

Research Fellow: Eric Benoit (2019) **Concentration: International Relations**

Faculty Mentor: Robert Kraynak **Department(s): POSC; Center for Freedom and Western Civilization**

Title of Project: John Jay – Religious Liberty and the American Founding

Project Summary:

Scholarship on the American Founding and the Founders typically focuses on the same figures. Men like Thomas Jefferson, Alexander Hamilton, James Madison, and George Washington are examined at length with regard to their views on natural rights and the role of government, both major topics in the study of the American Founding. However, in limiting scholarship to just those Founders who are the most well-known, a significant number of contributions to the Founding are overlooked. One such case is John Jay. Jay is perhaps the most notable Founder whose contributions are overlooked, possibly due to the fact that he never served as President, nor was he killed in duel by the sitting Vice President. Despite the relative lack of recognition of Jay's accomplishments, he had a noteworthy career in public service that spanned forty years, serving as the Foreign Minster to Spain, the first Chief Justice of the U.S. Supreme Court, and as Governor of New York. As a result of Jay's relative lack of recognition, most scholarship relating to Jay focuses on the accomplishments that prove his central role in the American Founding, rather than the personal experiences and perspectives that set him apart. Jay, unlike the other Founders, held a unique understanding of religious liberty that was influenced by both personal experience, his philosophy on the role of government, and his Christian faith. However, this understanding is often regarded as being more inclusive than it was in reality.

In one of the few scholarly pieces on John Jay involving his religious views, "John Jay and Religious Liberty," Dr. Jonathan Den Hartog, provides a jumping off point for examining Jay and his understanding of religious freedom. In his argument, Den Hartog makes four claims about Jay's understanding of religious liberty: it was influenced by his own personal experience and the experience of his family, it developed over time, it was meant to encourage a role for faith in politics, and his experience with religious liberty encouraged a voluntary expression of Christianity. While some of his claims regarding Jay's understanding of religious liberty are correct to an extent, he seems to overstate the role of Jay's family experience as persecuted Huguenots in Catholic France in shaping his thinking on the matter, and also mistakenly claims that Jay's understanding of religious liberty developed into a universal principle of freedom for all faiths.

Jay, unlike the other Founders, was devout in his religious convictions. While many of the Founders saw a role for religion in public life, it was viewed simply as a tool for the cultivation of republican virtue in the masses, as the general public was unable to reach conclusions regarding virtue and morality via reason, as did the intellectual Founders, like Thomas Jefferson. The least perplexing aspect of Jay's views on religious liberty may be his Anti-Catholic sentiments that arose as the result of his family's persecution in France and his fears that allegiance to the papacy and the ability of priests to forgive sins would threaten national security and the rule of law, as evidenced in personal works and his contributions to *The Federalist*. His true understanding of religious liberty, however, was not particularly inclusive, as he saw a major role for Christianity specifically in politics and, as evidenced by his "Address to the American Bible Society," in which he stresses the role of divine Providence in the American Founding and the view that religious freedom served as a way to create an environment in which Christianity could thrive. Thus, I argue that Jay had a unique view of religious liberty, not as a natural right, but as part of a Providential design for Christian evangelization.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Center for Freedom and Western Civilization
(James Madison Research Fund)

Research Fellow: Skyler Berardi (2019) **Concentration: Biology**

Faculty Mentor: Timothy "Tim" McCay **Department(s): Biology; Environmental Studies**

Title of Project: Crazy Worm Invasion

Project Summary:

Native earthworm species in the northeastern United States became extinct roughly 10,000 years ago during the last glaciation period, and native species have been slow to recolonize the northeast following the recession of the Wisconsin glacial shield. As European countries began establishing colonies in North America, settlers introduced invasive earthworm species that have changed the ecological composition of hardwood forests. Following an increase in international trade between North America and East Asia in the nineteenth century, residents of the northeastern United States began to report the presence of invasive earthworms from a new family, Megascolecidae. They are found in the top layers of soil, and some can grow up to 25cm in length. Megascolecid earthworms are commonly referred to as "crazy worms" due to their serpentine locomotion and defensive behavior.

Crazy worms alter the ecological conditions of the forests they invade, changing soil composition and impacting the native species present, so it essential to closely monitor and prevent their spread. *Amynthas agrestis, Amynthas tokioensis,* and *Metaphire hilgendorfi* are three crazy worm species that have been co-invading regions of upstate New York, including Madison County. These megascolecid species are difficult to differentiate due to similar morphological characteristics, and there is not a large body of information available that could indicate the magnitude of their invasive potential.

This summer, I conducted research to determine the distance these species of crazy worms could travel over the course of a year in order to formulate more accurate predictions for their future spread. I designed a grid that can be used to study a pre-existing population of crazy worms. The grid was laid over a 15m by 15m plot of forest, and it was separated using an array of brightly colored stakes and string into 25, 3m by 3m squares. When the next generation of crazy worms hatches in the spring of 2019, the worms in the grid will be examined, tagged, and revisited over the course of several months to determine their movement, behavioral patterns, and preferred environmental characteristics.

In order for the grid experiment to be successful, an effective method of tagging earthworms needed to be developed. I began the summer by attempting to use PIT tags to mark the worms. Each PIT tag had a unique identification number that could be read using a scanner, making them an ideal tag option for the grid experiment. However, the PIT tags tended to migrate to the tail end of the worms after a few days of retention, and the majority of worms ejected the tags through their anuses. I attributed the failure of the PIT tags to their 12mm length, and I began testing the effectiveness of 1mm long, magnetic Coded Wire Tags (CWTs) during the final weeks of the summer. The small CWTs were easier to inject into the coelom of the worms, making them a stronger candidate for long-term retention, and they can be sensed using a metal detector. Further experimentation is necessary to determine the optimal insertion location of CWTs, but the initial results were promising, as the worms showed improved tag retention compared to the PIT tags.

In addition to preparing the grid experiment, I began gathering data on crazy worm movement in the lab using a one-lane, circular racetrack that was roughly 380cm long. Worms collected in mid-July "raced" in the track for 90 minutes, and the distance and direction they traveled was recorded at ten-minute intervals. Following the trials, which were held both during the day and night to simulate the natural 24 hour light cycle, the total distances traveled and the distances traveled in one direction were calculated for each worm. These values were used to determine the potential distance crazy worms could travel in Hamilton in July, and this experiment must be conducted in the future over the course of a year to produce an accurate prediction for how far crazy worms can travel throughout each stage of their lifetimes.

Fieldwork is an integral part of the research in our lab. We collected crazy worms from several locations in Vermont for genetic sampling, and this trip was a highlight of my summer experience. I also assisted my lab partner, Julieanne Montaquila, in collecting native earthworm species from bogs and swamps across New York for her summer project.

Ultimately, the information gathered this summer and during a continuation of these studies will be used to predict the invasive potential of Megascolecid earthworms in the northeastern United States over the course of decades, providing the data necessary to prevent and control their spread into new territories. This will limit the ecological and economic consequences of their presence in North America.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Picker Interdisciplinary Science Institute

Research Fellow: Louis Berkowitz (2020) **Concentration(s): English; Political Science**

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

Title of Project: Legal Aid Society of Mid-New York, Inc.: Consumer Bankruptcy Law Project

Project Summary:

The Legal Aid Society of Mid-York is a not for profit law office that provides legal advice and representation for civil cases to individuals that cannot afford attorneys in 13 counties surrounding the Central New York region. The staff attorneys assist clients in legal matters that can include: elder law, domestic violence, sexual assault, disability advocacy, foreclosure help, divorce, evictions, public benefit cases and unemployment disputes. The Legal Aid Society of Mid-York employs a limited number of attorneys and houses a large caseload that is important and time sensitive. These lawyers are motivated by a passion for helping others and an understanding of the vast issues that can affect the population that they serve. Legal Aid's clients either hover around the poverty line or are below it, making this law office a vital option for people that desperately need legal advice. The free legal services that the office provides can be life changing for some people. Essentially, Legal Aid provides high-level legal services to a population of people that need it the most, but lack the financial resources to afford it.

At the beginning of the summer, I received extensive training in bankruptcy law and legal ethics in order to do this work. My role is to organize the client's financial history to categorize their income, expenses, and debt to coincide with the forms needed for a Chapter 7 bankruptcy. The Consumer Bankruptcy Law Project is a cooperative effort between the Legal Society of Mid-New York and the Upstate Institute. This project attempts to help individuals who have accrued significant debt because of domestic violence, medical expenses or unemployment. Once clients call the Legal Aid hotline about their debt, they are referred to my supervisor Susan Conn '79 who then screens the client to make sure they are appropriate for this specific project. Once a client is identified, I function as a paralegal to prepare various forms and schedules with the client. This paperwork is then forwarded to the Legal Aid Society's network of lawyers that take bankruptcy cases on a pro bono basis.

Debt is an all-encompassing experience that can set people up for spiraling financial woes, affecting both mental and physical health. Therefore, the goal for this project is to alleviate that crippling debt to pave the way for financial freedom and a fresh start for the clients. The most important contribution I hope I am making to Legal Aid this summer is to help streamline the process of getting the cases to the network of pro bono attorneys faster, thus allowing for even more cases to be done in the future.

My summer at the Legal Aid Society through the Upstate Institute allows me to experience community-based learning that supports a liberal arts education from Colgate, and coincides with my studies very well. As a Political Science and English major, this project enhances my studies of local and federal public policy using both a normative and empirical perspective from both subjects. This fellowship has granted me unparalleled legal experience as a college undergraduate, which has only deepened my interest in law and confirmed my desire to attend law school after I graduate from Colgate. I was drawn to the idea of being an Upstate Institute Field School Fellow because the program gave me the opportunity to have a meaningful summer helping the Central New York region. Through this fellowship, I have expanded my learning from the classroom, giving me a broader sense of appreciation and knowledge for the surrounding region, while also gaining a great deal of knowledge about the field that I want to enter after my time at Colgate.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Upstate Institute

Research Fellow(s): Peter Bertone (2020) **Concentration: Physics**
Sihyun "Si" Wei (2021) **Concentration: Undeclared**

Faculty Mentor: Linda Tseng **Department(s): Physics; Environmental Studies**

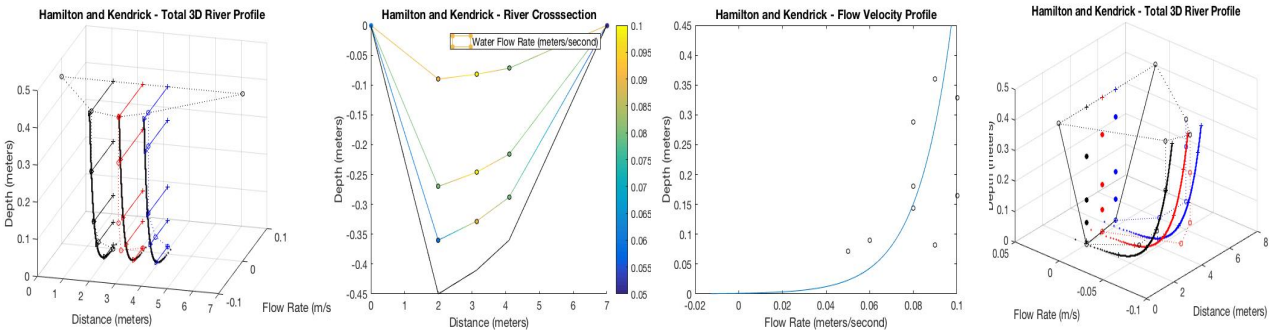
Title of Project: Characterization of Local Natural Water and Municipal Wastewater

Project Summary:

Hamilton, NY, located in the Susquehanna River Watershed, loads its runoff to the Chesapeake Bay. This research aims to provide a better understanding of the organic particles in water in Hamilton area and its relationship to the wastewater treatment plant. Our goal is to find out the amount of nutrient loads that Hamilton, NY contributes to the Chesapeake Bay. This is important because excess amount of nutrients degrade the water quality as it causes an excessive growth of algae, which decreases the sunlight that reaches the aquatic vegetation. We collected water and sediment samples from a total of 6 selected sites along the Payne Brook, and 5 water samples within the Hamilton wastewater treatment plant. The sample sites were selected to see if certain places are contributing to the nutrient load and where the nutrient load originates from.

We analyzed the quality of our samples by performing various tests including Chemical Oxygen Demand (COD), Total Suspended Solids (TSS) and Volatile Suspended Solids (VSS). COD is used to measure the amount of organic carbon nutrient in a specific water sample. We filtered the water sample with a 0.2 μm filter and added 2 ml of the filtered water to the prepared COD vials with 1500 ppm detection limit. The COD vials were placed in a thermo-reactor at 150 ℃ for 2 hours. The chemicals were transferred into a cuvette using a glass pipet to measure the absorption of the sample at 620 nm via spectrophotometer. The COD concentration of a given sample was calculated through the use of the Beer-Lambert law and a standard curve obtained by using glucose. TSS measures the amount of solid materials that are not dissolved in water and VSS measures the amount of combustible organic matter in water. We measured the mass of an aluminum weighing dish with a 0.45 μm filter. The filter was then washed with 20 ml of water sample. After the filtration, the aluminum dish was placed in an oven at 103 - 105 ℃ for an hour. The difference between the mass of the aluminum dish before and after the filtration and heating was calculated to obtain TSS. After performing TSS, the aluminum dishes were placed in a furnace at 550 ℃ for 15 minutes. VSS is the difference between the mass of the aluminum dish after heating in the oven and after heating in the furnace.

The flow rates of the stream at 0.6, 0.8 and 0.2 of its depth were measured using the Flow Mate. Based on the collected data, we used the logarithmic profile method to figure out the mean flow velocity of the stream at each height. The calculations were carried out by MATLAB.



The highest levels of COD, TSS and VSS were all observed in the samples obtained in the wastewater treatment plant. Consistent with the results last year, Mixed Liquor (ML) and Return Activated Sludge (RAS) had the highest rate of TSS. This is due to the bacteria in raw sewage and materials added to treat the water. The water that leaves the treatment plant, Chlorination Effluent (CE), had the closest COD and TSS levels with the water samples collected along Payne Brook. Based on the data collected this year and the previous year, we believe that nutrient removal efficiency of the wastewater treatment plant is not high. The level of organic materials in water rises after Soccer Field (SF). The possible causes of the increased COD level in SILO are fertilizers used in farms and the wastewater treatment plant as they are both located in between SF and SILO. In the future, we hope to identify the specific amount of phosphorus and nitrogen in the water sample by using Ion Chromatography to find where most of the P and N originated from.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☒ UNST Div.
☐ Other (specify):

Research Fellow(s): **Vincent "Vinny" Betti (2021)** **Concentration: Biochemistry**
Ryan Kiel (2019) **Concentration: Biochemistry**
Madeline "Maddie" Loffredo (2019) **Concentration: Chemistry**
Sam Schlichting (2019) **Concentration: Biochemistry**

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

Title of Project: Novel Unnatural Amino Acids to Study the Role of Hydrogen Bonding in Proteins

Project Summary:

Proteins are essential for all forms of life, playing important roles in metabolism, information transfer, and reproduction. In all species, these proteins are derived from a set of 20 common building blocks called amino acids. To first approximation, by arranging these amino acids in well-defined sequences, organisms can construct complex scaffolds that accelerate chemical reactions or serve as structural supports for almost all cellular components. Our work concerns the development of new, unnatural amino acids that can be selectively incorporated into proteins and shorter protein fragments—peptides—to study the mechanisms through which proteins facilitate these processes and the forces that govern protein stability and activity.

Solid-phase peptide synthesis methods allow for the inclusion of unnatural amino acids into protein sequences. We have attempted to incorporate unnatural, structurally altered amino acids into proteins in order to examine the changes in function that result. Unnatural amino acid insertion methods can also be used to label a specific portion of a protein to simplify subsequent analysis. Specifically, we began the semi-synthesis of ribonuclease A (RNase A). We synthesized the C-terminus of RNase A (95-124) and have begun work to join it to a biologically expressed portion of RNase A (1-95) using intein-mediated protein ligation (IPL). RNase A is a protein comprised of 124 amino acids. The C-terminal is defined as amino acids 95-124 (a 30-mer) and is shown in ***Figure 1***. During the synthesis of the C-terminal peptide fragment, we can substitute our unnatural amino acid residue into any desired location in the sequence.

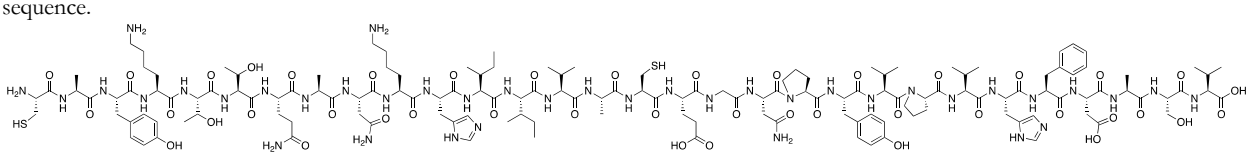


Figure 1. The structure of the synthesized C-terminal of RNase A is shown above. It consists of 30 amino acids (95-124) and contains the required N-terminal cysteine for ligation.

The 95th residue of RNase A is a cysteine and is necessary for native chemical ligation. A C-terminal thioester on the biologically expressed portion (1-94) is required and will be generated by cleavage of a fusion protein containing the target protein and an intein in the presence of a thiol reagent. The two portions of RNase A, 1-94 (containing the C-terminal thioester) and 95-124 (containing the N-terminal cysteine), will react to give the final product, which will be used in future studies. In separate work, we have also developed assays to measure RNase A activity.

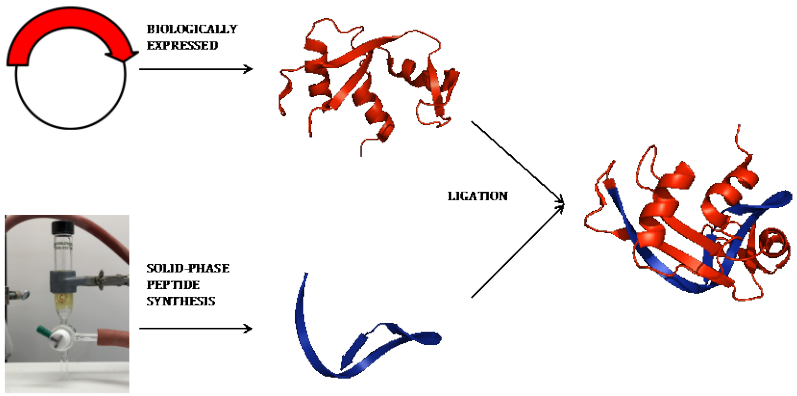


Figure 2. A schematic showing the semi-synthesis of ribonuclease A. Amino acids 1-94 are shown in red and 95-124 are shown in blue. Residues 1-94 are biologically expressed and residues 95-124 are synthesized using solid-phase peptide synthesis. The fragments are joined together by intein-mediated protein ligation.

Source of Support: ☐ AHUM Div. ☒ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Michael J. Wolk '60 Heart Foundation; Miller-Cochran Fund

Research Fellow(s): Kiana Billot-Vasquez (2020) Mara Devia (2019) **Concentration(s):** Neuroscience; EDUC Concentration: Psychology

Faculty Mentor: Spencer Kelly **Department(s):** Neuroscience; Psychological and Brain Sciences

Title of Project: Dual Streams of Iconicity: Sound Symbolism and Iconic Gestures in Foreign Vocabulary Learning

Project Summary:

Past research has shown that hand gestures and iconicity aid in second language learning. Gesture has been shown to facilitate word learning (Macedonia & von Kriegstein, 2012; Kelly, McDevitt & Esch, 2008). One form of iconicity that researchers have studied for L2 learning is sound symbolism, the non-arbitrary relationship between the sound of a word and the thing the word stands for (Dingemanse, Blasi, Lupyan, Christiansen & Monaghan, 2015). One example of this would be the sound symbolic Japanese word for "birds flapping", which is "pata pata". This study will contain various forms of iconicity that will help us understand the effects of hand gestures and sound symbolism on Japanese language learning when presented together, individually, or not at all.

In this study, we are examining Japanese second language learning in the context of native-English speaking college students. In this study, participants wear an EGG net that measures their brain activity. Each participant sits through two 15 minute experiments, in which they are repeatedly presented with 20 Japanese words. Figure 1 below shows how the videos are presented. A Japanese word is presented and spoken aloud, followed by a fixation cross and the written English word. From the 20 words presented, each participant will receive 5 words in the gesture + sound symbolic condition (e.g., doki doki as heart beating with an appropriate gesture), 5 words in the gesture + non sound symbolic condition (e.g., kide kide as heart beating with an appropriate gesture), 5 words in the no gesture + sound symbolic condition (e.g., doki doki as heart beating with no gesture), and 5 words in the no gesture + non sound symbolic condition (e.g., kide kide as heart beating with no gesture). Each word is presented 10 times, resulting in a total of 200 videos. The EEG net records the participant's brain activity through event related potentials. After the participant watches all of the videos they are given two memory tests. The first memory test is a free recall test. We created a powerpoint containing the audio of each of the 20 words in a random order. As the participant listens to the audio they write down the English translation of the Japanese word. Additionally, the second memory test provides the participant with a word bank of all the English words they learned and 20 new random words. They are then give two minutes to categorize the words into three different boxes, depending on if they learned the word (e.g., Yes, No, Maybe). This study follows a within-subjects design where the subjects are used as their own controls. We predict that the gesture + sound symbolic condition will produce the best learning and deepest neural encoding.

During the summer, we ran approximately 10 trial participants and finalized the study in preparation for our real data collection this fall. This preparation time over the summer was important because we were able to correct for system errors, read the relevant literature, and create an improved study design that we have finalized.

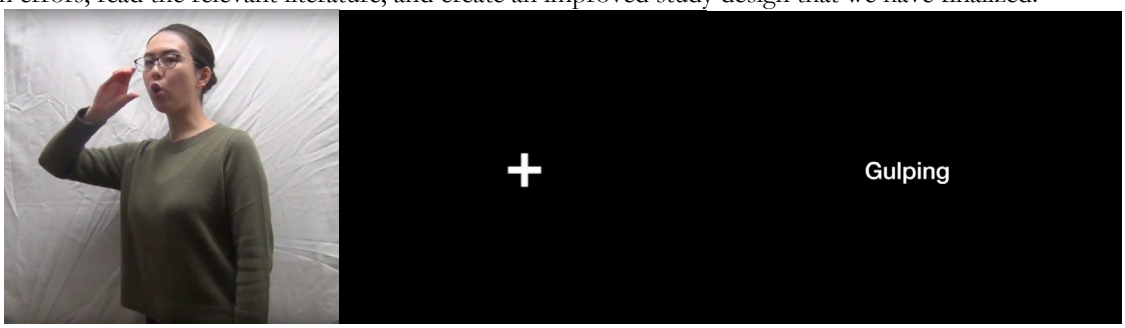


Figure 1

Source of Support: ☐ AHUM Div. ☒ NASC Div. ☐ SOSC Div. ☐ UNST Div. ☐ Other (specify):

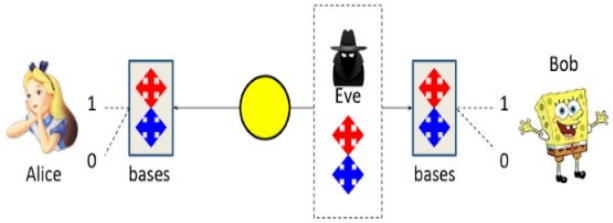
Research Fellow: Aayam Bista (2020) **Concentration: Physics**

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

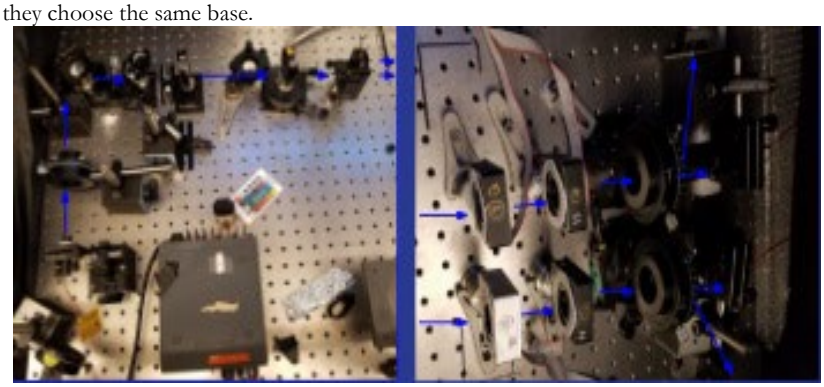
Title of Project: Engineering Liquid Crystal Optics

Project Summary:

Secure communication lines use large prime numbers to encrypt information. Today's computers can take up to years to perform the calculations required to decrypt these channels. However, quantum computers could potentially do this within minutes, introducing major security risks. A possible solution to this is to use entangled photons accessible to two communicating parties (Alice and Bob) via a quantum channel to generate the encryption key. Since a quantum state can never be perfectly reproduced, an eavesdropper (Eve) will inadvertently alter the initial quantum state, hence giving away their presence.



As shown in the figure, Alice and Bob randomly use two sets bases to measure the polarization of the photons. Since Eve has no way to know which base either of them will choose at a certain point, her measurements will cause there to be discrepancy in Alice and Bob's data even when they choose the same base.



We used down converted photons that are entangled in terms of their polarization. Eve was placed in front of Bob to intercept the photons. Alice, Bob and Eve could use two possible bases; horizontal-vertical (HV) or diagonal-anti-diagonal (DA). If Alice and Bob used the same base, the photons they received should have had the same polarization unless Eve was using a different base. Since all three of them were unaware of what base the others were using, Eve introduced errors in Alice and Bob's data. The errors signaled the presence of an eavesdropper. The arrows in the figure show the direction travelled by photons.

While collecting data, we used three-digit numbers to name states that represented the bases used by Alice, Bob and Eve. A 0 represented a HV base and a 1 represented a DA base. For instance, in the state 001, Alice and Bob were using HV while Eve was using DA.

The data we collected agreed with our expectations. For states 000 and 111, all three had used the same base, so the polarizations were correlated. For states 011 and 100, Alice and Bob had different bases, so the polarizations were not correlated. For states 001 and 110, Alice and Bob had the same bases, but the polarizations were not correlated since Eve was using a different base. We also took ratios of correlated coincidences to total coincidences for three scenarios. When Alice, Bob and Eve all had the same base (000, 111), the ratio was 0.92 (the expected value was 1). When Bob and Eve had the same bases (000, 011, 100, 111), the ratio was 0.72 (the expected value was 0.75). When Alice and Bob had the same bases (000, 001, 110, 111), the ratio was 0.70 (the expected value was 0.75).

The way the correlation depended on the bases Eve chose shows that we can detect the presence of an eavesdropper in quantum communication lines, hence making them a secure way to transmit information in the future.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Picker Interdisciplinary Science Institute

Research Fellow: Andrew Blum (2021) **Concentration: Undeclared**

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

Title of Project: Krüppel-Like Factor 4 Regulates Glycolytic Metabolism and The Cellular Response to Metabolic Stress

Project Summary:

Krüppel-like factor 4 (KLF4) is a zinc finger-containing transcription factor, responsible in the regulation of cellular growth, proliferation, differentiation and embryogenesis. Our lab has found that KLF4 regulates mitophagy (recycling of defective mitochondria) and mitochondrial dynamics (fission and fusion). Given the close relationship these processes have with cellular metabolism, we aimed to determine how KLF4 regulates glycolytic and oxidative metabolism. Given that KLF4 has been found to act as an immediate early response gene in response to certain stresses, and given the importance of fast metabolic shifts, we looked into how KLF4 influences short term metabolic shifts. In addition, KLF4's effect on cellular morphology and function may result in longer term effects on metabolism. By characterizing metabolic behavior of modified cell types in both the long term and short term, KLF4's mechanism(s) for regulating metabolism can be understood.

We first found that cells lacking KLF4 have both oxidative and glycolytic impairments. Wild type MEFs showed increased glycolytic capacity and maximal glycolytic in a glycolytic stress test as compared to MEFs null for KLF4. Further analysis of the MEFs demonstrates that Basal glycolysis was found to be the same between null and WT MEF, glycolytic capacity is greater in WT MEFs, and glycolytic reserve is greater in WT MEFs. KLF4 increases overall metabolic efficiency, found using an ATP assay where WT MEFs produce more ATP than KLF4-null MEFs. Given that basal glycolysis is not altered in the absence of KLF4, the gene may instead increase oxidative metabolism. This is demonstrated by an increased non-glycolytic acidification rate in WT cells and greater levels of oxidative respiration by WT cells in an OCR test. KLF4s effect on metabolism is consistent in RKO cells, where a glycolytic stress test showed increased glycolytic capacity and maximal glycolytic rate in PA treated RKOs, and higher OCR in PA treated RKOs.

In order to identify a mechanism behind this KLF4 dependent metabolic efficiency, we looked at how KLF4 affects the expression of proteins associated with glycolysis using western blots. We first found that when KLF4 is induced in RKO cells, Hexokinase 2 (HK2), a rate determining step of glycolysis, PKM2, a facilitator of lactate production, and MCT4, a lactic acid export protein, are all significantly upregulated. This not only tells us that KLF4 expressing cells are performing more glycolysis, but also shows some of the proteins through which it does so. In MEFs, we found that GLUT1, a glucose transport protein, was higher in the WT than the Klf4-null cells. Interestingly, increase in KLF4 expression results in lower GLUT1 expression. Using western blots, we determined that KLF4 regulates aspects of the basal cell metabolism in a p21 dependent manner. We tested specifically for p21 because KLF4 directly upregulates it, and it is a widespread regulatory gene similarly to KLF4. By transfecting p21 expression into klf4-null cells, we found that PKM2 and GLUT1 were significantly upregulated.

Since metabolic stress tests showed that KLF4 cells have an increased glycolytic capacity, we figured that they may have an increased ability to quickly intake glucose in response to particular stresses. Because of this, we turned our attention to GLUT1 expression and membrane localization with respect to KLF4. As a transport protein, GLUT1 it is only active when localized to the cell membrane. Immunostaining of GLUT1 shows that WT MEFs have greater GLUT1 localization than klf4-null cells. Interestingly, the null cells exhibit a greater density of GLUT1 surrounding the nucleus, localizing to the membrane only when in close contact with it. This may suggest that a lack of KLF4 impairs the transport of GLUT1 to the membrane. When starved, WT MEFs have a less intense GLUT1 fluorescence, but increased GLUT1 localization. This increase in localization is likely correlated with increased KLF4 expression when MEFs are starved. The decrease in GLUT1 is consistent with western blot data, and is likely a feedback mechanism that reduces GLUT1 expression when enough is localized to the membrane. In the null MEFs, the absence of KLF4 results in no increase in GLUT1 membrane localization despite being starved. When treated with 2 Deoxy-D-Glucose (2DG), a modified glucose molecule that competes with glucose by binding to enzymes to inhibit glycolysis, WT cells have less GLUT1 localization than in UT and starved cells. This localization correlates with the decrease of KLF4 expression after 2DG treatment. GLUT1 localization and KLF4 expression is likely lower after 2DG treatment since the cells are able to detect that glucose is entering the cytosol but not being processed. This further supports KLF4's function in regulating glucose intake in glycolysis. In klf4-null MEFs, membrane localization is still lower than the WT. In RKO cells stained for GLUT1, overexpression of KLF4 via PA treatment increases membrane localization. Furthermore, PA treated MEFs have very minimal GLUT1 free in the cytosol as compared to the EtOH treated cells. This suggests that KLF4 allows for efficient transport from organelles to the membrane instead of relying on release of GLUT1 into the cytosol and proximity to the outer membrane. KLF4's ability to localize transport proteins and ability to express GLUT1 through p21 likely combine to give WT MEFs a greater glycolytic capacity.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Michael J. Wolk '60 Heart Foundation

Research Fellow(s): Matthew Bousquet (2020) **Concentration: Chemistry**
Leah Weisburn (2020) **Concentration: Mathematics**

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

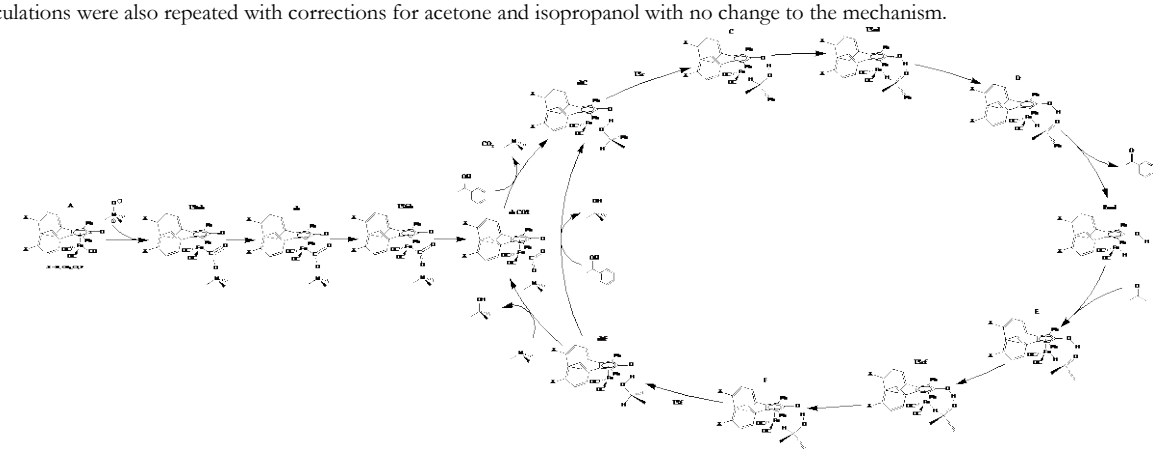
Title of Project: Applications of Density Functional Theory to Electronic Structure, Spectroscopy and Mechanism

Project Summary:

In the chemical industry, ligand-metal catalysts are increasingly being utilized for transfer hydrogenation. This process conveniently and effectively adds molecular hydrogen to a compound without involving the gas itself, which is both difficult and expensive to use in lab and industry.[1] These catalysts can be used to oxidize alcohols to ketones and amines to imines, with some also promoting the oxidation of alkenes. Transfer hydrogenation has further application in both synthesis and the petroleum industry. The most common catalysts used for this process today contain precious metals; Shvo's catalyst, a bifunctional catalyst developed in the mid-1980s, and later chiral catalysts developed by Noyori all contain ruthenium.[1] Other similar catalysts contain rhodium, iridium, and osmium along with other metals.[1] Due to the expense, limited availability, and toxicity of these metals, bifunctional iron catalysts are being developed and examined as replacements to oxidize alcohols and amines; they also have potential applications in the synthesis of esters from aldehydes. Iron, which is more common, cost-effective, and eco-friendly, has been shown to effectively replace ruthenium in some of these reactions.

This summer, we explored the reaction of Shvo's-type iron catalysts, similar to Knölker's catalyst, with various alcohols and amines. We sought to map out the mechanism of this reaction as it proceeded by an outer-sphere mechanism, as suggested by previous research, by evaluating the energy of possible intermediates and transition states.[2] We further investigated the inductive and electronic effects of varying the catalyst's substituents.

To evaluate this mechanism, we used the Gaussian09 research program to construct and optimize each intermediate and transition state. For each of these species, the energy was calculated using B3LYP-d3 flavor of dispersion corrected hybrid density functional theory. The 6-31G(d,p) basis set on H, C, N, O, Cl, and F was used, as was the LANL08(f) effective core potential (pseudopotential) and basis set for iron. Stability calculations were performed on each structure to ensure that the most stable of each was used in further calculations. Based on the output of these calculations, frequency calculations were performed to obtain data on each structure's energy as well as thermal corrections to the internal energy, enthalpy, and entropy. Each intermediate and transition state was verified to have the correct number of imaginary frequencies. Further calculations were performed to find solvent corrections in free energy for the reaction performed in toluene. Calculations were also repeated with corrections for acetone and isopropanol with no change to the mechanism.



Through our research, we propose a catalytic cycle through which this reaction proceeds (the reaction with 1-phenylethanol is shown above). The proposed mechanism begins with the activation of the catalyst using trimethylamine n-oxide. Per our most current calculations, the CH_3NO aligns with the CO ligand so that the oxygen binds to the carbon to form an ester-like intermediate. The compound then reacts so that the CH_3N and CO_2 gas separate from the iron. Next, CH_3N and CO_2 gases are evolved while the alcohol introduced binds to the catalyst, so the oxygen of the alcohol is bound to the iron. The compound undergoes a transition so that the alcohol is carbon, not oxygen, bound to the iron, while the alcohol's oxygen is bound to the to the catalyst's oxygen. Two linear hydrogen transfers then occur as the catalyst becomes reduced and the alcohol becomes oxidized. These hydride and proton transfers occur symmetrically and simultaneously. The resulting ketone is then removed, and acetone is used so that the catalyst is regenerated following the analogous mechanism and can be used again. Similarly, this catalyst can be used with isopropanol in the reverse direction to reduce ketones and imines to alcohols and amines.

Sources:

1. Lu, X.; Zhang, Y.; Yun, P.; Zhang, M.; Li, T. *Organic & Biomolecular Chemistry.* **2013**, *11*(32), 5264.
2. Von Der Höh, A.; Berkessel, A. *ChemCatChem.* **2011**, *3*(5), 861–867.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): American Chemical Society Petroleum Research Fund

Research Fellow: Katherine "Kate" Bundy (2020) **Concentration: History**

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

Title of Project: "The Generation of Change, the Generation of Peace:" Student Movements as a Formidable Political Engine in Colombia

Project Summary:

My research evaluates the level to which student-led movements have acted as a catalyst for political change in Colombia. For more than half a century, Colombia has been plagued with a violent civil conflict between the government and insurgent guerilla forces. In 2016, a push for peace began through the publication of an accord that would ensure ceasefire between these groups. Yet, in a contentious referendum surrounding this agreement, the proposal for peace failed. In the wake of this referendum failure and in the context of a highly polarized Colombian political spectrum, student groups in the capital city of Bogotá began to mobilize. Eventually, a revision of the accord was passed and the united student front for lasting peace was certainly an important influence. With this context in mind, I sought to understand: what about the university system fosters political involvement and activism, why these students were such a fervent force in the referendum protests, how their efforts have continued throughout the 2018 electoral cycle, and what all this might mean for the future of Colombian politics.

During my time in Bogotá, I conducted interviews with students and faculty, visited university campuses, and attended demonstrations. I drew my conclusions based on this on the ground observation as well as existing scholarship to formulate my paper. The synthesis of these results is organized into three core sections. The first evaluates how student activism is bred within the university system. The second details the 2016 referendum and protests. Lastly, the third section discusses the continuation of the student movements throughout the 2018 election cycle and beyond. Ultimately, student activism in Colombia has been realized both within the universities and on a national scale, by a generation that has broken traditional modes of thought through a vigilant demand for peace and a better future for their nation. Their academic upbringing has groomed them for a new national focus, shifting away from the student activism of the past that focused solely on educational reform. Private and public university groups, with or without political affiliations, all worked together to mobilize in response to the referendum failure. Considering the efficacy of their protests in 2016, and the efforts that continued throughout the 2018 election cycle, students have been a fundamental catalyst for the development of peace in Colombia. In summary, this was not only a retrospective investigation meant to assess the protests themselves, but also the impact and legacy of the initiative and mobilization tactics that has made student groups a formidable force in Colombian politics. In addition, through speaking with these student activists and leaders, I came to realize that their union resulted in so much more than just the eventual passage of the peace accord. Rather, the cooperation and dialogue between distinct student groups that had never worked together before, especially in regards to organizing protests, is instead symbolic and reflective of a new, united left in Colombia.

Student Groups and Political Parties at Demonstration in Bogotá, Colombia

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Lampert Institute for Civic and Global Affairs

Research Fellow(s): Alara Burgess (2021) **Concentration(s): Sociology; History**
Erik "Liam" Tuveson (2020) **Concentration: History**

Faculty Mentor: Graham Hodges **Department(s): History; Africana and Latin American Studies**

Title of Project: Black Flight in the Americas, 1500s-1865

Project Summary:

Our research project, *Black Flight in the Americas, 1500s-1865*, used slave narratives from the United States and some nearby locations to document patterns found in the vast escapes from slavery. Using the University of North Carolina's database of 400 North American Slave Narratives compiled in their "Documenting the American South" collection, we worked to individually summarize each history and then catalogue it within a larger matrix, finding similarities in the various escapes and noting aspects of the writing itself.

The summary of each narrative began with publication details of the account, detailing author, title, publisher, and date and place of publication. Though there are very few repeat publishers, nearly all place of publication are located in the Northern states, and in some cases, Canada and England.

Each narrative was then sorted based on time period and placed into one of five categories: Colonial period, Revolutionary period, Early National to 1810, 1810-1840, and 1840-1865. The histories were sorted based on the date of the subject's escape, not the date of publication, since some were published years after fleeing, once the author felt free enough to write about their experience in slavery, or after the subject's death by a biographer.

The majority of the research on these narratives was spent detailing the elements of the subjects' lives and escapes. For each history, we began with the aspects of the subject's early life, noting their childhood and introduction to work as a slave, the probable separation from their family, and the relationship with their master. Most of this section then focused on their flight from slavery. We looked at their reason for fleeing, their methods, destinations, and length of time spent escaping, as well as any assistants or adversaries on their passage. After reaching freedom, we documented how they lived their lives as freemen, summarizing their familial relations, place of residence, and work. We also examined whether or not the subject became involved in the Civil War or with the Underground Railroad as either a passenger or conductor.

After compiling all of this information within a spreadsheet, we also documented specific aspects of the style of the history itself, as many of the narratives use the same devices to convince readers to Abolitionism. Some of these included the use of religion, poetry, history, literature, or a focus on education, in addition to the incorporation of shorter tales of other slaves, though among these, religion is the most favored.

Though as of yet we have not concluded with the entire collection of narratives, we have found that in most cases, the escapees were male and generally worked in the fields. They often escaped alone and on foot, and by a slight margin tended to be married. In their lives as free people, the most popular profession was public speaking: lecturing about their experiences in slavery, sometimes associated with an Anti-Slavery society. Despite the qualities found as stated above, it was also common to find narratives in which the subject did not escape at all or was freed only by Emancipation Proclamation or the end of the Civil War.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☒ SOSC Div. ☐ UNST Div.
☐ Other (specify):

Research Fellow: Erin Burke (2018) **Concentration: History**

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

Title of Project: National Abolition Hall of Fame: Assessing A Crusade for Social Reform

Project Summary:

This summer I was fortunate to have the opportunity to intern for the National Abolition Hall of Fame and Museum (NAHOFM), located in Peterboro, NY. NAHOFM is a non-profit museum that explores the history of American abolition by offering exhibitions, guided tours, educational programs and special events. NAHOFM's main historical exhibition spans from antislavery agitation in the Colonial period to the Reconstruction amendments that granted African Americans citizenship and African American men the right to vote. Although NAHOFM is a museum that deals with the past, NAHOFM interprets the history of abolition to be living history that continues up to the present day. NAHOFM thinks beyond abolition and questions what legal equality really entailed and entails. In the period following Reconstruction, the establishment of Jim Crow, poll taxes, and the KKK sought to deprive African Americans of their rights and restore white supremacy; today, institutional racism and a resurgence of racist politics continue to oppress Black Americans. NAHOFM's mission statement reflects their commitment to sharing the past in order to question the present and imagine a better future: "The National Abolition Hall of Fame and Museum honors antislavery abolitionists, their work to end slavery, and strives to complete the second and ongoing abolition: the moral conviction to end racism."

Currently, NAHOFM wishes to work more on the final part of their mission statement - the moral conviction to end racism. The members of NAHOFM have recommitted themselves to understanding and combatting racism and they hope to become more of an activist museum. This activism will manifest itself through more programs and installations that explicitly connect the political, economic, and social inequities of slavery to their modern-day legacies.

This summer, I was responsible for moving the museum further in this activist direction. I was tasked with designing an installation that helps visitors understand implicit racism. Implicit biases are attitudes that shape cognition and therefore behavior, but unlike explicit attitudes, escape conscious control. These implicit biases are generally shaped by societal factors, such as media and stereotypes, beginning at a young and impressionable age. Although explicit beliefs override implicit biases in most situations, implicit biases often win out when one is stressed, tired, multi-tasking, or has to act quickly. Implicit racism is a complex issue, as it is possible for a person to be explicitly egalitarian and yet implicitly biased against people of color. Understanding implicit racism is key to understanding and countering racial injustice today, as although explicitly racist statements and actions have declined significantly in the past 40 years, racial injustice persists.

The installation was a part of NAHOFM's exhibition at the New York State Fair, and included an activity that helped visitors see how media images are often racist in ways that can escape immediate attention and yet nevertheless reinforce negative stereotypes about people of color. This activity worked to combat implicit racism because the first step to mitigating the effects of one's implicit biases is to understand implicit bias and how this bias is formed. It was designed to jumpstart this process of awareness because it reveals to visitors a major source of implicit biases: media representations.

This internship has been an enriching experience, both experientially and existentially. As a history major and museum studies minor, this internship has enabled me to gain more museum experience. Not only did I regularly welcome visitors and lead tours, I also learned how historical material can be mobilized and made relevant to current social issues, such as racism. Museums are not dusty repositories or irrelevant places lost somewhere in the past. They are places of impassioned discussion, places where differences can be bridged (or at least slightly mended). Existentially, this internship reenergized me with feelings of efficacy. I have struggled in this political moment, knowing my convictions, wondering how to live them. It is often uncomfortable or frustrating to have conversations about race, especially when these conversations so often devolve into shouting matches in Facebook comments. However, in a country where police brutality still disproportionately affects young, Black men; in a country where the Ku Klux Klan has reemerged with a vengeance; in a country that is more concerned with respect of the National Anthem than respect for the rights and freedoms it's supposed to represent - silence is violence. At NAHOF, it becomes clear that the past is demanding something of us - to finish what the abolitionists started.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Upstate Institute

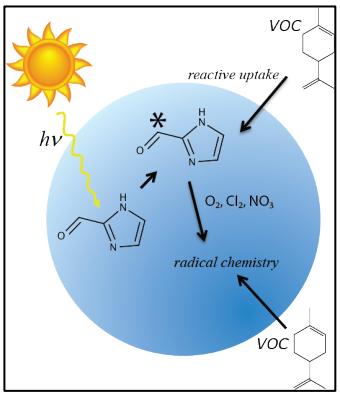
Research Fellow(s): **Nora Burner (2020)** **Concentration: Chemistry**
William "Will" Leiter (2020) **Concentration: Chemistry**

Faculty Mentor: Ephraim Woods **Department: Chemistry**

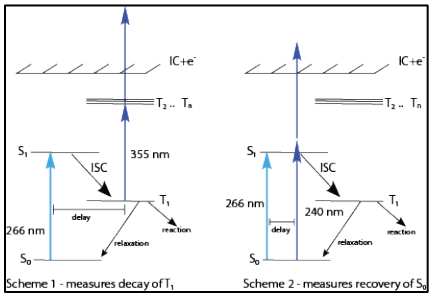
Title of Project: Reactive Transients in Atmospheric Photochemistry

Project Summary:

Imidazole 2-carboxaldehyde (IC) is an organic compound and a known photosensitizer (participates in light-initiated reactions with other compounds) that may be involved in the formation of secondary organic aerosols (SOA) through reactions with volatile organic compounds (VOC) found in the atmosphere. IC is a common aerosol phase compound and is a reaction product of ammonium with glyoxal, another compound commonly found in the atmosphere. Aerosols refer to particles (here droplets) in the atmosphere that can be from 10 nanometers to 10 micrometers in diameter, and contain a complex mixture of ionic compounds and organic molecules. A common example of an aerosol is sea spray, whose composition initially reflects that of sea water surface but evolves the longer it remains in the atmosphere. Volatile organic compounds are gas-phase compounds in the atmosphere, the most abundant sources of which are biological. Organic aerosols have a measurable effect on the climate, but not much is known about the photochemical (light-activated) reactions that result in the formation of SOA. These reactions cause aerosol particle growth and occur when a photosensitizer, such as IC, is in what is called a triplet state (^{3}IC). This is a reactive state in which the energy level of an electron in a molecule is elevated due to absorption of light, allowing it to react with other species. The triplet state is a relatively short-lived energy state, lasting only hundreds of nanoseconds to a few microseconds. The goal of our research was to better understand the mechanisms and dynamics of reactions between ^{3}IC and other species that may be present in an aerosol particle. To do this, we measured the lifetime of ^{3}IC in the presence of different possible reaction partners. Eventually, we can compare these lifetimes and determine to what degree different compounds, aerosol particle compositions, and ambient conditions (such as relative humidity) contribute to photochemically-activated SOA growth.

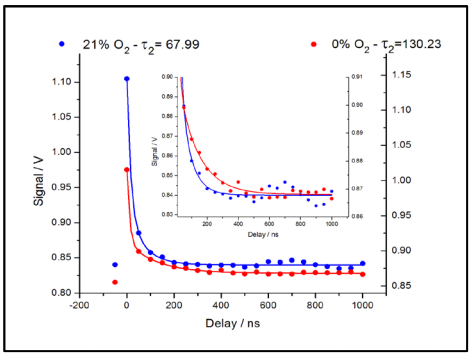


We used laser to create and detect ^{3}IC. One laser simulated the effect of sunlight in the atmosphere, exciting an electron and putting IC in the triplet state. The other laser selectively ionized the ^{3}IC, so that we could detect it using an electrometer to measure the charged particles. Below is an energy level diagram depicting the possible pathways the excited electron can take.



The lasers were optimized to produce a wavelength of light that would excite and then ionize the IC molecules. In one experiment, we used 355 nm light to ionize the ^{3}IC and we used 240 nm light in the other. For both of these experiments, we excited the molecules into the triplet state using 266 nm light. Other variables in our experiment were the concentration of IC in our atomizer solutions, the subphase (e.g. NaCl or $NaNO_3$), the relative humidity of the aerosol flow, and the presence of other organic compounds (e.g. malonic acid). We alternated between using air and nitrogen in the aerosol flow to test the effect of oxygen on the lifetime of the ^{3}IC.

To quantify the lifetime, we made the independent variable in our data collection the delay between the two lasers. As the delay between the lasers increases, the signal due to the ionized ^{3}IC molecules should decrease because more ^{3}IC molecules will have relaxed back to ground state and can no longer be ionized. Once we collected these data, we plotted them and fitted them to kinetic equations that allowed us to extract the lifetime of ^{3}IC for those conditions. Below is an example of one of these plots, comparing the data recorded with a sample in the presence of oxygen to data recorded with the same sample, but in the absence of oxygen. This plot shows that oxygen has a "quenching" effect, namely that it reacts with ^{3}IC so that the signal from the ionized molecules goes away more quickly. This reaction limits the efficiency with which ^{3}IC converts to SOA. Our future work will be to explore other quenching processes, including the introduction of VOC and quantification of its effect on the ^{3}IC lifetime.



Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): National Science Foundation Grant

Research Fellow: Claudia Buszta (2019) **Concentration: Environmental Geography**

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

Title of Project: Southern Madison Heritage Trust: Use of Aerial Photography Mapping to Establish Photographic Record of Land Trust Properties

Project Summary:

This summer, I worked through the Upstate Institute with the Southern Madison Heritage Trust. The Southern Madison Heritage Trust (SMHT) is an all-volunteer, non-profit organization that currently operates within the general Madison County area, including Hamilton, Earlville, and Madison to conserve natural resources for public benefit. The lands that SMHT owns are preserved for the purposes of protecting valuable habitats, resources, scenic landscapes, and historic features. SMHT currently manages five properties, each of which has their own unique features. Members of the community who wish to see a certain piece of land conserved can contact the land trust and either donate or sell their land outright, meaning that SMHT will own and operate the property themselves, or set up a conservation easement on the property. The organization is entirely run by volunteers, each of whom bring a unique set of skills and expertise to the organization. One of their major responsibilities is to produce monitoring reports of their properties on a regular basis by taking pictures, recording observations, and noting any changes to the property. These monitoring reports inform SMHT on the state of their properties and next steps they must take for them to continue to be maintained.

My research project revolved around assessing the feasibility of utilizing drones in producing these monitoring reports. Usually, members of SMHT have to go to the properties and take ground pictures, often hiking through dense brush to access boundary lines, landmarks, and any trail systems that may be present. Through the use of a drone, it is possible to produce imagery of the entire property in an efficient manner. My work involved not only researching how this would affect the monitoring methods of SMHT, but also how these images can be produced in a streamlined manner, with what technology, software, and other supplies. I developed a protocol for SMHT members to use in the future as guidance when they develop the next set of monitoring reports. The purpose of my research, to them, was to see the worth in investing in drone technology in their organization. This is part of a greater movement of land trusts across the nation exploring the use of drones in conservation.

For the long-term, SMHT is hoping to expand their services within Madison County and continue to work towards their mission. One of their goals is to gain national recognition from the Land Trust Alliance (LTA), a national organization of land trusts with its own standards of conservation and land management practices. Being recognized by LTA would mean that local community members could trust SMHT, as accreditation can be considered a stamp of approval from a national entity. Part of the accreditation process requires showing LTA that records are kept of each property, which includes consistent monitoring reports, accurate imagery, and updated maps. Initially, my research focused on developing a drone protocol that could essentially replace the current method used for developing a monitoring report. However, after some time, I realized that while the drone images that were produced from overflights were highly detailed, they were not practical in the way that ground images were. For instance, a lot of SMHT's properties are forested. The drone could offer insight into the general health of the ecosystem, the tree density of the property from above, and any issues around marked boundaries. However, one could not see any streams, elevation changes, or trail systems present underneath the vegetation. I realized that drone imagery could instead be used as a valuable supplement to, rather than replacement for, the monitoring reports that SMHT produces.

Through this work, I have learned a lot about how members of the community work together to conserve the land important to them. By attending SMHT board meetings and talking with the members, I was able to see first-hand how a community-based organization makes decisions and continues to meet its goals. I also learned a lot within the lab and out in the field, working with drones and imaging software. While planning overflights, conducting them, and processing the images obtained, I had many challenges come up. Dealing with these issues, I learned that often in independent research it is important to remember to reach out when you need help. The geography and IT departments were instrumental in helping me overcome any problems I had. As an environmental geography major with a minor in computer science, this experience has vastly influenced my decision to work in conservation upon graduation. This research experience has shown me the many ways in which new technologies are shaping conservation and sustainability efforts, and how these two areas can overlap to further benefit progress sustainable practices and benefit community members overall.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Upstate Institute

Research Fellow(s): Edward "Ned" Campbell (GR) **Concentration: English (MAT)**
Dylann McLaughlin (2018) **Concentration: English**

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

Title of Project: An Evaluation of Colgate's Teacher Preparation Program

Project Summary:

Colgate University is the site of a vivid teacher preparation program that develops teachers who have the capacity to view schooling and schooling practices through a critical social lens. Our teacher preparation program supports Colgate students who are interested in reimagining K-12 education to help dismantle structural oppressions that limit the futures of youth from non-dominant backgrounds. In order to achieve our programmatic goals, it is vital that we take an introspective look at the supports and practices that are currently in place at our institution. Reflection on progress made towards internal, state, and national goals will help guide our future instructional and organizational decisions. As part of this summer fellowship, we worked closely with the Director of Teacher Preparation to coalesce evidence and artifacts to highlight our work. Additional research of comparable programs was required -- the NY6 and some SUNY schools were looked at. We also reached out to program alumni to gather a sense of their experience once in the field.

One key site of our research was rural school districts. As a team, we interviewed and analyzed data collected from several teachers on the topic of teaching through a social justice lens and how rurality affects this practice. We found that most teachers in rural school districts faced resistance when broaching social justice topics from both parents and administrators. Teachers were tentative to bring up topics like racism and sexuality with their students without the support of district leaders, which was lacking in most cases. In one instance, a teacher persevered in discussing the injustices of police brutality against black children, only to be accused of reverse racism by a student; when the student's parent complained, the teacher was written up by the administration. The same teacher said she took seriously the responsibility to teach students empathy in a district marked by shared experiences but lacking in diversity. Another teacher said she built her classroom on a foundation of character education and tolerance and was able to foster critical discussions on politics within this context. Results from this inquiry showed a wide range of acceptance of social justice-related topics in rural classrooms, and that many educators must devise creative ways to get students to engage in these discussions.

Colgate's teacher preparation candidates are committed to working toward understanding how white supremacy, cis-heteropatriarchy, coloniality, ableism, environmental racism, and capitalism intersect to legitimate violence, knowledge, and power. This research will improve the teacher preparation program by equipping future teachers with the knowledge and strategies required to effect meaningful change in rural school districts.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☒ SOSC Div. ☐ UNST Div.
☐ Other (specify):

Research Fellow: Mackenzie Carroll (2019) **Concentration(s): Economics; International Relations**

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

Title of Project: Madison County Department of Health: Madison County's Healthy Workforce Initiative

Project Summary:

Through the Upstate Institute Summer Field School, this summer I had the opportunity to work with the Madison County Department of Health (MCDOH) in Wampsville, NY. During my time at the Health Department I worked mainly with the Preventative Health division. The Preventative Health division offers the following programs and services to aid the Madison Community: Community Disease Prevention and Control, Health Education and Promotion, Vaccination Program, Maternal and Child Health Program and Home Visitation, STI Program, Tuberculosis clinics, Childhood Lead Poisoning Prevention, Car Seat Safety, and Cancer Services. The Health Department deals with all kinds of people throughout Madison County and works in partnership with many of the nonprofit organizations in Madison County in order to better meet the needs of the people. From doing home check-ups for premature babies, to flu clinics on college campuses, the staff is always running around to accommodate as many people as possible, and they still manage to think of new ideas all the time to further meet the needs of the community. Many of the health clinics on campus are run by them, so next time you hear about one I strongly suggest you attend because the nurses will keep you healthy and they are super friendly!

The Health Department is currently working to improve employee health and wellness in Madison County. In October 2017, the Healthy Workplaces in Madison County report was created by MCDOH to outline a strategic action plan for linking health protection and health promotion in organizations throughout Madison County. My project over the summer was to create a survey that would help develop baselines for certain measures found in the Healthy Workplaces in Madison County Report. One measure aims to increase the proportion of worksites that offer a comprehensive employee health protection and promotion program to their employees; another aims to increase the proportion of employees that participate in employer-sponsored health protection and promotion activities; a third aims to increase the proportion of employees who have access to workplace programs that prevent or reduce employee stress. My project entailed getting organizations throughout Madison County with greater than 50 employees to take my survey. The results of the survey were then used to create baselines for the Key Measures by analyzing how many organizations were considered "passing" each measure. Eventually, MCDOH hopes to use the information from my project, as well as past and future projects, to create resources, trainings, and tool-kits to help aid the implementation of comprehensive health programs at worksite throughout the county.

Working as a Fellow at the Health Department was a great experience for me for several reasons. First of all, I got to know and work with a lot of genuine, caring people who want to do good for their community. Additionally, I was able to experience an office setting and learn about the environment in an office. And finally, I am interested in potentially pursuing a career of some type in public/global health, so this opportunity was a great fit for me. I was able to actually see public health at work, which definitely helped me to further narrow my interests for the future.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Upstate Institute

Research Fellow: Warren Carter (2020) **Concentration: Molecular Biology**

Faculty Mentor: Geoffrey "Geoff" Holm **Department: Biology**

Title of Project: Mechanisms and Functional Consequences of Reovirus Innate Immune Responses

Project Summary:

Reovirus is a non-enveloped virus containing 10 gene segments of double stranded RNA. It is used in research because it is non-pathogenic to humans, while still infectious to other mammals. μ2 is a structural protein encoded by the M1 gene segment that has been shown to play a vital role in reovirus replication. μ2 has also been linked to differences in infectivity among the strains of reovirus. μ2 has been shown to influence the way that the specific strains of reovirus organize their replication within the infected cell. The T1L strain organizes its factory for replication in a filamentous shape while the T3D strain viral factories take a more rounded, globular shape. This difference has been traced to position 208 of the μ2 amino acid sequence. T1L μ2 has a proline, but T3D μ2 has a serine leading to an ineffective association to the microtubules of infected cells, resulting in the round shape. This amino acid difference has also been linked to the T1L strain's ability to repress interferon, hindering the immune response and inducing myocarditis in mice.

The goal of my research this summer was to gain a better understanding of the molecular mechanisms of μ2 to explain the observed differences in infection within the reovirus strains. Investigating the binding partners of μ2 will likely provide insight into the mechanisms of μ2. To find binding partners of μ2, the protein must first be precipitated from cells reliably. My summer was spent focusing on optimizing the immunoprecipitation of μ2 of both T1L and T3D strains of reovirus from 293T cells.

To perform the immunoprecipitation, we transfected 293T cells with a plasmid containing DNA that results in the cells expressing either the T1L or T3D μ2 protein with an artificial flag on the end of the protein. These cells are lysed releasing all contents into a lysate. The antibody to the flag was attached to magnetic beads, allowing the protein to be pulled down from the lysate using magnetism. To find out if μ2 was present in the original lysates and the immunoprecipitations, we used gel electrophoresis, then probed the gel with μ2 antibodies. Throughout the summer we performed this experiment multiple times, altering different μ2 plasmids, transfection reagents, and magnetic bead methods.

We found that anti-flag magnetic beads worked better than dynabeads. The anti-flag magnetic beads are sold with the anti-flag antibody already attached. The dynabeads require an extra step to attach the antibody to the bead. Using the anti-flag magnetic beads, we successfully pulled down μ2. We found that using μ2 plasmids with the flag on the C terminus of the protein, as opposed to the N terminus, resulted in higher μ2 expression. We repeatedly found that cells transfected with T1L μ2 plasmid had more expression than cells transfected with T3D μ2 plasmid. We hypothesized that T3D μ2 may be degraded quicker in the cell than T1L. After re-probing the gel with a ubiquitin antibody, we found evidence of ubiquitin in both T1L and T3D μ2 immunoprecipitations. To further investigate degradation as the possible cause of T3D μ2 expressing in a lower amount on the gel, we used a proteasome inhibitor, MG132, but surprisingly we found more T3D μ2 expression in the cells treated with MG132 then we did in the cells treated with a control.

We found that a successful transfection of 293T cells with a C terminus flagged μ2 plasmid, followed with the use of anti-flag magnetic beads to pull down the protein, leads to a successful immunoprecipitation. The lab can continue to use this method of immunoprecipitation to do further experiments aimed at identifying the binding partners of μ2 to shed light on the mechanisms behind the observed strain-specific differences in reovirus virulence.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): National Institutes of Health (NIH) Area Grant

Research Fellow(s): Yesu Carter (2019) **Concentration(s): Japanese; COSC**
Priyadarshinee "Priya" Dhawka (2019) **Concentration(s): COSC; German**

Faculty Mentor: Joel Sommers **Department: Computer Science**

Title of Project: Design of A Web Application For Food Allergens And Dietary Restrictions

Project Summary:

We, Priya Dhawka '19 and Yesu Carter '19, addressed the challenges that people with allergies and dietary restrictions face when eating out via a Ruby on Rails web application we developed from the ground up during the summer of 2018. We recognized that there are a few existing websites that host allergen safety information for many restaurants. However, the information hosted on these websites is generated almost entirely from user input. Therefore, our goal was to automate the collection of restaurant menu data and the identification of possible allergens in restaurant menus. The unique feature of our web application is its ability to examine online restaurant menus, extract key allergen related information using natural language processing techniques, and display said restaurant's food items along with an accurate estimation of its allergen safety when compared to similar online recipes. Not only does this feature empower our users to eat out safely, but it also allows our users to feel more confident in knowing what they are eating regardless of the ambiguity of a dish's description.

Figure 1: Menu name, description and ingredients

Figure 2: Website Homepage and Search Bar Feature

We wrote the backend portion of our application in Python and made use of several modules and packages suited to web scraping, natural language processing, and optical character recognition. We developed web scrapers using Python's Scrapy module and Selenium to retrieve menu content from a restaurant's website and to query the web for commonly used ingredients for a given menu item. Depending on the format of the collected menu which can be retrieved as html, image, or pdf, we processed the collected menu content using the following packages respectively: BeautifulSoup, Tesserocr, and Apache Tika. Each menu being in a standardized format, we extracted the names and descriptions of menu items with the Python-based Natural Language Toolkit and queried the web for commonly used ingredients for each menu item utilizing a similar web scraper (Figure 1). With a working combination of web scrapers, we began writing our Rails web application which utilized JSON to translate the collected information from our Python backend to the frontend. Among several other features, we implemented a search restaurant-by-allergen feature alongside a user accounts feature (Figure 2). Using the Ruby gems, Devise and Omniauth, users were given the option of creating an account on the web app or signing in via Gmail to save their allergens for more efficient queries. We further improved our search feature by allowing more options for searching; a user can search specifically by a restaurant name or url, input a maximum distance, or search by any keyword and order the search results by name, distance, or best match. A user can also submit restaurants to be added to our database by providing pertinent details about the restaurant: name, url, description, address, and cuisine. We also implemented an administrator feature which allows a user with administrator privileges to accept or reject user submitted restaurants and menu information as well as the ability to manually edit both restaurant and menu data.

As we end our app development, there are many features remaining that we intended to implement. These include adding a review feature for restaurants and a user generated accuracy rating for allergen estimations on our database's menus. Nevertheless, we greatly appreciate the opportunity to embrace our creativity, to face many new challenges, and to fully experience full stack development.

Source of Support: ☐ AHUM Div. ☒ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Science and Math Initiative-SMI (NASC Division)

Research Fellow: Olivia "Liv" Castro (2019) **Concentration: Sociology**

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

Title of Project: Enhancing the Quality of Life: Physical Exercise and Social Networks in the Elder Generation

Project Summary:

Over the past few years researchers have identified the emergence of an expanding health care crisis: the world's citizens are living longer than ever before. Across all nations and cultures there is a growing number of elder individuals, characterized as 65 years or older. The old age cohorts of the 20th century no longer parallel the old age cohorts of the 21st century (Crews and Zavotka 2006). We are in the era of the aging baby boomers, which makes us wonder, how can we, as a country, as a world, handle such a large population and how can these individuals maintain and even enhance their quality of life? Social networks are considered to be an important determinant of the quality of life of the elderly; allowing them to deal with stressful environments or difficult life experiences. As human beings, our interest, our health, and our very happiness are connected to our sense of belonging and interactions with those around us. The sense that we are connected to a greater community in which we share common interests and goals is a critical component of a healthy self. Creating and maintaining these connections is the challenge every culture faces.

The purpose of my study was to determine how elder individuals experience the spaces in their lives such as: gyms, social networks, or doctor offices, improve quality of life- even mental health. This area of study is important because the baby booming population between 1946 and 1964 are in the older years of their life. If our country doesn't have adequate spaces to improve quality of life and foster social connections for this population now, it will only get worse in the coming years.

This past summer, I spent the greater part of 10 weeks interviewing 10 individuals in my hometown of Syracuse, NY, about their social connections, community involvements, and quality of life. Interview questions about their support systems and social engagements, to asking them their thoughts on the emerging problem of loneliness in America. Social networks are considered to be an important determinant of the quality of life of the elderly; allowing them to deal with stressful environments or difficult life experiences. As human beings, our interest, our health, and our very happiness are connected to our sense of belonging and interactions with those around us. The sense that we are connected to a great community in which we share common interests and goals is a critical component of a healthy self. Creating and maintaining these connections is the challenge every culture faces.

The individuals I interviewed were retired teachers, swim coaches, bus drivers, navy veterans, to describe a few. A pattern I found was that, in an area such as Syracuse, in order to keep one's mind and body healthy, one must engage in the community. Whether it's through volunteering or starting a new career, almost all of my participants were involved in the community in one way or another. As we age, creating social spaces to engage with others becomes increasingly difficult, and isolating oneself becomes easier. Many cited their social networks and community engagements as guides to curbing isolation in Upstate, NY.

In hopes to further develop this meaningful research, I have extended my study to the Hamilton, NY area for my senior thesis. With the help of the Lifelong Learning Program, I have currently been interviewing individuals in Hamilton, NY to identify similarities and differences between the urban and rural populations of elder individuals.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Walter Broughton '63 Research Fund

Research Fellow(s): MaKenna Cealie (2019) **Concentration: Neuroscience**
Jenna Taylor (2020) **Concentration: Molecular Biology**

Faculty Mentor: Wan-chun Liu **Department: Psychological and Brain Sciences**

Title of Project: Identification of Potential Avian Hippocampal Subdivisions via Molecular Marker Genes

Project Summary:

What hippocampal genes do birds have? This project attempts to identify the unknown subdivisions of the avian hippocampus and discover similarities with humans. In mammals, the different regions of the hippocampus have different functions important for learning and memory. We are interested in studying spatial and episodic memory, particularly episodic, as the neural mechanism behind this remains unknown. Food-caching birds may provide an effective model organism for mechanistic exploration of spatial learning and episodic memory. This study seeks to identify whether there are discrete subdivisions within the avian hippocampus by analyzing the expression of various molecular marker genes that are known to identify the hippocampal subdivision in mice. Using a songbird, the zebra finch, we aim primarily to identify the pyramidal cells of the CA1 and CA3 regions, as well as the mossy cells and granule cells of the dentate gyrus within the avian hippocampus. Should our findings indicate the presence of such subdivisions, we hope to investigate specific functions which may be associated with these regions, such as spatial learning and episodic memory in food-caching birds.

Previous studies have found differences in the hippocampal size of London taxi drivers compared to controls: the hippocampal volume differences were associated with greater spatial memory, and the rate of volume change was correlated with the length of their time spent navigating. This may suggest a capacity for plasticity in the hippocampus, and that individual experience may have an effect on adult neurogenesis, as the hippocampus is one of the only areas in the human brain that undergoes adult neurogenesis.

In birds, the hippocampus has been linked to food-caching behavior. Food-caching behavior and hippocampal neurogenesis changes seasonally in birds, both of which exhibit an increase during autumn and winter, when birds need to store food. Food-caching birds are also known to have larger hippocampi than non-food caching birds. Chickadees are one such species of food-caching bird; their peak hippocampal size and peak food storing having been found to coincide. Currently our study incorporates only zebra finches to provide a basis of knowledge, as they are readily available in our lab. There should be enough conservation of genetic material, where we can eventually incorporate chickadees as another model organism.

Over the summer, the desired hippocampal genes were cloned to test for gene expression. Four genes, WFS1, MGLL, Prox1, and Calb2, were chosen as the corresponded to the subdivisions of the mammalian hippocampus. At this juncture, it would appear that our research has been successful, as each of the four molecular marker genes have been observed to be the correct number of base pairs during gel electrophoresis at each stage of experimentation. We have sent the genes out for sequencing to confirm that we have procured the desired genes.

Future directions will include performance of *in situ* hybridization to determine if there are specific subdivisions within the avian hippocampus. This will allow for observation of gene expression in discrete areas of the brain. If successful, we will attempt to replicate our findings in chickadees. We would eventually like to see if certain functions, like food caching, are associated with the subdivisions. This study aims to further the knowledge of avian hippocampal gene expression, as well as to investigate the genetic basis of food caching behavior. This may aid in the development a unique animal model for studying the neural mechanisms relevant to spatial learning and episodic memory in humans, whilst also providing novel insight into adult neurogenesis.

Source of Support: ☐ AHUM Div. ☒ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☐ Other (specify):

Research Fellow: Rupika Chakraverti (2020) **Concentration: Computer Science**

Faculty Mentor: Michael Hay **Department: Computer Science**

Title of Project: DPComp: Realistic Data Mining Under Differential Privacy

Project Summary:

The aim of the research project was to come up with an easy way to implement better data privacy (in the form of differential privacy) in a data analytics platform called MacroBase.

Differential privacy: Differential privacy is a strong, mathematical definition of privacy in the context of statistical and machine learning analysis. The goal is to achieve a state where whether a particular privacy object's (i.e. the entity whose privacy we are trying to protect) data are included or not does not affect the result. Differential privacy can be attained in multiple ways, often including adding a calculated amount of noise to the output of the algorithm. An algorithm $\mathcal{M}$ is ϵ-differentially private if for any two datasets D1, D2 that differ by one record,

$$\frac{\Pr(\mathcal{M}(D_1)=0)}{\Pr(\mathcal{M}(D_2)=0)} \leq e^{\epsilon} \text{ for all O} \in \text{Range}(\mathcal{M}).$$

MacroBase: MacroBase is data analysis platform implemented in Java. The core concept behind MacroBase is simple: to prioritize attention, an analytics engine should provide analytics operators that automatically classify and explain fast data volumes to users. MacroBase executes extensible streaming dataflow pipelines to explain groups of points by aggregating them and highlighting commonalities of interest. Many settings where MacroBase can and has been applied contain highly sensitive data (e.g., telemetry data from mobile devices) yet Macrobase offers no privacy guarantees to participants in the database.

We implemented differential privacy in MacroBase using the sample and aggregate method. Instead of running the MacroBase pipeline on all the data at one, the data were partitioned into samples based on the privacy object (each object's data points are hashed to the same sample) and the MacroBase pipeline runs on each sample, resulting in a collection of 'Vector Explanations'. These explanations are then aggregated resulting in a singular Vector, to which noise is added resulting in the final output of the differentially private MacroBase pipeline.

Sample and Aggregate: As mentioned above, sample and aggregate is an implementation of differential privacy. It will partition the original dataframe into several smaller sampled dataframes (the number of samples is determined by user). All records with the same privacy object are grouped into the same dataframe so that the modification of a specific privacy object could only affect one of the dataframes. Due to the uncertainty of the definition of privacy object for every setting, sample and aggregate provides a hash function interface that every pipeline should implement. The sample and aggregate pipeline provides a default hash function that takes several columns as privacy object. Sample and Aggregate requires that the result of the pipeline must be of type Vector Explanation, which is an Explanation containing a vector of double values. The sample and aggregate pipeline provides differential privacy via adding Laplace noise to the values within the Vector Explanation.

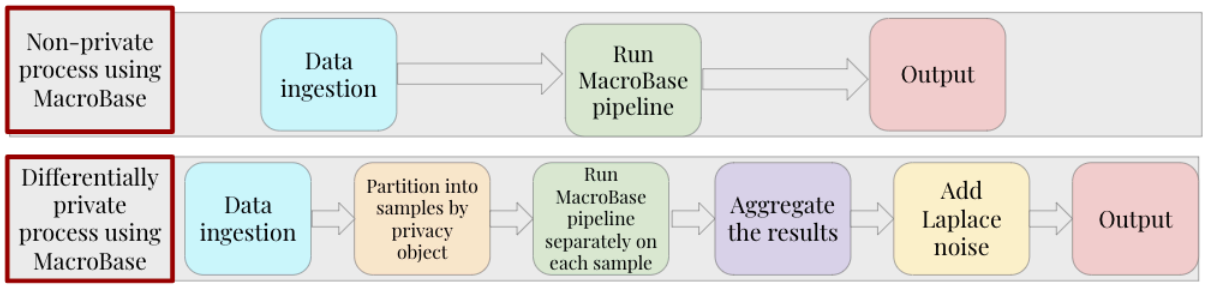


Figure 1 - Change in workflow to make MacroBase private

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): National Science Foundation Grant

Research Fellow(s): Mylah Chandler (2019) **Concentration: Sociology**
Gillian Nissenbaum (2019) **Concentration: Sociology**

Faculty Mentor: Alicia Simmons **Department: Sociology**

Title of Project: News Framing of Police Killings of Unarmed Blacks

Project Summary:

We, Gillian Nissenbaum and Mylah Chandler, are two rising seniors and sociology majors. We acted as research assistants for Professor Simmons in the Sociology department this summer. Our project aimed to answer the question "Who's Lives Matter?" in the context of studying police killings of unarmed black men. We primarily focused on analyzing cable news coverage of five main cases within the last 20 years. The victims we studied were Amadou Diallo, Sean Bell, Michael Brown, Freddie Gray, and Eric Garner. Most Americans recognize these names, but in reality, we researched dozens more. In addition to this project, we assisted Professor Simmons with some of her other research initiatives, which we will describe below.

As mentioned above, we completed an existing database, created in previous summers by past research assistants, of 111 cases of unarmed blacks killed by the police. To complete this database, we used LexisNexis to find out which victims of the 111 cases received any cable news attention. After completing the database, we performed a theme extraction to assess how the cable news reporters were setting the national agenda around police brutality and race relations. In our theme extraction, we focused on the community relationship with police, and the militarization of police forces. Previous iterations our summer research team had built a codebook with which to analyze print sources. We used that same codebook to analyze the cable news transcripts of the aforementioned five cases using MAXQDA. Unfortunately, the codes developed for the print news stories were incompatible with the cable news stories.

While Professor Simmons reevaluated the cable news coding technique, we moved on to another one of her research endeavors. This project, called Pretty Young Things, aims to evaluate factors that indicate social disorganization and the hierarchy of news coverage based on race and gender of perpetrators and victims. Using the Census and Bureau of Justice statistics, we created an original data set of over 1,100 cases to assess the relevant demographics of respondents, and the crime rates in their neighborhoods. This was used to understand their racial attitudes and how that may impact public policy.

Finally, after the completion of the Pretty Young Things database, we embarked on our third project, called Tweeting to Trump. We structured the corpora of three events; the Charlottesville rallies, Trump's first State of the Union address, and the recent separation of families at the southern border and related immigration policies. After building this database, we collected the cable news transcripts relating to each event through LexisNexis and cleaned the raw Twitter data. Then, after having a clear picture of the cable news coverage and relevant tweets directed at Trump, we helped extract themes from the corpora.

In short, through the various projects, research methods, and construction of databases, we have learned a few things about how cable and print news, as well as more modern types of media, frame stories and set national agendas on what is newsworthy. Professor Simmons focuses on what makes stories newsworthy by using the Justice frame. The Justice frame theorizes that if stories are portrayed as unfair or unjust, they will get more coverage and more sympathy. With our research on Diallo, Bell, Brown, Garner, and Gray, we witnessed how different networks frame these stories as just or unjust, and how they angle their coverage to reflect hidden agendas and personal opinions. This project is not only about police brutality; it's also about media intake, and our own biases. The media has decided whose deaths will be publicized, but as a nation, we have a responsibility to examine why only certain lives matter.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☒ SOSC Div. ☐ UNST Div.
☐ Other (specify):

Research Fellow: James Chaplin (2020) **Concentration: Asian Studies**

Faculty Mentor: Daisaku "Dai" Yamamoto **Department(s): Geography; Asian Studies**

Title of Project: Why do People Live in Disaster-Prone Houses? Machiya Preservation and Urban Sustainability in Kyoto

Project Summary:

The developmentalist state is characterized by the prioritization of economic growth and is shaped by state interventionism in a capitalist market economy which regulates social and economic behavior. In Japan, cases can be seen of this top-down approach being challenged by "grass-roots" organizations that are mobilized at the local community level. One such example can be found on the street of Pontocho in the heart of Kyoto. In particular, one *machizukuri*, or town-building, organization representing a single neighborhood located on Pontocho has demonstrated initiative that works within and at time challenges the developmentalist state model.

The methods of this study predominantly included interviewing and participant observation supplemented by literary frameworks. I met with residents of the Pontocho community, particularly those that were a part of the *machizukuri* organization and also with a representative of the City of Kyoto. Interviews were performed to collect information regarding the condition of the community and role that the machizukuri organization plays in the in the multilayered structure of governance of Japan. I observed different meetings and events hosted by this organization and assessed the impact that efforts such as construction projects and disaster ramification reparations, among other efforts, had on the well-being of the Pontocho community. The aims of these activities include the beautification and accentuation of the aesthetics of the Pontocho area, the preservation of the historical landscape of Pontocho, hazard prevention and safety measures, and the fulfillment of residents' wishes within the neighborhood but do not exist in separation from the economic context of domestic and foreign tourism which serve the city of Kyoto as a major source of capital.

Generally, the machizukuri organization and the activities it is able to perform are atypical compared to similar organizations in Kyoto and within Japan as a whole. The ability to receive requested sums from the city government for the purpose of public work projects, regulate the built landscape, and control resident and non-resident activities within its area is much stronger than in other districts. The reason for such exceptionalism may stem from member expertise and competency, economic viability, and/or social capital associated with the street of Pontocho.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☒ SOSC Div. ☐ UNST Div.
☐ Other (specify):

Research Fellow: Harrison Chen (2019) **Concentration: Chemistry**

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

Title of Project: Applications of Density Functional Theory to Electronic Structure, Spectroscopy and Mechanism

Project Summary:

The purpose of the research was to use the computer program Gaussian 09 to determine which reaction path is the most favorable for the reaction of inserting molecular Oxygen into a Rhodium (III) complex. The Rhodium complex was analyzed with different ligands attached to determine how that would affect the relative energy of each pathway. This reaction is important in the field of aerobic oxidation chemistry and in the creation and application of artificial fuels. There are several possible reaction pathways that were considered and evaluated. The pathways that were considered were a Hydrogen Atom Extraction pathway (HAA) and a Reductive Elimination (RE). Each intermediate energy was determined using the Gaussian program and the data was used to determine the relative energy of each step of the reaction.

For each of the Intermediates and transition states the energy was calculated using B3LYP-d3 Flavor of dispersion corrected hybrid density functional theory, 6-31G(d,p) basis set on H, C, N, O Cl and occasionally F when applicable, and LANL08(f) effective core potential (pseudopotential) and basis set on Rh. Stability calculations were performed on the structures to ensure that the most stable structure of each was used in further calculations. After the stability calculations frequency calculations were performed to obtain data on each structure Zero-point energy, and thermal corrections to the internal energy, enthalpy and entropy. Each transition state was verified to have the correct number of imaginary frequencies. All solvent calculations were done using Dichloromethane as the solvent.

The Migratory insertion pathway that was considered last summer was shown to be too high in energy to be considered a likely pathway. The initial step of the MI reaction was several Kcals larger than either of the other two pathway's rate determining step making it very unlikely that this is the correct pathway for the overall reaction. From the calculations it appears that the HAA pathway is the more favorable one by comparing the relative energies of each intermediate.

In the future I am planning on finishing the calculations for each intermediate and to compare the expected rates to the literature rates. The expected rates can be determined using the Eyring equation and the free energy of the transition state. I also plan on analyzing the electronic structure of the intermediate steps in the HAA reaction to determine if there are any changes to the oxidation state of the Rh. We can also use the electronic structure to determine how each substituent changes the energy level of the intermediates.

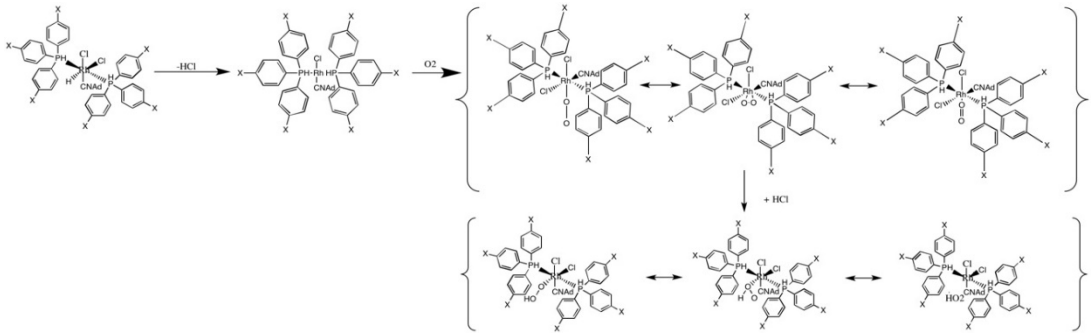


Figure 1:Reductive elimination pathway

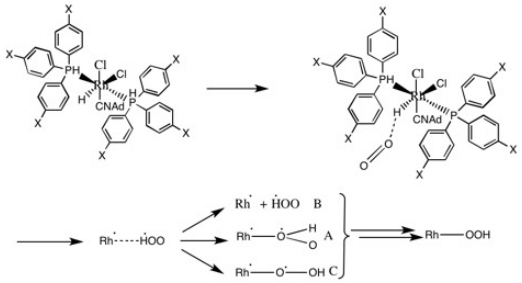


Figure 2:Hydrogen Atom Abstraction Pathway

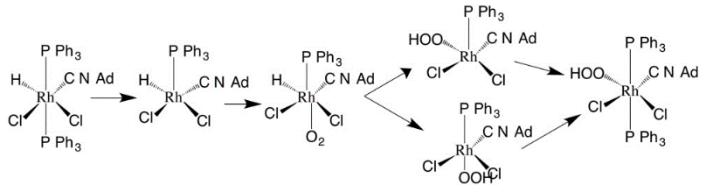


Figure 3: Potential Migratory insertion pathway

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): American Chemical Society Petroleum Research Fund

Research Fellow: Sifan "Sophie" Chen (2020) **Concentration: Art and Art History**

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

Title of Project: Reframing Hegel: Chinese and Western World Outlooks Juxtaposed

Project Summary:

The research project I participated in this summer intersects epistemology, science, and language as derived from Chinese worldview. An important goal is to correct Westerncentrism leading to the understanding of the West as automatically and inherently advanced and China as automatically and inherently backward. The research project aims to articulate Chinese worldview in terms of the integration between heaven and human (tian ren he yi), so as to provide perspectives of comparison with Western worldview. The work I did helped me understand that due to the integrative principle in its worldview Chinese culture promotes connection, tolerance, and co-growth. In these ways, and if these were upheld as standards, the Chinese worldview could provide effective and critical perspectives on Western culture.

In this general scheme, my summer work consisted flexibly of several domains as needed. I read some Chinese and Western philosophical texts to take notes of main themes. In this regard, I also typed and organized Prof. Wang's notes on Western philosophy. I had the opportunity to learn about important moments of continuity and change in Western intellectual history that helped me understand why Western thinkers misunderstood Chinese culture in the ways that they did, that is, concluding from their own enclosed and exclusive system of thinking rather than learning based on knowledge of Chinese culture on its own terms.

The linguistic component of the research focused on my close reading of the book *Path to Beauty*, an English translation of the Chinese masterpiece *Mei de Li Cheng* by modern Chinese art historian and philosopher Li Zehou. I took detailed notes and discussed important ideas with Professor Wang, covering ways that Chinese art (such as sculpture, fine arts, architecture, and calligraphy, etc., from around 1700 BC to the end of the 19th century) expressed the related worldview and value system. Li's the discussion of the abstracting principles, as well as the ideographic basis, of Chinese characters ties in with Chinese epistemology as best captured in the Chinese expression *qu xiang bi lei* (thinking in imagery and reasoning through analogy). The detailed work I did in this regard provided a good intellectual exercise that allowed me to see how art, philosophy, history, and social change correlated.

Chinese medicine, a full version of Chinese science and Chinese culture, was an important pivot linking Chinese epistemology and ways of logical reasoning. Professor Wang and I had much discussion on related topics. I transcribed archival audio-video material regarding the history of acupuncture in the US since the 1970s. In the process I learned in vivid detail about the hard and strenuous path of how acupuncture became finally legalized in the US to benefit people in health needs. The personal sacrifices made by two generations of acupuncture professionals, particularly by the central figure of Dr. Hung Po Jung, fully epitomized the central Chinese value of creating *fu* (福).

As a studio art major with a view of doing postgraduate studies in art history, the summer research was an extremely valuable experience.

Source of Support: ☒ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☐ Other (specify):

Research Fellow(s): **Sean Corrigan (2018)** **Concentration: Astrogeophysics**
Adrian Heath (2019) **Concentration: Geology**
Chelsea Jacques (2019) **Concentration: Geology**
Patrick Matulka (2019) **Concentration: Astrogeophysics**
Hayley Pearson (2019) **Concentration: Geology**
Michelle Tebolt (2019) **Concentration: Astrogeophysics**

Faculty Mentor: Joseph "Joe" Levy **Department: Geology**

Title of Project: Exploration Science: Mapping Antarctica and Mars and Simulating Titan Geological Processes

Project Summary:

Our summer research consisted of three projects potentially related to Martian surface ice and water: recurring slope lineae (RSL); lobate debris aprons (LDA) on glaciers; and boulder halos. Images taken by the HiRISE camera aboard the Mars Reconnaissance Orbiter were loaded into ArcGIS and used to map these surface features. These image data were translated into numerical and graphical data that we analyzed for patterns and unexpected findings. Of particular interest were our RSL data. We were able to confirm, and expand upon, what previous studies had determined – RSL form on steep equator-facing slopes and have a higher thermal inertia than the surrounding areas – with a significantly larger amount of mapped RSL than those previous studies. Currently, the data we generated are still being interpreted and expanded upon with the hope of quantifying the location properties of RSL, including the slope and thermal inertia. LDA and boulder halo data are still being compiled and analyzed with a similar goal of further quantifying these phenomena.

RSL are linear features that appear on certain slopes during Martian spring, lengthen in summer, and fade as the cold season returns in autumn. Previous studies have observed that RSL form preferentially on equator-facing slopes. For our project, we mapped the start and end points of all RSL we could identify at every confirmed RSL site. In total, we mapped over 10,000 RSL systems in ArcGIS using HiRISE images taken from orbit. Once all RSL were mapped, we recorded the elevation, slope, and thermal inertia at each start and end point. We made histograms of this data comparing elevation, slope, and thermal inertia values of RSL to those of each mapping area as a whole. We confirmed previous observations that RSL tend to form on equator-facing slopes. In addition, they tend to form on steeper slopes than the average slopes of the mapping areas. One interpretation of this observation is that the slope is a driving factor in RSL formation. On average, thermal inertia of RSL locations are higher than in the surrounding area. Our initial interpretation of this result is that RSL tend to originate in exposed bedrock, rather than in loose sediment. This can be seen from examination of HiRISE images, but incorporating thermal inertia into our analysis gives us a more quantitative way to understand RSL formation conditions. However, given the poor spatial resolution of THEMIS thermal inertia data, this part of the analysis is prone to some error.

LDA are a type of debris-covered glacial landform found on Mars at the midlatitudes (±30-60º). They behave similarly to glaciers on Earth, with downslope viscous flow. Additionally, LDA are found at the base of cliffs. Our investigation focused on mapping the distribution and size of these boulders along certain transects of the glaciers. Given the resolution of the images used, we were only able to map boulders with diameters of 1 m. Additionally, the transects of the glaciers were chosen to be in the direction of their flow, based on the images. This means that we mapped boulders near the top of the glacier and at every point further down. Previous studies have suggested that these glaciers might contain climate records. They suggest that the debris is entrained in the glacier with more accumulation before ultimately resurfacing further down the glacier. The implications of this are that LDA, and more specifically the boulders and other debris, can inform us about the past climates of Mars. More accumulation corresponds to cooler periods of Mars' climate, as boulders pile up due to slower glacier movement. Less accumulation corresponds to warmer periods, as boulders spread apart due to faster flow at the glacier origin. Although data analysis is ongoing, our results appear consistent with previous findings. The boulders appeared down glacier in discrete sections. This is consistent with the theory that these boulders were entrained during cooler periods, with more accumulation. Other boulders that were not entrained have been eroded at least to the point of being indistinguishable at our image resolution.

Boulder halos occur in the midlatitudes on Mars where an impact excavated subsurface boulders. These boulders remain even after the crater has eroded. The surrounding area is devoid of other boulders, highlighting the halos. In these areas, the soil is thought to be rich in ice. Our study of these halos was similar to our study of LDA: we mapped transects of these halos to eventually plot the distribution and size of the boulders compared to the distance from the center of the halo. Along with these measurements, we noted the diameters of the halos. Data collection from these halos is still in progress. Ultimately, the data collected from these halos will be used to further investigate many questions surrounding these features. This includes the relationship between the distance from the center of the halo and the size of the boulders, if the boulders are evenly distributed around the halo, and if different locations with different subsurface compositions have halos with distinct characteristics.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): NASA / New York Space Grant

Research Fellow: Julian Danetiu (2019) **Concentration: Environmental Biology**

Faculty Mentor: Rebecca Ammerman **Department: Classics**

Title of Project: Environmental Archaeology at Paestum, Italy (Summer of 2018)

Project Summary:

The 2018 season of the North Urban Paestum Project primarily sought to investigate the geomorphology of the foundation of the Temple of Athena, which itself lies on an elevated position relative to the rest of the ancient city which hosts two other temples (Temple of Hera and Temple of Neptune). My role in the project, in addition to excavating, would be to lead the documentation and organization of media collected throughout the project's duration so that our data could be better preserved as well as accessed by others studying the project's findings in the future. Academically speaking, as an environmental biology major my main interest was in constructing an understanding of the ancient peoples' relationship with their coastal environment, including how it affected city planning, productivity, and even diets.

Two excavation plots, or "trenches", of 3 x 2 meters were opened southwest of the Temple of Athena. Our first trench, about 20 m west of the temple, dealt more with recovering strata associated with documenting activities carried out within the sanctuary, while the second trench, close to the temple's southwest corner, aimed at uncovering more about the geomorphology underlying the temple.

Paestum has seen a number of different occupants over the past five millennia, some evidence of which we were able to recover in the form of refuse, ceramics, and sacrificial remains. The most recent visitors, Allied invaders during World War II, landed on the beaches of Paestum and slowly captured ground, pushing Axis forces north-eastward to nearby mountain ranges. As part of the Allied invasion several base camps were set up as land was taken, including communications and field hospital stations; these were installed next to and even within the temples themselves! From this occupation we were able to recover some minor artifacts, such as discarded tin-cans and empty ammunition shells. Digging deeper we came across an abundance of pottery sherds, some with glazes or painted designs giving hints to their date and original purpose. Paestum's earliest prehistoric inhabitants, later Greek colonists, Lucanian settlers, and eventual Roman imperialists relied heavily on ceramic containers for serving and storing food or fermenting beverages.

Observation of soil stratigraphy throughout the excavation was especially important for a number of reasons. Stratigraphy can serve as a reliable physical record of an environment's history. By keeping in mind soil accumulation rates and noteworthy historical events, dating estimates can be assigned to pottery, tools, bones, and other finds. This is critical for the reconstruction of ancient environments and cultural phases. For instance, we excavated an ash layer from the eruption of Vesuvius in 79 A.D. and observed evidence of ecological changes in the local environment by comparing soil qualities, such as color and firmness.

In terms of the project's primary goal, we were ultimately successful in collecting data supporting our directors' hypotheses that the "artificial mound" underlying the Temple was in fact composed almost entirely of travertine masses. Travertine, a calcareous rock resulting from the gradual deposition of minerals dissolved in local bodies of water, is especially light in weight and brittle due to its nature of formation. We believe that because of these properties ancient architects found it to be the perfect candidate as a "filler" for the artificial mound as it was easy to transport and readily available throughout the surrounding environments. Excavation of the second trench thus focused on the location of travertine masses used to build the artificial mound, the sizes of these masses, and their orientations when discovered. Ancient planners had most likely ordered masses to be "dumped" into the fill before covered with earth, thus allowing the Temple of Athena to stand on an elevated mound relative to the surrounding city.

Figure 3: "West Section, Trench 1 showing strata of volcanic tephra from Vesuvian eruption of 79 CE and lower edge of travertine of artificial mound beneath Temple of Athena."

Source of Support: ☒ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☐ Other (specify):

Research Fellow: Rachel Dansereau (2020) **Concentration: Neuroscience**

Faculty Mentor: Jason Meyers **Department(s): Biology; Neuroscience**

Title of Project: Signaling Coordinating Sensory Cell Progenitor and Stem Cell Fate

Project Summary:

Over the summer, I worked in Professor Jason Meyers lab using zebrafish as a model organism for the experiments. Zebrafish possess regenerative properties that allow them to repair organs after damage. It is thought that scientists can use this knowledge by studying this system and animal in order to find ways to help humans and cure to diseases, such as blindness and hearing loss.

Zebrafish make good model organisms for many reasons, especially for studying development. Zebrafish share around 70% of their genes with humans. These fish are also able to produce many offspring in a short amount of time, and these offspring become an able-bodied swimming fish in a three-day time period. Zebrafish larvae are also transparent, which allows researchers to examine their internal structures and embryo development.

We were interested in looking at the lateral line system in these animals, which serves as the sensory system for these animals. The posterior lateral line contains numerous sense organs called neuromasts. These neuromasts are mechanoreceptive organs that help them to sense changes in water flow when they are swimming. My project was centered around a zebrafish line that had a mutation involving klf17, or kruppel like factor 17, which belongs to a family of transcription factors.

The goal of my project was to breed fish with this mutation and associate the genotype with the corresponding phenotypes. To start, I used fish that had been previously manipulated by a previous student that carried the klf17 mutation. As all the fish were living in the same tank, it was hard to identify who were carriers of the mutation. Therefore, I bred these fish together, making sure to look for any abnormalities in the offspring. Since there were so many fish, it was decided that the fish would be genotyped in order to identify the carriers of the mutation to make the breeding process easier. The fish were genotyped by clipping their tails and running PCR on the samples. The samples were then examined using gel-electrophoresis. This process gave better insight as to which fish were heterozygous or homozygous for the recessive mutation.

Fish that were identified to be potential carriers were bred together, and their offspring were examined. Around one quarter of the offspring were maturing differently than the others. It was found that some larvae were staying inside their embryos for longer than 3 days. These fish, if they were transgenic, were examined. Observations of these fish showed that the lateral line system was delayed and not fully developed. The primordium, which deposits the neuromasts down the lateral line, was only about halfway down the body of the fish. After performing PCR and running gels on these samples, it was found that these larvae exhibited similar results as the identified potential mutants. For the future, the fish that were exhibiting abnormal primordium movement will be bred together, and we will continue to look for abnormalities in the lateral line system.

Source of Support: ☐ AHUM Div. ☒ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Science and Math Initiative-SMI (NASC Division)

Research Fellow(s): Alden DeBouter (2019) **Concentration: Anthropology**
Vanessa Lizana (2020) **Concentration: English**

Faculty Mentor: Mary Simonson **Department(s): Film and Media Studies; Women's Studies**

Title of Project: Staging Cinema: Performance, Liveness, and the Transition to Sound

Project Summary:

When patrons walk into movie theaters today, they enter with certain expectations of their movie-going experience. They expect to see a box office in the lobby and a concession stand. Inside the theater, they expect to find a dark room with rows of comfortable seats facing a large projection screen.

However, audiences entering prominent movie theaters in major U.S. cities in the early 1920s would have entirely different expectations. They would expect to see a grand hall, complete with elaborate decorations, velvet chairs, ornate architecture, and a full stage beneath a proscenium arch. Moreover, they would expect to see and hear a live orchestra, an organist, and a fleet of other actors, actresses, solo musicians, and dancers.

Long before the American film industry's shift to "sound" in the late-1920s, filmmakers, innovators, and particularly exhibitors were exploring ways to make film "sound." Using archival materials, particularly the trade journals *Motion Picture News and Moving Picture World*, we examined a wide range of silent era audiovisual experiments: live stage prologues in which music, dance, and dialogue were used to introduce and create an ambience for feature films; and live radio broadcasts of narrated motion picture programs, among others.

Taken together, these experiments expand our understanding of film's so-called silent era, adding a new dimension to contemporary debates about technology, perception, and sensation. Ultimately, these ventures show the way in which film's transition to sound was not a rapid technological shift, but an ongoing investigation of liveness, mediation, and the concept of the audiovisual enacted by a diverse group of exhibitors, performers, filmmakers, and the American public.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☒ UNST Div.
☐ Other (specify):

Research Fellow: Andrea De Hoyos (2020) **Concentration: History**

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

Title of Project: Fiver Children's Foundation: The Impact of A Public Speaking Curriculum on a Child's Self Confidence

Project Summary:

This summer I was fortunate enough to be given the opportunity to work with Fiver Children's Foundation at their camp in Poolville, NY. Their organization is meant to teach children from underprivileged communities to be upstanding citizens and to believe in their future. This camp is an annual part of a ten-year commitment that takes place for two weeks every summer. Twelve attributes are taught to the campers, giving them something to strive for: compassion, trustworthiness, self-confidence, responsibility, creativity, respect, courage, learning and being a peacemaker, a valuable team player, community-builder, and awareness of the environment. In these two weeks they try to focus on these twelve attributes. At the end of each session, each camper is rewarded with a dog tag with one of the attributes that they showed the most throughout their time at camp. At the end of their ten years, each camper will have approximately ten dog tags that they can look back on and remember the lessons they learned throughout camp.

My project involved created a video archive of their public speaking program. I worked directly with Larry Geller, the creator of the public speaking class at Fiver. With Larry, I observed every class and recorded a few of them in an attempt to show what certain activities in the class are meant to look like. I also helped him organize the class by camp age group (Lead I, Lead II, Serve I, and Serve II) and by the number of days they participate in this class throughout their two weeks at camp. Each age group attends a different number of days, and focuses on something different, making the class distinct for each group. By clarifying and documenting these different curriculums, a future instructor would be able to replicate them. Of course, I also focused on the presence that Larry Geller has on the camp and highlighted his personality is what ultimately teaches the kids how to stand in front of a crowd and speak loudly and proudly.

I hope that my work will help any future instructor for public speaking understand what this class is supposed to look like. I also believe that through my work in organizing the public speaking program I have helped future instructors know the main idea that this class is meant to teach so that they can emphasize them as much as Larry has, in and out of the classroom. I hope that my work also conveys how important Larry Geller's presence is on this camp and how his personality is shown throughout his persistence and refusal to give up on a camper.

I have found that I have grown throughout this summer. I feel as if I am able to better communicate myself and my ideas to others because of my participation in the classes. I have learned the impact that one person can have on another, whether it is a camper or a coworker. I saw the impact that these two weeks had on these campers and it made me so grateful to be a part of it. I witnessed the change in a camper from not being able to say their name above a whisper in class to giving speeches in front of the entire camp. Finally, this experience made me more comfortable to talk to others about my ideas, along with being comfortable with myself and my speaking abilities. I will take the lessons in the curriculum I helped to create with me throughout any future presentation, interview, and even day-to-day conversation. A major part of my job was to record and edit videos of the classes, graduations, debates and mock interviews so I will also take with me the editing skills that I had to learn in order to accomplish this task. This summer taught me a lot about myself while also teaching me critical skills that I will use in the future.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Upstate Institute

Research Fellow(s): Allison "Ally" DePuyt (2020) **Concentration: Neuroscience**
Erin Santos (2020) **Concentration: Neuroscience**

Faculty Mentor: Jun Yoshino **Department(s): Neuroscience; Psychological and Brain Sciences**

Title of Project: Effects of Anti-Depressants on Nitric Oxide Released from Glial Cells

Project Summary:

Microglia and astrocytes are neuroprotective glial cells in the central nervous system (CNS). Microglia are responsible for phagocytosing debris and initiating immune responses. Astrocytes are key players in the blood-brain barrier and tightly regulate brain infiltration. Though major depressive disorder (MDD) is characterized by a deficit in monoamine neurotransmitters, the inflammatory theory of depression postulates that microglia and astrocytes may be activated to produce CNS inflammation. Activated microglia produce nitric oxide (NO), a free-radical gas, as part of this immune response.

Paroxetine is a selective serotonin reuptake inhibitor (SSRI) frequently prescribed to treat MDD. Paroxetine blocks the serotonin reuptake transporter (SERT), increasing the availability of serotonin at the synapse; however, the drug has also been shown to calm microglial activation. When applied to the BV2 murine microglial cell line, 5 μM paroxetine reduces the production of NO after LPS challenge by 25%. Similarly, 5 μM paroxetine inhibits NO production by isolated microglia by 30%. This reduction in NO release suggests that paroxetine inhibits the inflammatory response to LPS in microglial cells. In contrast, primary mixed glial cultures containing astrocytes and microglia display a 75% increased NO production in response to LPS and paroxetine.

Purified secondary astrocyte cultures do not produce NO in response to LPS. Reconstructed cultures consisting of microglia or BV2 cells reseeded onto purified astrocytes display reduced LPS-induced NO production at day 6 when treated with paroxetine. At day 9, however, reseeded cultures treated with paroxetine displayed increased NO production in response to LPS. Taken together, these results suggest that microglial NO production is regulated by astrocytic communication that may take multiple days to establish in culture.

To further elucidate the mechanisms through which paroxetine affects inflammation, microglia and mixed glial cultures were treated with chlorpromazine, tonabersat, serotonin and norepinephrine to evaluate their effects on LPS-induced NO release. Chlorpromazine, an antipsychotic drug, is mainly known to antagonize dopamine and serotonin receptors. Although chlorpromazine has an opposite effect on neurotransmitter receptors than that of paroxetine, it induced a similar pattern of NO production; microglia had a decreased LPS response following chlorpromazine treatment while mixed glial cultures had increased NO release following co-treatment with chlorpromazine and LPS.

Tonabersat blocks astrocyte connexin43 hemichannels, which may contribute to the differential behavior of mixed and isolated microglial cultures. When BV2 microglia were exposed to tonabersat and LPS, there was no change in the response. This was expected as microglia do not express connexin43. Tonabersat did not alter the LPS-induced NO response in mixed glial cultures. Additionally, the drug failed to change the effect of paroxetine. The addition of serotonin, a neurotransmitter frequently evaluated in depression studies, had no effect on the inflammatory response of microglial cultures, indicating that SSRIs are mediating changes beyond simply increasing neurotransmitter levels.

Notably low concentrations of norepinephrine inhibited the LPS-induced production of NO in BV2 and isolated microglial cultures. Intriguingly, the LPS-induced inflammatory response was slightly but significantly reduced in mixed glial cultures. Norepinephrine also reversed the increase in inflammation caused by paroxetine.

Source of Support: ☐ AHUM Div. ☒ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☐ Other (specify):

Research Fellow: Ravendra Dhanraj (2019) **Concentration: Neuroscience**

Faculty Mentor: Frank Frey **Department(s): Biology; Environmental Studies**

Title of Project: To what extent does public awareness of epilepsy and attitudes towards people with epilepsy impact the access to antiepileptic treatments in Joanna and New Amsterdam, Guyana

Project Summary:

Over the summer, the Lampert Summer Research Fellowship provided me the incredible opportunity to conduct original research in Guyana, South America – my home country. The focus of my research was to gain a better understanding of epilepsy knowledge and awareness, in addition to learning more about attitudes about epilepsy and towards people living with epilepsy (PWE) and its impact on epileptic treatment in two separate regions: New Amsterdam and Joanna. My hypothesis going into this research was that cultural beliefs about epilepsy and the way epilepsy is perceived prevents epileptics from getting the appropriate treatment and thus, contributing to the overall treatment gap of epilepsy in the country [treatment gap is defined as the ratio between the total number of people who are diagnosed with epilepsy and the number of those people who are seeking appropriate treatment for their seizures – usually in the form of antiepileptic drugs (AEDs)]. I pursued this research topic after spending a semester abroad in Manchester researching epilepsy treatment gap in India, China and the US. I found that, while most of the literature focused on the economy of the country as being the main contributor to the epilepsy treatment gap, there were other factors, such as epilepsy education, awareness, perception, cultural beliefs, discrimination, etc. that are also major contributors – even more so than the economy in certain 'developing countries' like India. Since I grew up in Guyana with my epileptic brother, I was aware that there were cultural beliefs about epilepsy that exist in my community and these beliefs usually dictate the type of treatment an epileptic would receive. Additionally, at present, there is no research about epilepsy that was conducted in Guyana, unlike other countries in South America. Therefore, I thought that this research would provide a basic understanding of epilepsy awareness, attitude and treatment in New Amsterdam and Joanna.

Along my project, I had the opportunity to talk to teachers, trainee nurses, doctors, and epileptic patients – each group painting a picture of epilepsy that conformed to the hypothesis my research proposed. I wasn't shocked to find that almost all of the individuals I interviewed know of epilepsy by its common term "fits". As the Director of the Epilepsy Foundation points out, this term is generally referring to an individual who is having a mental breakdown. This therefore creates this stigma around epilepsy as having a mental breakdown or 'being mad'. This stigma is further perpetuated by a Psychiatric Hospital – which is commonly known in the region as 'Mental' – which institutionalized over 20 epileptics. Some people believed spiritual forces were the cause of epilepsy, while others thought that religion played a role in someone having epilepsy. Few believed that epilepsy was contagious. Though people recognized that PWE are discriminated in society, their attitude towards PWE was more positive compare to the same research done in other countries. For example, attitudes were positive towards PWE receiving an education, having a job and getting married/having kids. However, there were some reservations to these attitudes. For example, people agreed that PWE should get married, but recognized that finding a spouse would be harder; or, people favored PWE getting a job, but stipulated that they have to be in an environment where they can be supervised by others.

Some of the more interesting results that came out this my research had to do with opinions in regards to access to treatment for epileptics. Though some people believed that epilepsy is a medical phenomenon, and does not involve spirits or religion, they sill said that they would take an epileptic individual to a church/mosque/temple for religious treatment. As the director of the Epilepsy Foundation explained, there are a number of reasons why people may not go to the hospital: not only could be that private practice is expensive, people feel intimidated by doctors, some people don't believe that doctors are experience to treat epilepsy, some people may not have the transportation to get to a hospital, and some people just don't have the time to go to a hospital. I have also uncovered that when it comes to epilepsy care, the general public is not equipped with skills to properly take care of someone having an epileptic attack/seizure. People reported that they would restrain the individual, take them to a hospital, seek help from others, and, commonly, they would put a spoon in the mouth of the individual having the seizure to prevent them from biting or swallowing their tongue. Guyana has a long way to go to achieve progress in epilepsy care, and some of that progress in being pioneered by the Epilepsy Foundation. Since its inception in 2014, the organization has worked to sponsor events to raise awareness of epilepsy and teach epilepsy first aid to the general public. This is the direction the country needs to head in order to dispel some of these cultural beliefs about epilepsy and combat the misconceptions that are preventing epileptics from getting the care they should.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Lampert Institute for Civic and Global Affairs

Research Fellow: Colleen Donlan (2018) **Concentration: Political Science**

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

Title of Project: ADK Action and the Keeseville "Farmacy": Good Health Begins at the Table

Project Summary:

This summer I worked with AdkAction in Keeseville, NY in the Adirondacks. AdkAction has been creating projects that address unmet needs, promote vibrant communities, and preserve the character of the Adirondacks since 2011. They serve seasonal and year-round residents of the Adirondack Park and work in diverse project areas such as community revitalization, food access, environmental stewardship, arts and culture, and broadband internet access. My primary focus has been on "The Farmacy" which began in 2017 and is a partnership between the Keeseville Pharmacy and AdkAction designed to make healthy food, sourced from local and organic farms whenever possible, physically and economically accessible to all Keeseville residents within the Pharmacy space. We partner with six local farms and a food hub to make high-quality produce, dairy, meat, eggs, and value-added products available in the Farmacy. Together with the Keeseville Pharmacy, we are trying to help vulnerable populations gain access to affordable, locally-produced food.

When the only grocery store in Keeseville closed down in 2013, residents had to choose between traveling to other areas for groceries or shopping for processed foods at convenience and dollar stores. At the Farmacy, we aim to increase access to healthy products for all consumers, while supporting our local farmers. The Farmacy accepts SNAP/ EBT benefits and is in the application process for WIC checks. We aim to help SNAP/WIC recipients access higher quality food with their benefits and to help farmers access this larger under-tapped market. But one of the challenges is supporting the local farmers, who must charge higher prices, while making the food accessible to low-income consumers. Additionally, there is a lack of education around what the Farmacy offers and the health benefits of local, fresh, and healthy foods.

We address the lack of access to local food and education by offering incentives and educational opportunities. My goal this summer was to expand the Farmacy project, increasing education and outreach efforts. To increase awareness and education around using local foods, the Farmacy will be hosting three cooking classes this fall with a local chef. The classes will use products from the Farmacy to teach consumers how to best use the vegetables, meats, and cheeses. At these cooking classes, which are open to all SNAP participants, each person will receive $10 of Farm Fresh Cash from the Clinton County Health Department that they can use at participating retail locations, including to Farmacy, to buy fruits and vegetables. Additionally, we applied for grants to offer incentives for fresh, healthy produce for consumers picking up their prescriptions at the Pharmacy. These outreach efforts will help us combat the cultural, socioeconomic, and physical barriers to food access.

As a political science major with a minor in environmental studies and an interest in food justice, my experience with AdkAction has combined my academic interests with my interest in community-based food projects. After this summer, I will now go back to my home community of Portland, Maine to work with my county's food security council. My experience in the Adirondacks has shown me how an innovative food project can be successful in a rural area with the support of a close-knit, connected community. Through my work this summer, I've been able to work in all parts of the Farmacy project, from communicating with local farms to applying for grant opportunities. I hope to take those lessons back to the projects that the council is doing, working with both farmers and low-income consumers to make healthy food more accessible.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Upstate Institute

Research Fellow: Ethan Dorow (2020) **Concentration: Computer Science**

Faculty Mentor: Michael Hay **Department: Computer Science**

Title of Project: DPComp: Realistic Data Mining Under Differential Privacy

Project Summary:

Differentially Private Data Analysis

Project Summary: The aim of the research project was to come up with an easy way to implement better data privacy (in the form of differential privacy) in a data analytics platform called MacroBase.

Differential privacy: Differential privacy is a strong, mathematical definition of privacy in the context of statistical and machine learning analysis. The goal is to achieve a state where whether a particular privacy object's (i.e. the entity whose privacy we are trying to protect) data are included or not does not affect the result. Differential privacy can be attained in multiple ways, often including adding a calculated amount of noise to the output of the algorithm. An algorithm $\mathcal{M}$ is $\boldsymbol{\epsilon}$-differentially private if for any two datasets D1, D2 that differ by one record,

$$\frac{Pr(\mathcal{M}(D_1)=O)}{Pr(\mathcal{M}(D_2)=O)} \leq e^{\epsilon} \text{ for all O} \in \text{Range}(\mathcal{M}).$$

MacroBase: MacroBase is data analysis platform implemented in Java. The core concept behind MacroBase is simple: to prioritize attention, an analytics engine should provide analytics operators that automatically classify and explain fast data volumes to users. MacroBase executes extensible streaming dataflow pipelines to explain groups of points by aggregating them and highlighting commonalities of interest. Many settings where MacroBase can and has been applied contain highly sensitive data (e.g., telemetry data from mobile devices) yet Macrobase offers no privacy guarantees to participants in the database.

We implemented differential privacy in MacroBase using the sample and aggregate method. Instead of running the MacroBase pipeline on all the data at one, the data were partitioned into samples based on the privacy object (each object's data points are hashed to the same sample) and the MacroBase pipeline runs on each sample, resulting in a collection of 'Vector Explanations'. These explanations are then aggregated resulting in a singular Vector, to which noise is added resulting in the final output of the differentially private MacroBase pipeline.

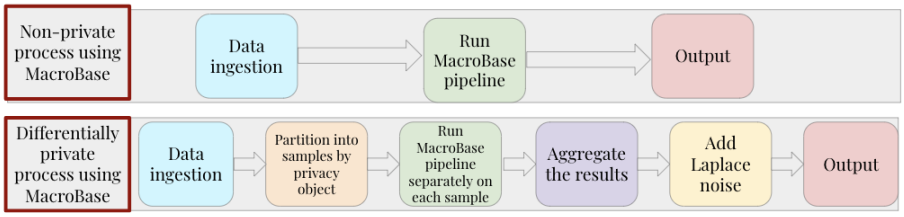


Figure 1 - Change in workflow to make MacroBase private

Graphical User Interface: The GUI was developed using Java, Javascript, and is displayed through the web browser of the client via HTML. It provides the user a simple frontend interface in order to generate explanations based on user inputted datasets, pipelines, etc. The backend code was constructed to be as flexible as possible, thus altering the code to run specific tasks is simple. The basic frontend implementation comes with a Batch executor, in order to run basic pipelines, as well as a Sample And Aggregate executor to run pipelines to be differentially private using the sample and aggregate technique.

Sample and Aggregate: As mentioned above, sample and aggregate is an implementation of differential privacy. It will partition the original dataframe into several smaller sampled dataframes (the number of samples is determined by user). All records with the same privacy object are grouped into the same dataframe so that the modification of a specific privacy object could only affect one of the dataframes. Due to the uncertainty of the definition of privacy object for every setting, sample and aggregate provides a hash function interface that every pipeline should implement. The sample and aggregate pipeline provides a default hash function that takes several columns as privacy object. Sample and Aggregate requires that the result of the pipeline must be of type Vector Explanation, which is an Explanation containing a vector of double values. The Sample and Aggregate pipeline provides differential privacy via adding Laplace noise to the values within the Vector Explanation.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): National Science Foundation Grant

Research Fellow(s): **Julia Dottinger (2018)** — **Concentration: Natural Sciences**
Devin Ferri (2021) — **Concentration: Peace and Conflict Studies**
Marie Pugliese (2020) — **Concentration: Biology**
Caio Rodrigues Faria Brighenti (2020) — **Concentration(s): PCON; COSC**
Emily Weaver (2020) — **Concentration: Environmental Geology**
Katherine "Katie" Weber (2020) — **Concentration: Molecular Biology**

Faculty Mentor(s): **Joe Eakin** — **Department: Vis Lab**
Karen Harpp — **Department: Geology**

Title of Project: Virtual Galapagos Project

Project Summary:

The primary objective of the Virtual Galapagos Project is to construct a digital educational experience for children around the globe to learn about science through the lens of the Galapagos Islands. Our project differs from many existing informal science efforts, in that students encounter concepts from multiple disciplines, with an emphasis on geology and evolutionary biology. Most importantly, the Virtual Galapagos resource is designed to inspire students to pursue careers in science by leading users toward sophisticated scientific concepts, culminating in results from recent research efforts in the Galapagos and highlighting contributions from leading Galapagos scientists and conservationists.

The project blends a set of intersecting storylines that lead users through modules, each focused on fundamental concepts critical for understanding the development of the Galapagos Archipelago and its unique flora and fauna. For instance, students are given the opportunity to explore how the volcanic islands develop and subside, how species colonize the islands, the genetic relationship between land and marine iguanas, how currents support Galapagos biodiversity, and how adaptive radiation works, as illustrated by the Galapagos finches. We employ many types of interactive mechanisms to engage users intellectually, as well as images and 360o video collected last year in the islands, whiteboard animations, interviews with research scientists, and suggestions for experiments students can do on their own as complements to the resource's content. A set of narrators guide the users through the experience, while allowing students freedom to select their specific exploration path.

Once this pilot phase of the project is operational, we will begin to incorporate contributions from Galapagos naturalist guides and residents, as well, making the outreach project a truly grassroots effort, built by people who work and live in the archipelago.

Because this resource is intended to be accessible to a wide range of audiences, we are collaborating with the SolarSPELL team at Arizona State University to host the digital resource on portable, ruggedized, solar-powered equipment that can generate a local wireless server that anyone nearby can connect to without needing internet connection. Consequently, students lacking reliable Internet access will be able to use both the Virtual Galapagos resource and a digital library of supporting material.

The Virtual Galapagos Project is funded through support from NASC, Colgate's Geology Department, and a collaborative grant from the Office of Science and Society at McGill University's Labs without Borders.

Source of Support: ☐ AHUM Div. ☒ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Doug Rankin '53 Endowment-Appalachian Research; Doug Rankin '53 Endowment-Geology Research; Hackett-Rathmell 1968 Memorial Fund; National Science Foundation Grant; Norma Vergo Prize; Vis Lab

Research Fellow: Daniel Dougherty (2021) **Concentration: Astrogeophysics**

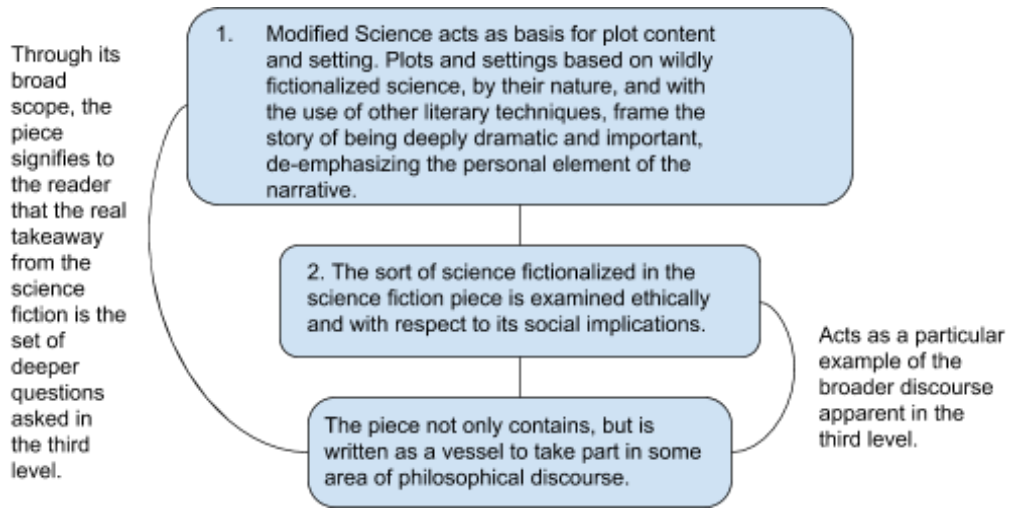
Faculty Mentor: Christina "CJ" Hauser **Department: English**

Title of Project: Science Fact vs. Science Fiction

Project Summary:

This summer, I researched the nature of the relationship between science and science fiction. This was done through reading several science fiction books or books examining science fiction (eight to be exact: *Brave New World, the Island of Dr. Moreau, The Time Machine, Frankenstein, I Robot, Science Fiction by literary critic Robert Adams, Oryx and Crake, and Never Let Me Go*) as well as the viewing of some science fiction films and television episodes (*Star Trek, Doctor Who, Star Wars, Her, Interstellar).* All of this culminated in a forty three page paper which interprets this relationship as a literary structure shared between pieces across the genre. In addition to this project, a smaller endeavor was pursued on the side; interviewing professors in STEM fields, I assembled their general musings about the relationship of science and science fiction into an eight or so page journalistic piece.

The larger paper interprets the relationship between science and science fiction as a three rung literary structure: on the first level, some distorted from of science-related phenomena is used by the science fiction to develop a story and narrative. The nature of these stories tends to be grand in scope and more concerned with ideas than characters. On the second level, the science fiction by necessity must examine the article of science it bases its distortion on, essentially, robot science fiction examines robots, and apocalyptic science fiction examines climate change, and so on. On the third level, the narrative construction of the science fiction, as developed on the first level, which emphasizes the broader questions being posed rather than giving priority to literary character arcs, and the existence of deeper meanings which transcend the observations about scientific phenomena on the third level, such as the discourse regarding robots in sci-fi being a 'stand-in' for subjects of tentative personhood, and it becomes clear that science, in this modified form, allows science fiction to act as a modern philosophical dialogue. To investigate this idea, I had to incorporate some brief further research into the rhetorical construction of philosophical dialogues; for the purposes of demonstration in the paper, I chose Plato's *Euthyphro* and Nietzsche's *Thus Spoke Zarathustra* as comparison points.



In the side project, in my interviews with faculty members Jeff Bary and Beth Parks, both said that they wanted to see science's system of information accruement more accurately expressed in science fiction. Both cast doubts on Sci-Fi's capacity to meaningfully inform the public of some area of science, but they both agreed in separate interviews without knowledge of the other's answer that the idea that science is a neat, five or so step list of exercises was 'nonsense' and that the incremental accruement of knowledge through peer review and re-experimentation, as well as the skeptical, questioning nature of scientific discourse, would be a great thing to see in a science fiction piece, an interesting development that makes me wish that I had interviewed more people and considered as more of a side project to sharpen my ability to write in the journalistic style and condense long interviews.

This project has been most beneficial in its providing a framework with which to view any sci-fi piece and ascertain its deeper meaning, and opening an interesting criticism of the genre's portrayal of science, namely its method of information accruement. Personally, it has allowed me to build stamina in writing by being my first 'big' paper and it helped me practice my research skills.

Source of Support: ☒ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☐ Other (specify):

Research Fellow: Isabel Dove (2019) **Concentration: Geology**

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

Title of Project: Polar Marine Diatoms and Antarctic Paleoclimate

Project Summary:

In order to understand present climate change, it is important to study past climate change via paleoceanographic records. The Antarctic is a region particularly sensitive to climate change. However, certain areas of East Antarctica remain notably understudied due to presumed stability of the East Antarctic ice sheet. This project focuses on the Edward VIII Bay, which is a little-studied area located on the Kemp Land Coast of East Antarctica. Two sediment cores, which were collected on a 2001 research cruise along the East Antarctic margin, provide a record of climatic and oceanographic change over the past ~8,000 years, a time period known as the Holocene. Edward VIII Bay is an important area to study because it currently represents a gap in the record of circum-Antarctic Holocene climate.

While on the Kemp Land Coast, the NBP0101 cruise conducted multibeam swath mapping of the region, collected CTD data, and retrieved a kasten core and a jumbo kasten core of marine sediment. The swath map displays mega-scale glacial lineations, while the CTD data suggest the presence of modified Circumpolar Deep Water. Samples of organic matter were collected at intervals throughout each core and were subsequently radiocarbon dated in order to create an age-depth model. Magnetic susceptibility, electrical resistivity, biogenic silica, and grain size were measured throughout each core. These data indicate relatively stable climate conditions. Diatom abundance and assemblage data provide additional details of past oceanographic change. Diatoms are microscopic algae that are sensitive to environmental conditions such as temperature, light, and nutrient availability. Their siliceous skeletons are preserved in the sedimentary record, enabling diatoms to be used as a proxy for past oceanographic conditions. The assemblage data reveal an inverse relationship in the abundance of *Fragilariopsis curta* and *Chaetoceros* subg. *Hyalochaete*, indicative of colder conditions later in the Holocene, corresponding to a Neoglacial period.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Bob Linsley/James McLelland Fund

Research Fellow: Miller Downer (2021) **Concentration: Environmental Biology**

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

Title of Project: Unpacking the Climate Smart Community Checklist with the Village and Town of Hamilton

Project Summary:

This summer, I had the opportunity to work with both the Town and Village of Hamilton in achieving Climate Smart Community Certification to promote green and sustainable action in the local communities that they represent. The offices that I aided in this process naturally aim to promote the will of the people that they govern through means of promoting local businesses and other such developments that allow the small area of Upstate New York to stay happy and afloat. Ultimately, the offices aimed to pass important legislation that would benefit themselves in their certification as well as their populations in their businesses and daily routines.

My work with the Town and Village involved gathering the various documents that they have accumulated over the years that will be needed to work towards the state-wide recognition of CSC Certification, ultimately allowing them to apply to more competitive grants that may benefit them in future endeavors and set an example for other such small communities in New York. In addition to sorting and uploading their memorandum and resolutions for sustainable practices that they had passed, I also aided the municipalities by providing guidance in which direction they should be moving when it comes to adopting more and more actions that relate to CSC Certification, such as Climate Smart Action Plans for both governments as well as audits that they both can conduct independently.

Because of my work, both the municipalities have made substantial progress towards receiving their certification, notably setting a date to submit their final application in the summer of 2019. Among my own accomplishments during my time with the Town and Village are my completion of solid waste audits for both office buildings, the establishment of the Climate Smart Community Task Force, and the appointments of CSC Coordinators for both governments. Through my project, the Town and Village ultimately made their first steps to becoming certified green communities and gained substantial understanding in the application process, allowing them to operate and continue without any outside assistance—although, it helps for there to be someone whose sole job is sorting documentation in an orderly fashion.

Working with the Town and Village has taught me several things that I would have never even considered, mainly pertaining to exactly how government processes need to run through multiple people before they're finalized and resolved. The process of submitting the resolution to recognize the CSC Task Force had to run through many people and be approved by a council before finally being fit to upload to the New York State CSC Portal. In addition, our focus as the Task Force mainly pertained to actions that were time-efficient and quick-acting as opposed to long-term projects that could benefit the community at large and potentially cost much more money; we were first going to get short-term and easy goals out of the way. However, this does not mean that the community will simply follow the steps of the government. For the most part, the businesses in Hamilton willingly act in sustainable manners and support the governments in their endeavors. I also learned that my interest in Environmental Biology can span more than what I initially thought it could; I had never even considered that sustainable action has a place in local government.

After my work was finished over the summer, I was approached by the Town and Village representatives and asked to continue my work during the school year, so I hope I can continue helping the governments achieve their certification in a timely fashion. I also hope that I can learn more about sustainable practices as they are adopted in local government bodies and the impact they can make on a small population of people, mostly because I'm interested in bringing sustainability back home to Mississippi, which can benefit greatly from learning how to properly manage waste and record assorted emissions to save money in the long run.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Upstate Institute

Research Fellow: William "Caio" Driver (2020) **Concentration: International Relations**

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

Title of Project: Forcing Germany's Hand: Principle and Pragmatism in German Foreign Relations with Turkey since the European Migration Crisis

Project Summary:

Since German reunification, the European Union has increasingly turned to Germany for direction and stability during times of uncertainty. Crises, including most recently the refugee crisis in Europe, have thrust Germany foreign policy into an exposed position that has led many to question the path of German policy. Notably, attention has been called to German responses during the Kosovo intervention, Iraq War, Euro crisis, and recently the Libyan intervention, Ukraine conflict and refugee crisis. Questions have been raised about Germany's commitment to its previously lauded principled foreign policy; whether it has turned to a more pragmatic approach, or even returned to playing power politics, a previous staple of German policy. My research and paper attempt to answer one of the essential questions in this debate: Why does the balance of principle and pragmatism vary the way it does?

In answering this question, I selected case studies that showed variation on two axes: *process* and *substance*. The process variable is a continuum from unilateralism to multilateralism, whereas the substance continuum stretches from nationalism to cosmopolitanism, creating four categories of foreign policy choices: *Principled Policy*, *Proselytizing Policy*, *Uploading Policy*, and *Pragmatic Policy*. This is a new method of study in looking at a state's foreign policy choices, presenting a different way of thinking about the outcome and process by which foreign policy is categorized. Through author interviews, news reports, secondary literature and published policy statements, I built a list of indicators placing each policy decision on the both the process and substance continuums, before looking at the driving factors behind those choices.

Using the primary case studies of the refugee crisis, Ukraine conflict, and UN Security Council abstention on the Libya Intervention, my research finds domestic politics to be the driving force behind many of the choices, causing policy to be ideologically scattered, contrasting the previous centrist stability Germany was known for. Traditional International Relations theories, such as structural realism, liberal institutionalism, and constructivism, expect outcomes in German foreign policy, which, in some of the cases studied, are reflected in the actual policy outcome. However, my research indicates domestic politics to largely be the driving force behind a foreign policy choices made. Public opinion and party politics have become a sort of testing ground for foreign policy choices--if the policy in question is accepted by domestic constituents, such as Germany's response to the Ukraine conflict, the policy-making procedure moves forward as normal, but when controversial, decisions become stuck in a political quagmire, and often the resulting policy mirrors the domestic muddle.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Lampert Institute for Civic and Global Affairs

Research Fellow: Margaret "Maggie" Dunn (2019) **Concentration: Geography**

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

Title of Project: Aquaculture as a Possibility in Food Deserts

Project Summary:

Food deserts are a recurrent problem across the United States and throughout the world. Millions of people live in these areas, so named because they cannot get access to fresh, affordable, and healthy food. The United States Department of Agriculture (USDA) defines the term "food desert" as an area with at least 20% of the population earning at or below the federal poverty level and at least one-third of this population live more than a mile away from a proper grocery store (i.e. a store like Price Chopper) (USDA, 2017).

In 2014, Greensboro, North Carolina was ranked 1st in MSAs (metropolitan statistical area) in the nation for food hardship and second in 2011-2012 (City of Greensboro, 2015, pg. 6). North Carolina also ranked as the eighth hungriest state overall. Greensboro continues to be one of the most concentrated areas of hunger in the state as it contains 17 of Guilford County's 24 food deserts.

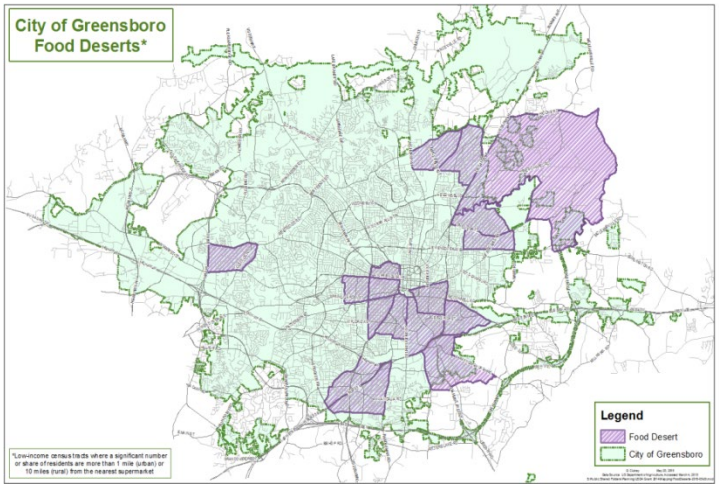
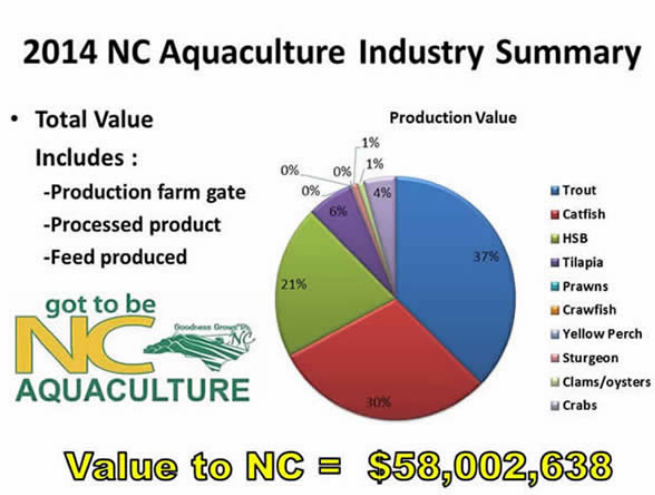


Figure 4: City of Greensboro's Food Deserts
Source: city of Greensboro Food Plan, 2015, pg. 6

Living in a food desert can be detrimental to ones health for a multitude of reasons. Obesity, cardiovascular issues, and other health problems are more likely to occur among people living in these areas (Starnes, 2015, pg. 11). These people are also more likely to be food insecure, meaning they do not have sufficient access to affordable and nutritious food. There is limited access to fresh, healthy foods because corner stores and gas stations do not typically carry such foods. Transportation is also a critical issue when looking at food deserts. If a family does not have access to a vehicle, they will have a much harder time getting to a grocery store in a timely and efficient manner and bringing their groceries back home.

The City of Greensboro created a task force to combat the food deserts within its borders. While the task force focuses on many beneficial solutions, it does not consider the option of aquaculture or aquaponics which is where this research becomes useful.



Aquaculture is the raising of marine or freshwater species for consumption. According to NOAA Fisheries, half of the seafood eaten worldwide is farm raised, including in the United States (NOAA Fisheries, 2018). As one of the fastest growing segments of North Carolina Agriculture (Aday, 2018), and according to NOAA Fisheries, aquaculture, including marine and freshwater, is the fastest growing form of food production in the world.

Numerous sustainable solutions involving aquaculture are considered and the benefits and pitfalls of each outlined in this paper. The North Carolina General Assembly approved funding to install refrigerators in corner stores to try help alleviate some of the food insecurity people feel in food deserts. Aquaculture products as well as those produced either through aquaponics or integrated multi-trophic aquaculture could fill these corner store refrigerators and give people a fresh, healthy, affordable, and sustainable option for their produce and/or meat.

However, certain barriers stand in the way of making aquaculture a long-lasting solution. These include the actual installation of the aforementioned refrigerators, Greensboro's public transportation, funding for various solutions not including refrigerators, and attitudes about seafood produced through aquaculture. However, aquaculture is a viable solution which could be utilized to help make a difference.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Lampert Institute for Civic and Global Affairs

Research Fellow: Vanessa Escobar Acosta (2019) Concentration(s): Environmental Studies; Spanish

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

Title of Project: Administration and Perceptions of Water Resources in Northwest Honduras: Case Studies of a National Park, a Wildlife Reserve and a Botanical Garden in Comayagua, Yoro, and Atlántida, Honduras

Project Summary:

My summer research project was possible through the Lampert Institute for Civic and Global Affairs' Summer Fellowship. With the help of Professor Andrew Pattison in the Environmental Studies Program, I conducted a personal research project on water resources at areas of conservation in Northwest Honduras. The goal of this project is to provide insight to the ways water resources have been managed and operated at three conservation sites in Northwest Honduras over recent years. Focus was placed on three sites with varying management categories: *Mico Quemado Wildlife Refuge*, *Cerro Azul Meámbar National Park*, and *Lancetilla Botanical Garden*. Honduras was selected as a research site given the historical corruption of its government. I wish to assess how shifting environmental spheres and a larger political system affect local efforts at conservation of water resources. I chose these sites due to their national importance, their proximity to community-valued water resources, and their geographical location making them susceptible to major impacts by tropical storms coming in from the Caribbean Sea and Gulf of Mexico.

My aim was to shed light on the extent of protection water resources receive in Honduras. Moreover, what lies beyond the power of administrators in charge of the conservation sites as climate change makes Central and Latin American regions, their resources and populations more vulnerable. This was conducted all through the lens of sustainability and efforts and knowledge of the notion. With a bottom-up framework of environmentalism, I want to place a particular focus on two things: i) how management works at these sites and ii) the influence of local, state-level and federal environmental policies. My research was interview-based. This approach hopes to provide firsthand reporting on the experiences of local stakeholders, groups and organizations, political leaders and residents over the years. Moreover, I plan to get professional opinions on how these entities should respond to major political, economic or environmental changes that may be present. I was able to conduct interviews with a range of individuals. I have personal connections in Honduras that will help me build a network and schedule interviews before I travel there. I will conduct interviews with park visitors in situ, by randomly selecting and asking for participants in person. I was able to build connections with interviewee subjects and through local organizations build a network of references at all three sites. As part of my results, I noted some outstanding themes throughout the three sites. Most notably are the efforts at reforestation and hope for expansion in environmental education. With the primary goal in mind to preserve its land and natural resources, local stakeholders have expressed their concerns with deforestation and resource depletion. From this, local leaders aim to create a more sustainable path for the future of the site and its inhabitants- human and nonhuman. Another trend that was present at all sites was the interconnection of non-governmental organizations, local governments and residents through *juntas de agua*, or water committees. When contrasting the three protected sites, there are four main differences: the lack of in-situ environmental law enforcement at Mico Quemado, high percentage of protected land coverage that is still forested and "thriving" at Cerro Azul Meámbar and Lancetilla Botanical Garden, and the geographical vulnerability of Lancetilla to natural disasters such as hurricanes and tropical storms, and lastly, the importance of tourism for Cerro Azul Meámbar and Lancetilla.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Lampert Institute for Civic and Global Affairs

Research Fellow: Taylor Flaherty (2020) **Concentration: Molecular Biology**

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

Title of Project: Molecular Analysis of Development in C. elegans

Project Summary:

My research was concerned with the effects of Diethylstilbestrol (DES) on multiple generations of Caenorhabditis *elegans*. C. *elegans* is a hermaphroditic nematode that serves as a good model organism for research. This is due to their short life cycle of 3 days, the fact that 40% of their genome is conserved in humans, and their convenient brood size. Diethylstilbestrol is a non-estradiol chemical that was given to women from the 1940's-1970's believed to help with fertility and pregnancy. However, it was found to have the opposite effect as it caused issues like infertility and reproductive tract abnormalities in their offspring and future generations. Previous research has indicated that the F1 generation has seen effects from DES on fertility and reproductive tract issues, but not much research has been done on further generations. This summer I studied the multigenerational effects of DES, given only at the parent generation, on fertility, head thrashing, and growth in C. *elegans,*

In order to investigate the effects of DES on fertility the worms were egg prepped using a bleach solution and plated using various DES concentrations: 0 uM (control), 0.5 uM, 5 uM, 10 uM, 20 uM, and 30 uM. The total number of progeny was counted to determine fertility for each of the six DES concentrations (n=20 worms). Fertility was tested for five generations (Parent-F4), but the worms were only treated with DES at the parent generation. Our results indicated that the higher concentrations had a significant decreased effect on the total number of progeny, specifically, 20 uM caused the most adverse negative effects. Significant negative effects were seen through the F3 generation for fertility. Our research showed that by the F4 generation the total progeny counts had returned to normal. This suggests a possible epigenetic inheritance mechanism due to the recovery in fertility by the fifth generation.

The next assay performed was head thrashing which is defined by: a change in the direction of bending at the middle of the body. Worms were egg prepped and allowed to grow into young adults on plates with various DES concentrations. After, they were transferred into M9 solution onto worm plates containing no food. They were given a one-minute recovery period and then the number of head thrashes was counted for 30 seconds. The total number of head thrashes for each of the six DES concentrations was determined (n=20 worms). Like the fertility assay, this was repeated for five generations (Parent-F4), but only the parent generation was treated with DES. The F1 generation saw a significant decreased effect in the number of head thrashes at 20 uM. The F2 and F3 generations both saw significant decreases in the number of head thrashes for almost all of the DES concentrations (0.5 uM, 5 uM, 10 uM, 20 uM, and 30 uM). Similar to the fertility data, by the F4 generation the total number of head thrashes had significantly increased for most of the DES concentrations, compared to the control. The significance was determined by performing a statistical t-test analysis ($p<0.5$). Overall, there were significant effects seen on head thrashing from the early to later generations. There was no prior data on the effects of DES on head thrashing in C. *elegans*, so in order to further investigate this assay I think it would be useful to repeat it and compare results.

In order to determine the effects of DES on growth in C. *elegans*, worms were egg prepped and transferred to plates with varying DES concentrations. At the young adult stage, the worms were transferred to slides and length was measured using microscopy. The pictures did not yield any significant differences that indicated DES had an effect on growth in C. *elegans*.

To continue studying the effects of DES on C. *elegans* it would be useful to investigate the mechanism through which DES binds to the estrogen receptor and to further study genes that are associated with fertility and locomotion behaviors to better understand the mechanism through which the genotype affects the phenotype.

Source of Support: ☐ AHUM Div. ☒ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☐ Other (specify):

Research Fellow: Diana Flores (2020) **Concentration(s): Peace and Conflict Studies; History**

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

Title of Project: Mountain Lake PBS and "Promised Land": Original Opera and the Making of Rural Identity

Project Summary:

Through the Upstate Institute Summer Field School, I worked with Mountain Lake PBS to conduct interviews for a website for "A Promised Land: An Adirondack Folk Opera." Mountain Lake PBS is the PBS network covering the Adirondack region, Champlain Valley, Quebec and Ontario. PBS has long been a non-profit television channel serving people with enriching media. The television network is meant to entertain, educate and inspire and ranges in its media from children's shows to Emmy award winning documentaries to local productions. Through the power of media, Mountain Lake PBS sets out to encourage public engagement, and ensure a quality television outlet for all through the power of media. I hope that my work will help them to stretch their reach even further, and to do more with the Promised Land project than they had originally intended.

Media attention is crucial for the "Promised Land" opera, not only for the sake of gaining the opera credibility and ultimately funders, but for the sake of educating this community on their role in a national struggle. "A Promised Land: An Adirondack Folk Opera" highlights the work of abolitionists Gerritt Smith and John Brown and their fight against racist and unjust voting regulations. It tells the story of black Americans Lyman, Anna Epps and John Thomas, and their struggle for the right to vote. While Mountain Lake PBS Producer Paul Larson worked on four stories covering the history and importance of Timbuktoo, my work focused on the community impact of this story and this art piece. Rural opera is difficult to fund and maintain, but that doesn't mean it doesn't exist. Similarly, the Adirondack region is extremely white, but that doesn't mean it always was. My job was to interview community members, historical experts, and members of the choir performance of the opera to explore what it means to be an Adirondack local. We questioned how this opera and this history affects Adirondack identity and how it can bring about a positive change to the community. While my interviews will not be shown on TV, they will be accessible on the MLPBS webpage and will help more people learn about this beautiful history and emerging opera.

Because I study both history and Peace and Conflict Studies (PCON) at Colgate, I have learned how to navigate history in terms of what it means to people. A lot of the course material in PCON concentrates on the lived experience of people, and seeing people not through the lens of one's own life and expectations but through a local context in which one must understand all the rarities that have led to this person being the way they are. After coming to Colgate and being introduced to the unique Central New York community, I was excited about further exploring the identity of a region that is often overshadowed by the fame and grandiosity of New York City. As a result, I wanted to become a Field School Fellow. Although the Adirondacks are obviously not in Central New York, I welcomed the opportunity to become exposed to another unknown community.

Overall, I learned that interviewing people is a valuable skill-- sometimes you can't just stick to the predetermined questions and it is necessary to delve into deeper inquisitions, which open up a beautiful conversation. From this experience I gained a deep sense of what it means to be a community, and why a television network as famous as PBS wants to work with a university professor-composer like Glenn Mcclure to help spread the beauty of opera. Through the interviews I conducted, I have seen the passion of people who live in this region to committing themselves to help promote their community, and the warmth and kindness with which they have received me into their community.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Upstate Institute

Research Fellow: Elena Forbath (2021) **Concentration: Undeclared**

Faculty Mentor(s): Heather Kropp **Department: Geography**
Michael "Mike" Loranty **Department: Geography**

Title of Project: Combing Drone Remote Sensing and Field Measurements to Understand Plant Function

Project Summary:

Over the course of 10 weeks, research regarding the relationship between leaf temperature and sap flow in response to water stress was completed in collaboration with the Geography Department. Sap flow is the measurement of water moving through a plant stem and relates directly to rate of transpiration or evaporation of water from the stomata of plants. Sap flow sensors on honeysuckle plants, as well as other sensors collecting meteorological data, were installed at a field site on the Bewkes Center. They were used to establish a relationship between precipitation, soils moisture and other factors and sap flow. A DJI Phantom 4 Advanced quadcopter drone and a FLIR Duo R thermal camera were utilized to take aerial RBG (normal color photos) and thermal images of our field side, in order to determine the average leaf temperature throughout the site. The images taken were processed and stitched together to create thermal and RGB maps of the field site, also known as orthomosaics.

Drone technology played a huge role in this project, mostly contributing to obtaining, as well as some processing, of images of the Bewkes Center. The Phantom 4 Advanced drone used was only equipped with an RBG camera. In order to obtain aerial thermal images necessary for this project, it was found that attaching our FLIR Duo R thermal camera to the base of our drone using a 3D printed mount to be the most effective strategy to do so. The FLIR was then programmed to take photos every second while, simultaneously, the drone takes the RGB images of the field site. A flight-planning app, called Altizure, was also used which provided an easy way to clearly establish an area of interest where the drone will fly over and take images. The Altizure app included an option for creating different flight paths, which programs the drone to take photos with a different camera angles. These photos from different angles were used to create 3D reconstructions of the field site.

For RBG image processing, the aerial images were imported into Agisoft Photoscan, a processing software which identifies common points on each image and matches them to eventually create a map of the area of interest consisting of hundreds of overlaying photos. Processing the thermal images, on the other hand, required a more complicated work flow, including normalizing the color range/gradient used to represent plant temperatures. To do so, a code made in R, a type of programming and coding language, was used. These methods were tested with thermal imagery taken in Healy, Alaska, investigating how plant temperature varies across different plant species and types. A thermal orthomosaic demonstrating this temperature gradient was then created as a result (as shown to the left). The same work flow and software used for stitching together the RGB images was also applied to the thermal images. Research for this project will be continuing into the fall 2018 semester.

Figure 1: Aerial image (left) and orthomosaic (right) of Bewkes field site. Aerial image corresponds to location of the red circle on orthomosaic.

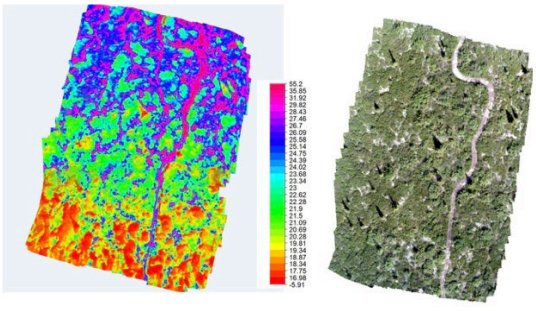


Figure 2: Thermal orthomosaic (left) with temperature range legend and corresponding RGB map (right) of Healy, AK field site.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): National Science Foundation Grant

Research Fellow(s): Heather Fredrick (2020) **Concentration: International Relations**
Kimberly "Kim" Ravold (2019) **Concentration: English**

Faculty Mentor: Jennifer Brice **Department: English**

Title of Project: Living Writers

Project Summary:

Living Writers is both a Colgate course (ENGL 360) and a self-paced, online literary learning experience that is free and open to all. Each fall semester, Colgate invites approximately ten authors to campus for discussion of one of their works. Students enrolled in the Colgate course read the texts, meet the authors, and participate in discussions with them. The authors, in addition to visiting the class, give talks that are open to all Colgate students, faculty, and staff as well as the surrounding community. Living Writers online provides a livestream and archives these events. Living Writers online also features video or audio discussions between Jennifer Brice and an affiliated faculty member about each text, as well as resource pages with numerous reviews of the texts, interviews with the authors, and any other pertinent sources that may enhance readers' knowledge of the authors, texts, and content of the texts. This fall, nine authors will come to campus, three of whom are alumni authors. Currently, 518 people, many of whom are Colgate alumni and parents, are participating in Living Writers online, and 42 students are enrolled in ENGL 360.

As Jennifer Brice's research apprentices, we worked on a variety of projects to help launch Living Writers 2017. The core of our work involved research on the authors and the texts. We read each text and researched each author, compiling numerous sources for the Living Writers online resource pages for both the class and larger community to use. The research varied for each author, and the information we sought included but is not limited to interviews with the authors, reviews of the Living Writers texts, updated or additional research on the texts' content, biographical information about the authors, video or audio recordings of the authors, and reviews of the authors' other texts. These resources will give readers better context of each work, leading to a greater understanding of the text. Once Jennifer Brice reviewed this research, we uploaded the sources to the Living Writers site. Each week, Professor Brice met with us to discuss possible avenues of research and major themes within the primary texts that would be useful to focus on in each class.

In addition to this research about the authors and texts themselves, we performed various tasks for the Living Writers program. When needed, we communicated with faculty partners and colleagues in IT about the Living Writers site and content needed. With Professor Brice's oversight, we wrote summaries of each text and short biographies for each author for use on the Living Writers website and for marketing materials. We attended marketing meetings and offered feedback on effective marketing strategies and website language. We brainstormed ways to advertise this year's lineup, focusing on our alumni authors visits coinciding with the Bicentennial celebration. For use on various social media platforms, we wrote marketing pitches such as "13 Days of Living Writers," leading up to the day the site launches. We also worked with Stephanie McClintick in proofreading designs and distributing Living Writers marketing materials such as postcards, posters, and stickers.

Our research for Living Writers included a wide variety of tasks aimed to help launch Living Writers 2018. In this apprenticeship, we gained research, marketing, analytical, and communication skills as well as proficiency in various administrative tasks, as well as a deeply enriched understanding of the Living Writers texts.

Source of Support: ☒ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☐ Other (specify):

Research Fellow(s): **Ada Gao (2019)** **Concentration: Psychology**
Yingyi "Wenny" Lin (2020) **Concentration: Psychology**

Faculty Mentor: Caroline "Carrie" Keating **Department: Psychological and Brain Sciences**

Title of Project: Dialects of the Body: Concealing and Revealing Emotion and Power in US and Asian Cultures

Project Summary:

Since cultural misunderstandings due to flawed language translation are common and may lead to serious consequences, it is important to understand the match between cultural values and body expressivity (Matsumoto & Hwang, 2017). This summer project aims at deciphering the fit of these values with elements of nonverbal displays in the US, Vietnam and Chinese citizens.

The disguise and concealment of felt emotion requires effort to prevent true emotions and may "not be convincing due to the leakage" age of emotions in through the nonverbal (NVB) cues they present (DePaulo et al., 2003). In the U.S., variables such as smiling, high blink rate, indirect gaze, and self-touch can be NVB manifestations of nervousness, which may be interpreted as deception (DePaulo et al., 2003; Ekman et al., 1988). In this particular study, we chose to count blink rate, shrugging, furrowing and raising of the eyebrows, the duration of smiling, direct gaze, and self-touch. We chose these particular cues because as they can be indicative of nervousness (DePaulo et al., 2003; Ekman et al., 1988). However, we can expect that the cultures will vary in how frequently they use these NVB cues. These were used to track how U.S. and PRC student "encoders" cloak and reveal positive and negative feelings.

Participants (encoders) were recruited from a U.S. and a Chinese university in Hunan, PRC, ages 19 to 23. Encoders were videotaped while responding to four, emotionally-valenced images. Videos were shortened, muted and coded by trained research assistants (blind to condition) for 6 NVB cues. We predicted that NVB cues will be most muted by PRC encoders when reacting to negative (disturbing) stimuli while NVB cues will be enhanced for U.S. encoders overall.

Results are still under analysis, but impressions were that U.S. encoders were much more expressive in when reacting to both positively and negatively valenced images. NVB cues utilized by Chinese encoders appeared much more subtle especially when presented with negative stimuli. Limitations of the study include sampling issues, such as small and convenience sampling and exclusively European U.S sampling. The limited four stimuli may also not have had the desired effect across cultures.

Future research should include more variables that analyze NVB cues tied to deception and a more diverse sample such as Asian American to see how biculturalism influences the way in which individuals conceal and reveal their emotions.

Examples of Non-verbal Cues in the study

Source of Support: ☐ AHUM Div. ☒ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Science and Math Initiative-SMI (NASC Division)

Research Fellow(s): Amanda Gastel (2019) **Concentration(s): French; Psychology**
Christina Towse (2019) **Concentration: French**

Faculty Mentor: John Gallucci **Department: Romance Languages and Literatures**

Title of Project: Translation from the French: Madame De La Tour du Pin in Upstate New York

Project Summary:

This summer, our team translated a portion of *Journal d'une femme de cinquante ans, 1778-1815*, the memoir of Madame de La Tour du Pin, from French to English for possible use in a FSEM course at Colgate University. We strived to translate the text in a way that retained historical integrity and the personal voice of the author while also sounding natural in the English language. To give context to our project, we visited Madame de La Tour du Pin's house in Albany, New York. The Delatour house is now a part of the Sisters of St Joseph of Carondelet Convent. The Sisters gave us atour of the house and shared the history of the house, time period, and of Madame de La Tour du Pin herself.

Translating involved preliminary research and multiple revisions. Our research focused on the time period, the author, and vocabulary specific to the time period that we were unfamiliar with. The next step involved each of us translating every other page. Our advisor, John Gallucci, discussed with us parts of the translations that needed to be changed due to grammatical errors, unclear translation, or awkward phrasing in English. In this draft, we translated more literally.

We then revised each other's translations in order to blend our translation styles and to correct errors that had been overlooked; we also provided alternative translations as we refined our work. Next, we read our translated draft of the text through and made corrections to the English to make it sound more natural. We focused on changing only what was absolutely necessary to make sense in English in order to keep the integrity of the time period and voice of the author. Last, we checked our translation line-for-line line with the original text and made small adjustments. We also checked for consistency in our translations during this step, making sure that specific vocabulary was translated the same way throughout our translation.

A witness to the French Revolution and to the early American republic, Madame de La Tour du Pin provides in her memoir an important window into the 18th century as seen through the eyes of a French woman. Her work is a significant source for the understanding of French refugees from the French Revolution, the relations between Native Americans and European settlers, the early Quakers in New York State, and the institution of slavery in early New York.

This project lends itself to future research about historical figures, places, and terms to be included in an index and footnotes.

Source of Support: ☒ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☐ Other (specify):

Research Fellow: Rebecca Gowen (2019) **Concentration: Molecular Biology**

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

Title of Project: Role of the Circadian Clock in Seasonal Affective Disorder

Project Summary:

Mood disorders, including anxiety and depression, affect greater than 20% of the global population and are commonly associated with sleep and/or circadian disruptions (Steel et al., 2014). Genes involved in the circadian clock, the molecular mechanism regulating daily rhythms, are implicated in moods disorders, including seasonal affective disorder (SAD). Seasonal affective disorder is a common type of depression that occurs during the winter as a result of short days with limited exposure to light. SAD is most commonly found in individuals who live in northern latitudes, and symptoms of SAD include depression, fatigue, and irritability (Melrose, 2015). Given the global prevalence of SAD, it is critical to determine how circadian mechanisms influence mood in order to design more effective treatments.

In a year-long project, we are examining the epidemiology of SAD using behavioral measures and molecular analyses in two populations that are at high risk for SAD, an undergraduate population and a population of refugees from equatorial origins. The behavioral measures include the Seasonal Pattern Assessment Questionnaire (SPAQ) and Beck's Depression Inventory (BDI). Taken together, these behavioral measures provide insight into the relationship between seasonal changes and mood, as well as the prevalence of seasonal affective disorder in undergraduate and refugee populations.

For the molecular approach, we are analyzing DNA derived from participants' hair samples to determine the genetic background of SAD through gene association studies. Single nucleotide polymorphisms (SNPs) in circadian genes, such as CRY2, have been linked to SAD (Lavebratt et al., 2010a). We are examining select target SNPs in circadian genes in order to better understand the effects of circadian variants on seasonal affective disorder. We are also looking at RNA to test the hypothesis that specific circadian gene polymorphisms are associated with a decrease in amplitude of clock oscillations and a subsequent increase in circadian misalignment. We are measuring the correlation between the amplitude of circadian oscillations (RNA) and self-reported seasonal depression and will compare the data obtained during long days in the summer and short days in the winter.

Seasonal affective disorder is a common type of depression and has significant economic and social costs, yet little research has been done to investigate the role of genetic background and circadian phenotypes on SAD. This study takes a public health approach to examine these roles through epidemiological and molecular analyses on undergraduate and refugee populations in the Northeast. These populations are especially susceptible to SAD given their distance from the equator and limited exposure to sunlight during the winter. I hope to characterize the circadian phenotypes and genotypes of equatorial populations and explore the relative risk of SAD in these populations following relocation to temperate regions.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Beckman Scholar Program

Research Fellow: Seth Grimes (2019) **Concentration(s): Anthropology; Psychology**

Faculty Mentor: Mary Moran **Department(s): Anthropology; Africana and Latin American Studies**

Title of Project: The Modern Gladiators?: An Ethnography of the Lives of Combat Sports Competitors

Project Summary:

Combat sports are currently experiencing a high degree of recognition, perhaps because of the rising popularity of pay-per-view mixed martial arts (MMA) events. These sports include many full-contact styles of fighting to include boxing, kickboxing, Jiu-jitsu, Muay Thai and Capoeira, with MMA (also known by its more pejorative name: cage fighting) being the amalgamation of just about every practical style. Competitors of combat sports willingly expose themselves to the dangers of violence, serious injury, brutal weight cutting processes, shame, anxiety, and (on the professional level) monetary insecurity. What justifies participation? Even in the face of such negative aspects, the combat sports community is a strong one, fostering attitudes of kinship and self-mastery. This seems to indicate something unique about the style of violence in combat sports. I set out to find out whether the violence of modern-day combat sports is fundamentally different from other forms.

During the summer of 2018, I conducted an ethnography of combat sports competitors, paying particular attention to the motivations for and effects of this domain of competition. My investigation was conducted using interviews (formal and informal) as well as participant observation. I conducted 13 formal interviews, dozens of informal interviews, and visited 4 different training locations in Southern New Hampshire and Northern Massachusetts.

One of my foremost interests was the motivation for competing in combat sports. The responses I received to this area of inquiry were the most diverse of any of my queries. "We're not all fighting for the same reasons", a Muay Thai and MMA fighter training out of California told me, as she then proceeded to cite three separate motivations for competing in such demanding fields. This was a common thread during the interviews. Generally, several motivations conspired to bring an individual into the dangerous world of hand to hand combat.

The most common reasons for competing were closely-associated variations of the desire to challenge oneself and to inspire others. Only one of the professional fighters I interviewed listed monetary compensation as a primary motivation for competing. Another mentioned money as a secondary motivation, behind the challenge of the sport. However, money never served as the original impetus to prompt fighters to begin competing. This finding came as a surprise. My exposure to the professional fighters displayed in the most-watched television events of combat sports presented money as the most ubiquitously expressed motivation, but this is not what I found.

Unlike the disparate motivations, the effects of combat sports between individuals were almost universal. The consequences of competing and training in mixed martial arts are severe, upon both the bodies and the psyches of participants. In the physical sense, the sport exacts a very heavy toll. Fighters suffer from the extreme bodily punishment that the violence dishes out. However, the psychological and behavioral effects of competing in combat sports appear to be very positive. A Jiu-jitsu black belt and international fight league (IFL) competitor eagerly informed me that since starting to fight at age 20, he has been sober ever since. Many participants had stories similar to this. All participants indicated that since training martial arts, they have avoided non-sanctioned forms of violence, and this was a marked change for several.

An interviewee, once considered one of the top fighters in New England, confidently declared, "when you're good at something, never do it for free". Though this answer made me laugh, it does contain an important truth disguised within the simple platitude. Hand to hand combat is an art that carries a substantial risk, and those who dedicate their time to learning to master an art form should be fairly compensated for that mastery. This is no different from the reason why a painter should never be expected to scuffle with the canvas for free, nor a musician to wield their instrument without fair compensation. Mastery produces professionalism.

Another reason elite fighters tend to avoid unsanctioned violence is the recognition of their own command of violent ability. The intense training instills them with the knowledge of what they "can do to people." Indeed, combat sports competitors who realize just how dangerous they are, become much less likely to unleash that dangerous expertise upon people outside the boundaries of the sanctioned arena.

In the end, all these responses can be distilled down to a simple concept: control. Combat sports grants a measure of control to its participants, whether that be the self-control to resist unwelcome substances and altercations, or the potential to exert control over a given situation. This, I found, was a primary difference between the kind of violence conveyed in combat sports and other forms. This violence is largely introspective. The competitor is far more concerned with how the mutual violence shapes oneself than how it affects the opponent.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☒ SOSC Div. ☐ UNST Div.
☐ Other (specify):

Research Fellow: Amogh Gupta (2021) **Concentration: Undeclared**

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

Title of Project: Supporting the Development of a Spaceflight Dating Spectrometer

Project Summary:

The purpose of this summer research project was to measure the conversion of potential and kinetic energy into thermal energy. We wanted to create a pedagogical experiment to show, quantitatively, how energy is transformed from one form to another. To do this, I turned over a tube of buckshot thousands upon thousands of times, giving the buckshot potential energy as I raised it each time, and letting it convert to heat as the buckshot fell and stopped at the bottom of the tube. For each trial, I determined the specific heat (c) of the buckshot and thermal conductivity (k) of the tube.

We then modeled the function as an exponential decay graph in the form of $y = \alpha + \beta e^{t/\gamma}$. The initial temperature should be α+Beta(Beta is negative), then the initial rise rate should be Beta/Gamma, and the final temperature should be α. The graph should show an initial rise and then an eventual decay where the temperature stops rising.

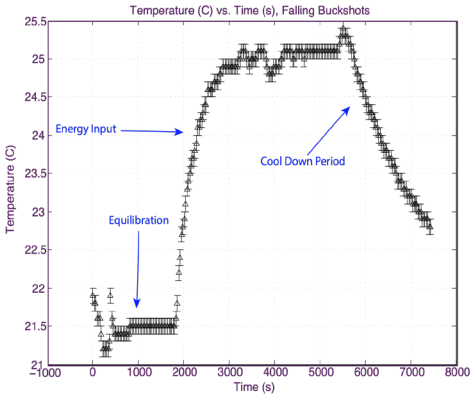


Figure 1

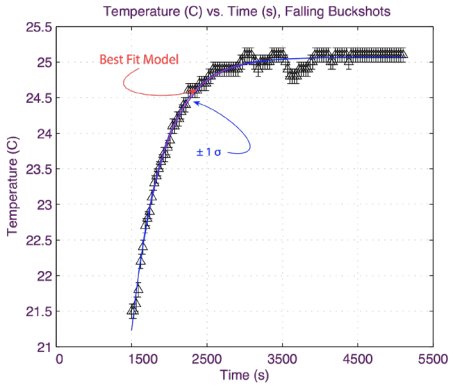


Figure 2

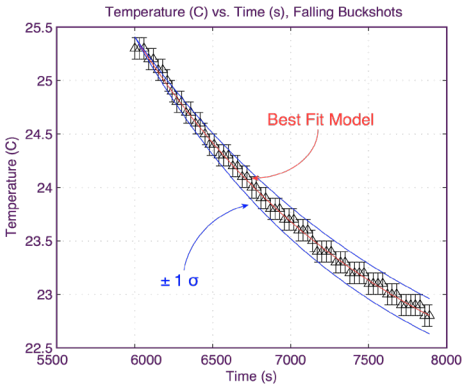


Figure 3

The lines are our best fit model and it is within one standard deviation. As you can see from the graph, our model fits very well with the data that we have collected within one sigma. Figure 1 shows the total data collected over a span of more than 2 hours, then Figure 2 is the temperature rise and then Figure 3 is the temperature decay.

The specific heat we deduced from our turning experiments turned out to be factors of 3-10 higher than our direct measurement. This means that most of the energy we add to the system is not converted into heat of the buckshot. A likely explanation is that heat goes into the tube, and from there to the outside air, at an uncontrolled rate. We could control for this effect by jacketing the entire tube with ice water, so that the exterior temperature stays constant.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Justus '43 and Jayne Schlichting Student Research Fund

Research Fellow(s): Caroline Hashagen (2019) **Concentration(s): Psychology; Spanish**
Emma Meyer (2019) **Concentration(s): Classical Studies; Psychology**
Fanyi Zhang (2019) **Concentration(s): French; Psychology**

Faculty Mentor: Jennifer Tomlinson **Department: Psychological and Brain Sciences**

Title of Project: Understanding the Benefits of Shared Activities in Long-Term Relationships

Project Summary:

This summer we worked in the Relationships and Health Lab at Colgate University with Professor Tomlinson. We helped design and conduct two studies looking at the benefits of shared activities for retired couples aged 55 and older. Our studies aimed to extend the existing literature on self-expansion, a process that has been widely studied in relationships and has been shown to increase relationship satisfaction as a result of joint engagement in exciting activities.

The self-expansion model proposes that people are innately motivated to seek opportunities to self-expand. One way that individuals are able to do this is through close relationships (Aron & Aron, 1986). As people incorporate their significant other into their own self-concept, they develop closeness, resulting in a larger self-concept with diversified content (Mattingly & Lewandowski, 2014). However, previous self-expansion research has mainly focused on younger couples. For this reason we chose to study married retirees, who are 55 and older, in order to investigate whether shared participation in self-expanding activities would also have a positive impact on older couples. This is an interesting age group to study because research has shown that goals change over the course of a relationship, thus older couples may view self-expanding activities differently than younger couples.

After reviewing the literature about self-expansion in romantic relationships, we decided to replicate a study of younger married couples done by Reissman, Aron, and Bergen (1993) in a sample of retired couples. In the original study, participants completed a pretest where they rated a list of leisure activities for how pleasant and exciting they were, as well as how frequently they engaged in them as a couple. They also completed measures assessing their marital satisfaction and personal well-being. Couples were then randomly assigned to exciting activities, pleasant activities, or no activity control condition. Participants in the first two conditions were asked to complete an activity from a list that had been generated based on their activity ratings in the pretest. After the activity they completed a posttest assessing the same measures of marital satisfaction and personal well-being. In the original study, participants in the exciting condition, and not the pleasant or control conditions, showed an increase in marital satisfaction from pretest to posttest.

Our first study aimed to test the activity list used by Reissman et al. (1993) with older participants, to ensure that the activities fit our target population. We created a survey with Qualtrics that included a 100-item activity list and 8 measures assessing relationship quality and personal well-being. In addition to fine-tuning the activity list (which we used in Study 2), we wanted to investigate how frequently older couples actually participate in the activities on our list, and whether frequent participation in exciting or self-expanding activities is correlated with higher individual and relationship well-being. The survey was posted on Amazon Mechanical Turk, where we obtained a sample of 188 participants. We chose to use this platform because it gave us access to a large sample where we could receive responses quickly. An important finding from Study 1 was that participation in exciting activities did not appear to be as distinct from participation in pleasant activities as we had originally thought. We were also able to add and remove activities from the original list based on the frequency ratings. An unexpected result was that participation in pleasant activities was more strongly correlated with our measures of individual and relationship well-being than participation in exciting activities.

While our first study was correlational, our second study investigated self-expansion in retirement experimentally. We used the same pretest as Study 1, but included our modified activities list. To analyze our data dyadically we chose to obtain responses from both members of a couple. We recruited participants at the Hamilton Farmers Market, local concerts, retirement homes, local businesses, churches, and posted on online platforms such as Craigslist and Nextdoor. Once a couple expressed interest, we sent them a link to the survey online, or mailed them a hard copy of the survey. In order to keep the procedure the same for all participants we developed standardized emails to send the pretest, manipulation, and posttest portions of the study. So far we have received completed surveys from 43 couples, and we are waiting for responses from couples that are still in progress. While we are still in the process of data collection, we hope to gain insight about the benefits of self-expanding activities in retirement when we analyze our data this fall.

Source of Support: ☐ AHUM Div. ☒ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☐ Other (specify):

Research Fellow: Amanda Hauser (2019) **Concentration(s): Neuroscience; Spanish**

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

Title of Project: Assessing Transportation for the Madison County Rural Health Council and Madison County Emergency Management

Project Summary:

The Madison County Department of Emergency Management is in charge of the Emergency Medical Services, firefighting operations, 911 Center, and mitigation/coordination/recovery of emergency situations. The project I worked on focused on the EMS portion of emergency management. The EMS system in Madison County consists of 13 ambulance corps. The county and the ambulances are independent of each other so EM has to find ways to improve care for patients without changing any aspects of the individual stations, such as effecting change in the 911 center and how the call is dispatched.

In 2016, Emergency Management conducted a study looking at ambulance agencies and found a need to investigate "chute times" further. Chute times are a measure of how long it takes from the time an ambulance is dispatched to the time when the it physically leaves the station. These measures are very important to providing good patient care especially in rural areas where the travel time for an ambulance could be 30 minutes or more. In a time sensitive call like a stroke or cardiac arrest, every minute counts. Agencies have full control over their chute time and as a result, my project focused on this data to allow the county to determine which county agencies needed their assistance the most.

The Madison County 911 center provided call reports for every agency except for Vineall Ambulance, which does not contact the 911 center once they accept a call. Each data set was analyzed to determine the severity of the call (a life threatening injury necessitates a faster response) and the time it took for the agency to leave the station and begin their response. The results obtained from this data study shows that some agencies have longer chute times than what can be considered optimal for quality patient care (Figure 1). Madison County has a wide range of ambulance services that range from those staffed entirely with paid medical professionals to those that are run entirely by volunteers. Some agencies have one ambulance, while others have a larger fleet. It is invariably harder for some agencies to have a shorter response times, but this study shows that there is a lot of room to improve. The Department of Emergency Management has and will continue to use this data to create and enforce different projects to decrease these times. The current project consist of a new mutual aid plan and dispatch policy, both of which alert ambulances faster and give them a smaller window to accept a call before moving on to the next closest agency. They are also looking at different projects such as community paramedicine to improve patient care and help agencies.

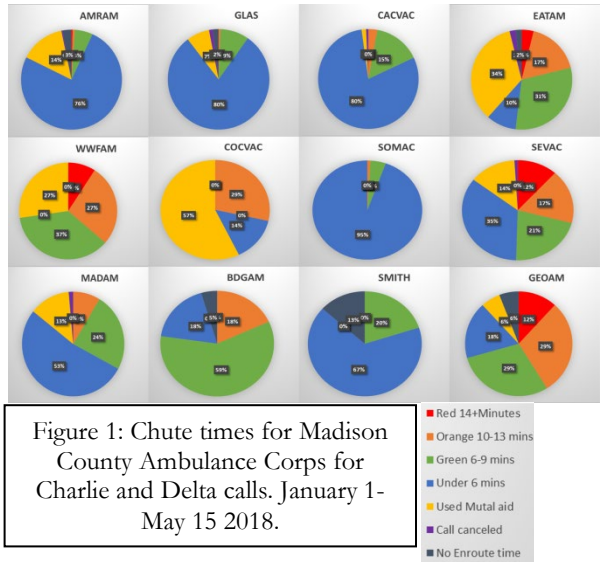


Figure 1: Chute times for Madison County Ambulance Corps for Charlie and Delta calls. January 1-May 15 2018.

This project has taught me about the different ambulance services and the problems that they are facing. I have also learned about Emergency Management and how they are involved in the EMS, fire, and disaster preparation/response. My project was a small introduction to large scale EMS and how it is a difficult mix of providing the best quality patient care and keeping the business side of the ambulance financially stable. I also had the opportunity to work on other projects such as creating a Disaster Preparedness Guide that is going to be given to the public and editing a recruitment manual for fire departments. The Department of Emergency Management works on many different projects to try to plan for everyday and large-scale disasters and during my time in their office I learned how they handle all different kinds of problems.

I will use my experience in Emergency Management to incorporate new ideas into my EMS work while running the student organization on the Southern Madison County Ambulance Corps (SOMAC) during my senior year. This summer I have found that I am passionate about emergency management and will pursue and internship in it. I will also continue to pursue it after medical school and in a future career.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Upstate Institute

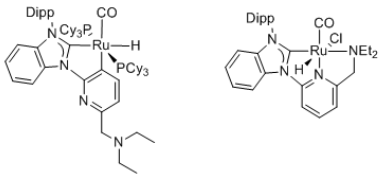
Research Fellow: Tianyi "Mike" He (2019) **Concentration(s): Philosophy; Chemistry**

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

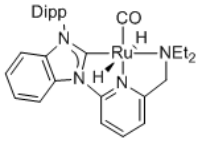
Title of Project: Bifunctional Catalysts for the Hydrogenation and Dehydrogenation of Polar Bonds

Project Summary:

My research this summer under the supervision of Prof. Anthony Chianese focused on the computational mechanistic study of Ruthenium (II) pincer catalysts for ester hydrogenation. The two catalysts of interest were:

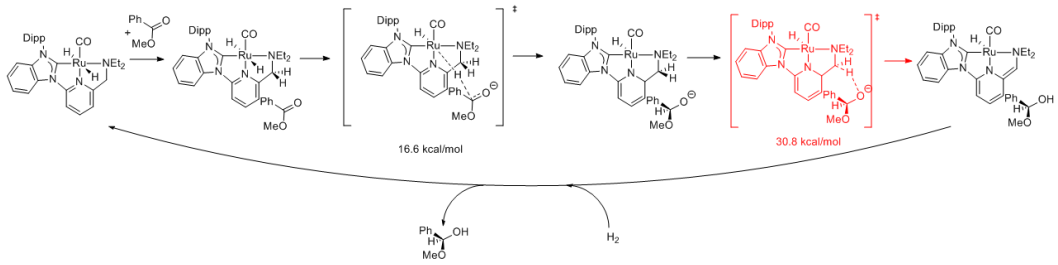


My first project was optimizing the reaction pathway proposed by Jiachen (Ed) Liu 18' in his senior thesis, where he proposed that the two catalysts operate through the same active species:

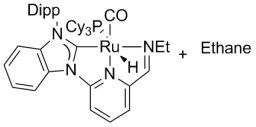


In the mechanism proposed by Ed Liu 18', the amine arm dechelates during catalysts, resulting in a vacant site to which the catalyst could bind. The hydride on the metal center then transfers to the ester, which gives a hemiacetal oxide, leaving a vacant site where H_2 could bind as a sigma complex. The H_2 sigma complex is then heterolytically cleaved by the metal center and the hemiacel oxide, where the hydride remains on the metal and the proton is transferred to the hemiacetal oxide oxygen, resulting in a hemiacetal molecule and the dechelated dihydride complex. The aldehyde form from decomposition of hemiacetal is then hydrogenated in the same fashion. The rate-limiting step is the heterolytic cleavage of H_2 with a free energy barrier of 34 kcal/mol. In my research, I investigated an alternative pathway of H_2 cleavage suggested by Prof. Keith, where the proton is transferred to the alkoxy oxygen, which gives a molecule of aldehyde and a molecule of alcohol directly. This step has a free energy barrier of 30 kcal/mol, which is lower than the previously proposed step.

My second project was computing the "classic" bifunctional pathway for ester hydrogenation, where the metal acts as a hydride donor and the ligand acts as a proton donor.



The hemiacetal then decomposes into methanol and benzaldehyde. The benzaldehyde is then hydrogenated in a similar fashion. The highest barrier is 30.8 kcal/mol, which is virtually identical to that of dechelation pathway. Towards the end of my research, however, a new precatalyst experiment revealed that the active species is *not* the proposed dihydride species, as our PCy_3 catalyst decomposes into ethane and an imine species at the temperature of our hydrogenation:



This means that our catalyst may well operate through some other pathway, despite the plausibility of the two proposed mechanisms. I shall conduct more kinetic and precatalyst experiments to probe the "actual" mechanism, and perform computational studies accordingly.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): National Science Foundation Grant

Research Fellow: Christine Horn (2019) **Concentration: Biology**

Faculty Mentor: Frank Frey **Department(s): Biology; Environmental Studies**

Title of Project: Volatile Organic Compound Expression in Response to Herbivory in Tomatoes

Project Summary:

Tomato plants constitutively express volatile organic compounds (VOCs) stored within glandular appendages known as trichomes on the leaf epidermis. When attacked by herbivores, the expression of VOCs can increase drastically and may serve as an important biochemical signal for plant defense. However, the role of this enhanced expression is of some debate in the literature. Some studies suggest that increased VOC emission recruits parasitic and carnivorous arthropods, whereas other suggest that increased VOC emission primes nearby plant tissue to accumulate proteinase inhibitors to diminish the ability of herbivores to digest plant proteins thereby affecting herbivore performance and development. Changes in VOC emission can be induced directly through mechanical damage or through the application of herbivore oral secretions such as jasmonic acid.

In tomatoes (*Solanum lycopersicum*), there are approximately 20 known VOCs, and there is significant variation among cultivars in both the total abundance of volatiles emitted and the relative abundance of the constituents. Preliminary research in Professor Frey's lab has shown that constitutive expression of tomato VOCs differs widely among cultivated, heirloom, and wild cultivars and that this expression is plastic with drought and nutrient stress. Cultivated varieties of tomatoes have been strongly selected for in terms of pigmentation, aroma, and taste of the fruit; the chemicals responsible for these characteristics are linked to the production of VOCs through the carotenoid pathway where geranyl diphosphate is utilized as a building block for both the production of fruit attributes, such as lycopene, and also as a building block for monoterpene VOCs. I hypothesize that selection for increased fruit quality might have come at the cost of reduced constitutive VOC expression, therefore also impacting the ability of tomato plants to defend against herbivory.

I grew nine varieties of tomatoes—four cultivated, two heirloom, and three wild type. Within the cultivated and heirloom cultivars, I used varieties with varying phenotypic traits, such as redness and taste. I measured trichome abundance and density, leaf weight, and leaf area for all varieties. I compiled baseline VOC profiles from all plant varieties using "leaf dip" and "headspace" procedures to collect volatiles stored within the trichomes and volatiles constitutively released respectively. I exposed plants of each cultivar to a variety of experimental treatments including simulated herbivory through mechanical damage, simulated herbivory through chemical induction with jasmonic acid, and simulated herbivory through both mechanical damage and chemical induction with jasmonic acid. I collected leaf dip and headspace data during these treatments and analyzed the responses of the experimental tomato plants with respect to control plants. I also measured lycopene, the carotenoid believed to cause red pigmentation in tomato fruits, across varieties using spectrophotometry.

Although I am still collecting data, there seems to be evidence that tomato cultivars respond differently to simulated herbivory treatments. While the relative abundances of different volatiles do not change within varieties, the total quantity of volatiles produced, stored, and emitted does vary in response to treatment. Additionally, there does seem to be a correlation between redness of fruits, lycopene content, and volatile emission. Moving forward, I will conduct more herbivory treatments and collect more volatile and lycopene data. Additionally, I will use spectral image analysis of photographs of tomato fruits to further elucidate how agricultural selection for redder, more phenotypically appealing fruits is associated with defensive ability. Preliminary data is potentially indicating that the pathway linking volatile production, pigmentation, and lycopene is mostly driven upstream, meaning that these traits are connected, and if a variety lacks one of these traits, they will lack them all. If the pathway is mostly driven upstream, I would therefore expect for the wild type tomatoes to also have varying, yet high, volatile responses. Similarly, the cultivated varieties which have yet to be tested but supposedly have been highly selected for in terms of redness, should also have a strong volatile response when exposed to simulated herbivory. The current data is beginning to show that variety, cultivar, and redness all may be correlated with defensive ability in tomato plants, and I look forward to further researching this topic.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Beckman Scholar Program

Research Fellow: Ezra Hornik (2019) **Concentration: Chemistry**

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

Title of Project: Towards the Synthesis of a Tn Antigen Mimic via Stereoselective Oxime Cyclization

Project Summary:

Carbohydrate chains that are attached to proteins on the cell membrane have several functions, including cell development, differentiation, and motility. Tn antigen is a truncated version of one of these carbohydrate chains and is associated with tumors. Our group is working towards the synthesis of a Tn antigen mimic that could potentially be used in future cancer research and therapy.

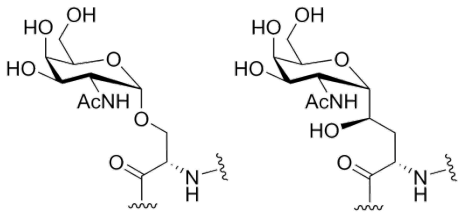


Figure 1: The molecule on the left is the naturally occurring Tn antigen. The molecule on the right is our lab's Tn antigen mimic, which contains a C-link with a hydroxyl instead of an O-link.

This summer I have been testing the synthetic scheme of the Tn antigen mimic on an analogous compound. A crucial step in the synthesis of our Tn antigen mimic is adding the hydroxyl group stereoselectively. We have chosen to do this through an oxime cyclization reaction (Figure 2).

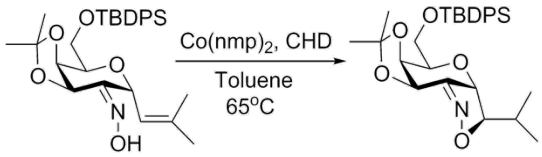


Figure 2: The oxygen of the hydroxyl group is added stereoselectively by cyclizing an oxime with a sterically hindered alkene.

Previous attempts at a stereoselective oxime cyclization on a non-sterically hindered alkene were found to be completely non-selective. I synthesized this new oxime (figure 2) in order to test the oxime cyclization reaction on a more sterically hindered alkene that would better imitate the geometry of the Z-alkene involved in the synthesis of the Tn antigen mimic. This oxime cyclization reaction was found to be stereoselective, as supported by 1H NMR and NOESY evidence. We have theorized that the more sterically hindered alkene leads to a stereoselective oxime cyclization because the exo-conformation of the alkene in the oxime, which leads to one diastereomer, is much more stable than the endo-conformation, which leads to the other diastereomer.

Most recently, I have reduced the double bond in the isoxazoline ring formed in the oxime cyclization using tributyltin hydride. Next, I plan to add an acetate group to the nitrogen to form an acetamide, and then to open up the ring and deprotect the compound to yield a molecule that will be analogous to our final Tn antigen mimic.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): National Institutes of Health (NIH) Area Grant

Research Fellow: Alec Hufford (2018) **Concentration: Religion**

Faculty Mentor: Robert Kraynak **Department(s): POSC; Center for Freedom and Western Civilization**

Title of Project: Weeping Over Jerusalem Together: Discerning the Catholic Way in Israel Anew

Project Summary:

Catholic Christians make up approximately half of the 2.4% of the Israeli population that is Christian. This number is currently rising due to a great migration of peoples from Catholic countries, such as the Philippines. However, there is a new generation of "Israeli" Catholic Christians, Catholic people raised completely within the Israeli, Jewish milieu. For this minority church, a new and unique generation rises up, disciples of Jesus raised completely immersed in Israeli-Jewish milieu. These Catholic Christians grow up speaking Hebrew and participating in Jewish schools and holidays, with many entering the Israeli army. Even their religious experience is immersed in Jewish culture, with the Mass celebrated in Hebrew, the Eucharist consecrated in the matzah of the Passover, and the relationship to the Jewish people central to their Christian community's mission. While many prior generations have lived Christian lives in the so-called Holy Land and sought the Lord and his will in this place of conflict, [1] this new generation – born and nurtured in this soil – may have to find a different way. As the inabilities of the past generation to bring an end to the conflicts and challenges become clear, perhaps it is this community of young, local, and indigenous Christians who must discern what Jesus is asking of them in this hour. Perhaps prompted by the Spirit, they will be able to offer a new perspective on the Lord's will in this region. The complexities of the modern Israeli question are well-known, but the path forward is not. In this new generation of marginalized Israeli, Hebrew-speaking, Christians, a communal discernment is beginning. These young people know Israeli culture deeply, and are conversant with the historical, political, and religious dimensions of the day-to-day reality they experience. Looking to and engaging the voices of this young community, we attempt to contemplate where the Church in Israel is and where she is being called. Through in-depth interviews of a selected young adult Catholics and theoretical discussion about Catholic teaching and biblical theology, this project seeks to explore the questions of who the Catholic Christians of the state of Israel are and how they fit into their homeland as citizens and religious believers

This project seeks to understand the striking political and theological views of Israeli Catholics when it comes to the religious legitimacy of Israel as the fulfillment of God's promise to the Jewish people. While evangelicals and Messianic Jews have shown significant Zionist tendencies and pro-Israel politics based in a particular eschatological reading of the Bible, Catholics tend to represent a far more critical political bloc – often rejecting Israel's claim to the land as not legitimately biblical with the Catholic magisterial tradition refusing to validate the Jewish religious claim to the land of Israel. This project seeks to understand what young Israelis Catholic think about the Zionist question, while speculating upon the political, Biblical, and theological legitimacy of various conceptions of the mystery of Israel.

Advisors: Professor Robert Kraynak and Rev. Fr. David Neuhaus S.J.

[1] As David Neuhaus S.J., former Episcopal Vicar of the Hebrew Speaking Catholic community, writes, "those who are active in this domain today are expatriates who are predominately formed by circumstances in Europe and are not from the Local Church, predominately Arab in its composition." David Neuhaus, "Catholic-Jewish relations in the State of Israel: Theological Perspectives," *Writings from the Holy Land.* (STS Publications, Jerusalem, 2017), 198.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Center for Freedom and Western Civilization
(Stone Summer Research Fund)

Research Fellow: Jin Won "Jin" Huh (2019) **Concentration: Physics**

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

Title of Project: Quantum Ghost Imaging

Project Summary:

Ghost imaging is an optical technique that is used to produce an image of an object without having the object directly in front of the camera. The easiest way to accomplish this is to use mirror reflection, but reflection imaging may not practical if the geometry involved gets too complicated, or if we want better resolution. In ghost imaging, instead of having mirrors, we use entangled photons (particles of light) to obtain an object of the image. Quantum physics tells us that two entangled photons share information, no matter how far they are apart from each other. In particular, Ghost imaging utilizes the spatial correlation between photons to determine the position of the object with respect to the photons. Several applications have been proposed for this relatively new discovery in Optics, including medical applications which promises to greatly reduce the amount of radiation dosage required to take X-ray scans.

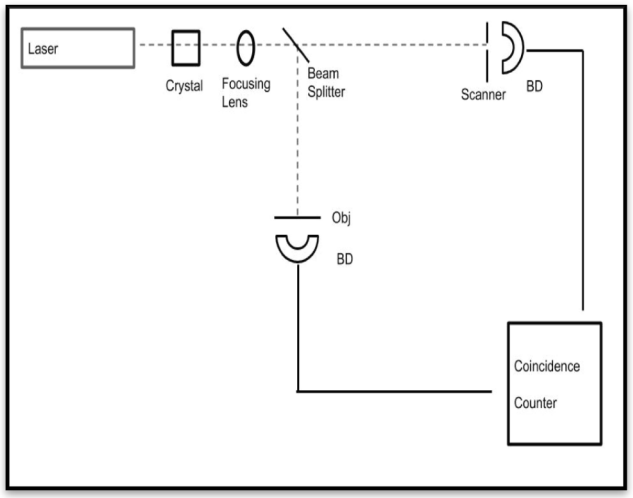


Fig 1. Experimental setup for ghost imaging

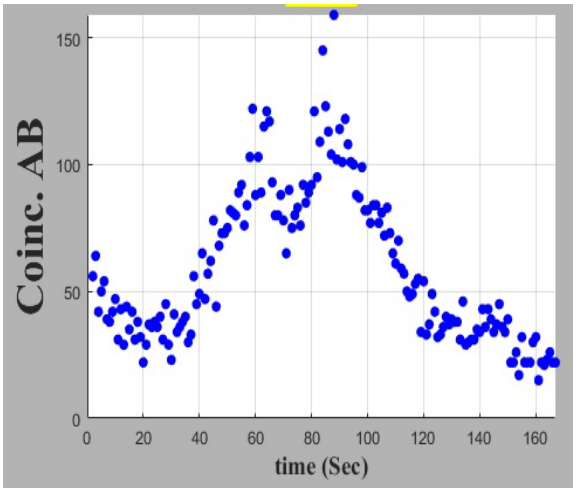


Fig 2. Experimental data showing ghost image of a small electrical wire

To obtain a ghost image, one of the entangled photons is sent to the camera, the other is sent to the object in question. Because these photons share information, the photon at the camera's side knows where the object is, how the object is shaped, how large the object is without directly interacting with the object, thanks to the other entangled pair that interacts and record the actual information of the object. We are not able to determine the image of the object by only looking at the photons that reach the camera, but the ghost surfaces when we look at the coincidence counts of the two entangled photons, which takes both entangled photons into account. Light reaching the camera has no first-hand experience with the object but thanks to quantum information sharing it has second-hand information to tell us what the object looks like. I was able to produce a ghost image of small objects this summer.

Source of Support: ☐ AHUM Div. ☒ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☐ Other (specify):

Research Fellow: Daniel "Danny" Jaris (2019) **Concentration: Biology**

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

Title of Project: Facial Recognition on Harbor Seals in Harpswell, Maine

Project Summary:

Although marine mammal research has made great strides in the past few decades, one of the greatest challenges to population-level studies has been the ability to reliably and easily identify individuals. Of the behavioral research that has been carried out on marine mammals, invasive or inaccurate methods have often been used to track populations, such as tagging or using distinctive markings to recognize individual animals. A recent study done on lemurs, however, found that through using facial recognition technology individual animals can be accurately and humanely identified. Therefore, in our research, we were looking to see whether or not this facial recognition technology could be applied to harbor seal populations in Casco Bay, off the coast of Maine.

Over the summer, we compiled a library of harbor seal faces in populations off the coast of Harpswell, Maine (six of which are shown below). Just from looking at the pictures of these faces, it is clear that there are distinct differences in the faces of individual seals. These differences include the shape, angle and size of facial features of individual seals. Therefore, we believe that a facial recognition program could be developed to be able to accurately identify individual seals so that harbor seal populations in Maine can be more easily monitored. As a result, we could potentially make broader behavioral observations about harbor seal populations, including whether or not individual seals haul out at the same locations over time, whether individual seals return to haul outs year after year, and whether seals haul out in social or family groups.

Figure 1: Sample of harbor seal photos taken off the coast of Harpswell, Maine. Photos of the seal faces were obtained from boat or from land over a period of four weeks.

Source of Support: ☐ AHUM Div. ☒ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☐ Other (specify):

Research Fellow: Kendra Jeans (2020) **Concentration: Biochemistry**

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

Title of Project: Esterification of Galactose Heptenitol and an L-Serine Analog for the Synthesis of a Tn Antigen Mimic

Project Summary:

Cell membranes contain a multitude of glycoproteins, proteins with carbohydrate attachments, which serve many important purposes on the cell surface, such as cell recognition, cell-cell interaction, and cell development. The Tn antigen, or GalNAc-α-1-O-Ser/Thr, is a truncated version of an O-mucin, a glycoprotein found in mucosal membranes, and is found on 70-90% of cancerous cells. The high association between Tn antigen and cancer has led to extensive research on the potential synthesis of a mimic molecule that could assist in immunorecognition of cancer cells, via a molecule with important differences while maintaining overall structural and conformational similarities. Our research this semester worked on the synthesis of a mimic featuring a carbon-linkage with an attached hydroxyl group, to create a key structural difference while generating the correct conformation due to hydrogen bonding in this location.

My specific research focused on a preliminary step in the overall synthesis of the mimic, the esterification of galactose heptenitol and the *L*-serine analog, a step that allows for critical cyclization and intramolecular chemistry later in the synthetic plan. The amino acid used in the esterification must possess specific structural elements for later chemistry: a leaving group at carbon three for later cyclization and a protected nitrogen to prevent interference throughout the synthesis. These structural pieces proved to be problematic in the esterification, so work was primarily done to determine and solve the issues surrounding this reaction.

Previous work done by Maya Cao, '18, was done with a dangling acetyl leaving group and a tosyl-protected nitrogen, with no esterification occurring. It was determined that the free acetyl group was likely interfering with the activated intermediate, attacking intramolecularly and aborting the reaction. We then removed this group to attempt esterification with the amino acid with the tosyl-protected nitrogen and no leaving group, in order to determine if there were other issues within the molecule. Unlike when protected with a Boc group, the tosyl amino acid did not esterify, potentially due to a key difference in pKa values of the hydrogen on the nitrogen. The tosyl group generated a lower pKa value of ~17.5, compared to ~20 with Boc, possibly causing protonation of the DMAP catalyst and aborting the reaction.

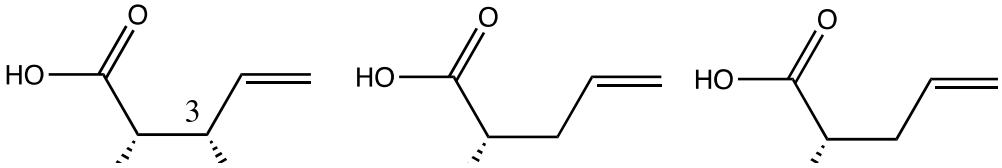


Figure 1: Amino Acids used in the esterification. From left to right; analog with -OAc at position three with tosyl-protected nitrogen; analog with tosyl-protected N; analog with Boc-protected N.

Having determined that the leaving group must be tied back and the nitrogen proton cannot be too acidic, a cyclic amino acid analog was proposed, picture in **Figure 2**, which would encompass both of these needs and create an analog that can successfully esterify, which is currently being synthesized by Brynn Lewis, '20. Current work has generated the ester with Boc-protected *L*-serine analog at 54% yields (based on recovered materials), forming the ester at carbon two as the major product, likely due to the steric bulk of the silyl protecting group near the hydroxyl at carbon five. We hypothesize that the cyclic molecule should react similarly, allowing for the successful generation of the correct ester. After esterification occurs with this molecule, the product should be able to continue in the synthesis of a viable Tn Antigen mimic.

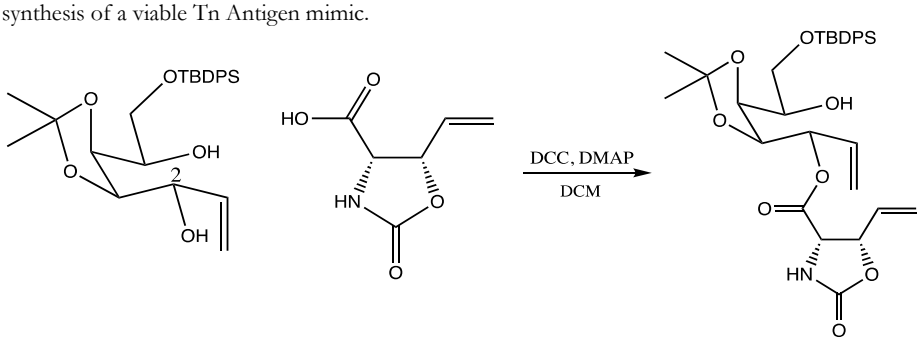


Figure 2: Esterification reaction with intended cyclic amino acid and Gal-heptenitol, forming the ester at the intended two position, using standard conditions.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): National Institutes of Health (NIH) Area Grant

Research Fellow(s): **Wentao Jiang (2021)** **Concentration: Undeclared**
Grace Macdonald-Gagnon (2019) **Concentration: Psychology**
Abraham Rodriquez (2020) **Concentration: Psychology**

Faculty Mentor: Julia Martinez **Department: Psychological and Brain Sciences**

Title of Project: How Does Alcohol Play a Role in One's Identity Formation?

Project Summary:

This summer research was completed in the Alcohol, Drug, and Behavior Lab at Colgate University with Professor Julia Martinez in the Psychology Department. The aim of this research was to attempt to better understand the connection between alcohol-use and identity development, with a focus on this transitional period between college and career. Research has indicated that identity development, especially during college and the transition to career, is a main theme of human development (Chickering and Reisser, 1993). Further, it appears that individuals may incorporate alcohol into their lifestyles and who they are as individuals, potentially leading to negative consequences (Benton, 2009). With this research in mind, we carried out two pilot studies: an exploratory interview study on the transition from college to career, and an experimental alcohol intervention study that allows individuals to make a change promoting positive growth.

For the first study, we interviewed 22 participants who were either enrolled in college currently or who had attended at some point. The participants were asked a range of questions regarding their perceptions of their own identities, the drinking and social cultures at college and work, as well more personal reflections on their place within this culture. Through our thematic analysis we found that the top themes appearing in the interviews could be categorized as heavy drinking, moderate/relaxed drinking, social exclusion, and social fraternity/bonding (see Figure 1). College was associated most frequently with heavy drinking and social exclusion, while work atmosphere was associated with moderate drinking and social fraternity/bonding as found through a chi-square (X^2 [3] = 14.92, $p < 0.001$., Cramer's V = 0.51).

For the second study, we asked participants to create a measurable goal, and then we followed them for four weeks. The experiment followed an ABAC style where the participant did their goal the first week, they stopped for the second, resumed doing their goal the third week, and chose whether or not to do their goal the fourth week. The participants completed a 16-item questionnaire at the beginning of each week. Results showed that all participants, except for one who did not report attempting their goal, progressed towards their goal, however only one participant reached their goal consistently. Of the five participants, three did not report drinking alcohol in any week. From week three to week four one participant drank a small amount more, while another reported drinking less.

Differences between college and work drinking, and how this transition relates to problematic drinking is important for understanding addiction. More participants are needed for study 2 to draw more accurate conclusions. However, from addressing the data collected, it is plausible that the method of setting a goal can shape alcohol use. Two participants reported a decrease in alcohol use which could mean that the method could be successful for decreasing alcohol use. In general, the results reveal the need for further research on the connection between alcohol and identity, especially for those transitioning into a career.

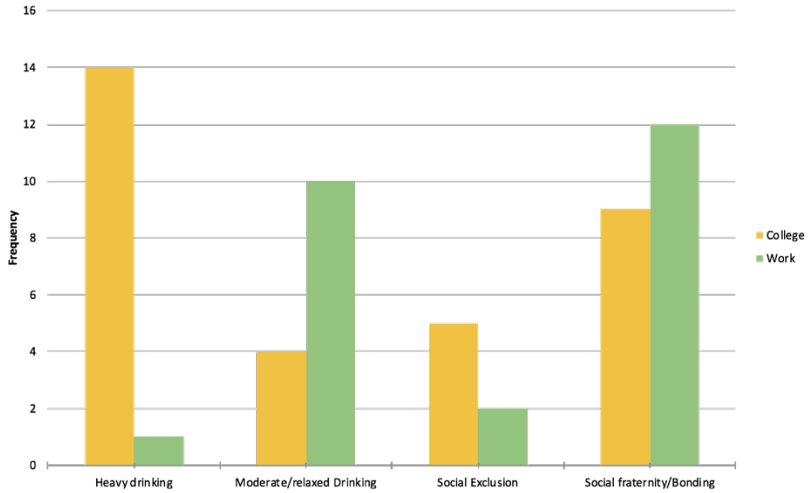


Figure 1. Most Common Themes from Study 1 Analysis of Drinking Culture in College and Work

Source of Support: ☐ AHUM Div. ☒ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☐ Other (specify):

Research Fellow: Sarah Jones (2019) **Concentration: History**

Faculty Mentor: Dan Bouk **Department: History**

Title of Project: From a Resource to a Colleague: Improving Foster Parent Retention in Missouri

Project Summary:

My research examines the issues that affect foster parent retention in my home state, Missouri. Across America, states have struggled to deal with the rising number of kids in foster care and a shortage of available foster parents. A study by the U.S. Department of Health and Human Services noted that 47 to 62 percent of foster parents exited their role within one year of the first placement of a child in their home. Besides the difficulty of providing care to traumatized children, I was curious about what other factors could be causing foster parents to quit. I interviewed foster parents, social workers, and nonprofit directors in Missouri and asked them about their experience in foster care. From there, I was able to create a list of five difficulties that foster parents encountered in Missouri: 1. Foster parents do not feel like respected members of the foster team. 2. Foster parents do not have enough physical resources to do their job. 3. Foster parents have difficulty obtaining medical care for their foster children. 4. Foster parents do not have enough support resources. 5. Policy regarding foster parents is often disregarded or inconsistently followed. Many of these difficulties were unnecessary and unexpected sources of stress. Although the people that I interviewed were still involved in foster care, they speculated that several of these reasons were why foster parents quit in Missouri.

Improving foster parent retention has become a nationwide project, but because foster care is implemented on a state level, I believe it is necessary to examine the issue state by state. Unfortunately, few studies focus on particular states. Local journalism addresses the struggles of particular cities or counties, but fails to connect them to a larger state level where policy is implemented. The rationale for my study was to collect relevant information not only about cities and counties, but about the entire state. At the same time, focusing on Missouri rather than on national trends allowed me to tailor my study to the specific limitations and needs of the state. In order to get a fair representation of the entire state, I attempted to space my interviews out geographically to capture the major regions of Missouri. Since most foster children and parents reside in urban areas, I focused my interviews there, but also conducted a few interviews in rural areas.

Additionally, this study focuses on foster parents and their experience. Much research conducted about foster care examines children impacted by the system. Although this is certainly a useful way to look at the system, it fails to address a significant component of foster care. Foster parents as service providers are in the unique position of parenting foster children 24/7. It is not going too far to say that foster parents likely have the largest impact on children in the system. Yet by the lack of studies addressing foster parent experience, many states including Missouri seem to dismiss the legitimate struggles of those most essential to the way our foster care system currently functions. One of the goals of this study is simply to take notice of foster parents as volunteers who take care of children in state custody. Hopefully, their voices shine clearly.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Lampert Institute for Civic and Global Affairs

Research Fellow: Katrina Judicke (2020) **Concentration(s): Psychology; Geography**

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

Title of Project: Pathfinder Village: Employment Opportunities for People with Disabilities

Project Summary:

I was fortunate enough this past summer to work with Pathfinder Village, an organization dedicated to improving quality of life for individuals with intellectual and/or developmental disabilities (I/DDs). Pathfinder Village is a residential community located in Edmeston, NY, and they offer a diverse array of activities and programs, including the Otsego Academy, a school, and a weekly produce market, among many others. The grounds of Pathfinder Village are beautiful, and the entire area conveys a sense of peace.

Though life at Pathfinder Village is wonderful for many reasons, employment opportunities for residents can be difficult to attain. In my work with Pathfinder, I designed and distributed a survey to businesses in either the Otsego County Chamber of Commerce, the Cooperstown Chamber of Commerce, or both. The survey was designed to measure local business engagement with the I/DD community. In addition to the information yielded by the survey questions, it was also our hope that through its distribution communication between the I/DD and the business community would become more open, and increased strides towards creating employment opportunities for individuals with I/DDs could be made.

The results of the survey were novel information, as no study such as this had taken place in Otsego County before. Overall, the results will be used to guide the development of communication and outreach programs, with an ultimate goal to increase the number of individuals with I/DDs that gain meaningful employment. At the time of my departure, a committee of Pathfinder employees was already being established to use the results of this survey to continue this project into the future. The results of this survey are the first step in a much longer process that has already begun.

Having the opportunity to work with Pathfinder Village as an Upstate Fellow was a wonderful experience and learning opportunity. Not only did I have the chance to design and distribute a survey that yielded meaningful information, I was able to do so surrounded and helped by the wonderful individuals at Pathfinder. Through this work, I have learned that interaction with people is important to me, and that any future job I hold will have to include working directly with coworkers. There were several times in the survey design process in which myself and several other Pathfinder employees were able to sit in a room and bounce ideas off one another. I greatly enjoyed these meetings, and always left inspired to consider the survey and its results in different ways.

I had never before designed or distributed a survey, and I now have a far greater appreciation for the nuances, time, and effort that go into such research. As a psychology and geography double major, it is possible that I will be conducting future survey research, in which case I will certainly draw on the skills that I developed during my time with Pathfinder. I am very grateful to both the Upstate Institute and Pathfinder Village for giving me this opportunity, and I look forward to hearing more about this project as it develops.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Upstate Institute

Research Fellow: Paul Jung (2020) **Concentration: Mathematical Economics**

Faculty Mentor: Penny Lane **Department: Art and Art History**

Title of Project: Documentary Film Production

Project Summary:

This past summer, I worked as a production / research assistant for Professor Penny Lane's upcoming documentary film. A production assistant is one of the most common entry level positions on a film or television set, and tasks can vary from day to day depending on what work is required at any given time. This position was my first opportunity to gain some first-hand insight into the film industry, and it has greatly informed me on some of the nuances involved in the production of a creative work.

My work this summer was divided up between working in the office and working on set. The office is the headquarters for Hard Working Movies, the production company that Professor Lane is working on the film with. When I would come into the office, I worked closely alongside the associate producer. Most of my day-to-day operations came from the associate producer, and my primary goal was to make his job as easy as possible. While I did also receive tasks to complete from Professor Lane and the producer, they were usually specific research assignments or more big-picture work. During the first three or four weeks at the office, I transcribed interviews that were filmed for the documentary. The transcription process did get monotonous at times, but it is necessary work because it helps the editor when they are later reviewing and organizing the footage. After transcribing for a few weeks, I started receiving some research tasks from Professor Lane where I was asked to find specific news footage or documents that could potentially be used in the film. One example of such an assignment was finding video footage and transcriptions of all recorded presidential inaugurations in the United States. I also ran some errands for the office, such as picking up and dropping off equipment in the city.

Besides being at the office, I also worked on set when they would film interviews. In the morning, I would go out and buy breakfast and coffee for the crew. I would assist the gaffer, who is the head electrician and is responsible for the lighting of a production, in setting up the background. I also often helped the director of photography with any errands she needed me to do while she was setting up the shot. Compared to working in the office, being on set was a very unique experience for me because I was a helping hand to everyone involved in the production. As a result, I was able to reveal a glimpse of everyone's job and their experiences. Before the break, I would go out with the associate producer, pick up lunch orders, and set up the dining table. Once shooting has wrapped, I would also help out with packing up the equipment and returning it back to the rental store if needed.

Overall, my summer was a great experience because it confirmed the aspects of filmmaking that I enjoyed, and perhaps even more importantly, it revealed which aspects I didn't like as much. Working in the office gave me a more formal experience of a traditional internship, while working on set allowed me to be a part of the 'movie magic' process firsthand. It has allowed me to hone in on my interests and given me a taste of the professional world of filmmaking.

Source of Support: ☒ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☐ Other (specify):

Research Fellow: Meaghan Kendall (2021) **Concentration: Natural Sciences**

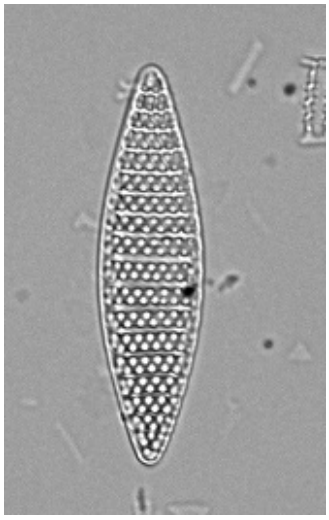
Faculty Mentor: Amy Leventer **Department: Geology**

Title of Project: Polar Marine Diatoms and Antarctic Paleoclimate

Project Summary:

This summer I conducted research with Professor Amy Leventer on diatoms, single-celled algae with siliceous shells from East Antarctica. Diatoms can be used to study past and present ice sheet behavior and oceanic conditions. The diatom valves studied are from sediment cores collected during a 2017 research cruise. Core IN2017-C012-PC05, from the Sabrina Coast continental slope, recovered a sequence of sediments deposited during alternating glacial and interglacial cycles.

One of the main projects I worked on was with the common Antarctic diatom *Fragilariopsis kerguelensis*. *F. keguelensis* makes up around 70-80% of the diatom assemblage, regardless of whether the sample is from a glacial or interglacial period. Since the species is so abundant, and its contribution to the overall assemblage is relatively constant, we investigated whether size variations may provide paleoenvironmental clues. For example, Shukla et al. (2013) studied the length, width, and surface area of *F. kerguelensis* and found that during glacial periods, the *F. kerguelensis* are larger than during interglacial periods. Thus, I measured the length of 100 *F. kerguelensis* from fourteen samples spanning over one glacial and three interglacial periods in core IN2017-C012-PC05. The length of the *F. kerguelensis* did not vary significantly between glacial and interglacial periods (average 33 um). This data suggests that the specimens that occur in the glacial continental slope sediments may simply be recycled from the prior interglacial, from the proximal continental shelf. During glacial periods, the location where the core was collected likely was covered by perennial sea ice, prohibiting local primary production. Therefore, *F. kerguelensis* in the glacial sediments may have been recycled as glacial ice advanced across the continental shelf.



F. kerguelensis 38um in length from IN2017-C012-PC05, 41cm depth

References

Shukla, S.K., Crosta, X., Cortese, G. and Nayak, G.N., 2013. Climate mediated size variability of diatom Fragilariopsis kerguelensis in the Southern Ocean. *Quaternary Science Reviews*, 69, pp.49-58.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Norma Vergo Prize

Research Fellow: Muhammad "Yasoob" Ullah Khalid (2021) **Concentration: Computer Science**

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

Title of Project: Deanonymization and Proximity Detection Using Wi-Fi

Project Summary:

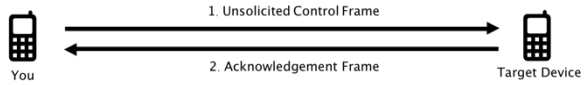
According to RAINN (Rape, Abuse & Incest National Network), 23.1% of female and 5.4% of male undergraduate students experience rape or sexual assault, with only a minute percentage reporting their assault to law enforcement[1]. In certain cases, survivors can forget who the perpetrator was due to trauma and/or intoxication. I want to use technology to counter this problem. My hope is to reduce the number of potential culprits when such an incident occurs to make it easier for the survivor to identify the perpetrator.

This can be made possible by using a device that most people carry at all times – a smartphone. The idea is to save the device identifier and the distance between your phone and that of each person who comes near you in a searchable database. This allows you, the user, to search for which device was near you at a particular time. The research is further divided into two parts. The first involved finding a way to effectively calculate the relative distance between two smartphones and the second involved information storage and querying. I focused mainly on the first part, which turned out to be more difficult and involved than I anticipated.

The cornerstone of this idea is Wi-Fi and the information your smartphone emits when the Wi-Fi is turned on, though not necessarily connected to an access point. The formal requirements of this system are as follows: it should be passive so you don't have to actively monitor it; it shouldn't require other people's smartphones to run any specific application; the error in distance estimation should be less than 1 meter so the algorithm can accurately identify a human interaction; the system needs to work in NLOS (Non-line-of-sight) scenarios since people often have their smartphones in their pockets; finally, it should not require more than three devices, including your smartphone, a nearby smartphone, and a Wi-Fi Access Point to which both phones are connected, because the system should be portable.

Previous research in relative distance estimation offers varying levels of precision. One method involves using RSSI (Received Signal Strength Indication) readings from multiple access points (4+ for accuracy) and triangulating smartphone position based on that. We cannot use this method because 4+ devices are required. Another method involves using Time-of-Flight (ToF) measurements. There are multiple variations of this method, but the basic idea is to send data from your device to the device being localized, and recording the time taken for the data to travel from one device to another and for an acknowledgment to be received. Based on this timing measurement and the required time delay (known as SIFS, or Short Interframe Space) between a device receiving data and sending an acknowledgement, we can estimate the distance between two devices. This gives the best accuracy but is not directly applicable to this situation, because it requires a direct connection between the two smartphones.

I sought to develop a modified version of the ToF method, because it offers the best precision and requires the least number of devices to work effectively. The method I developed was to send unsolicited control packets (a special type of data frame) to the target mobile device and force it to send an acknowledgement (see figure). The major research question is: how do we force the target device to send an acknowledgement even if we are not directly connected to it?



I set up a testbed with three desktops equipped with Wi-Fi cards and running Ubuntu Linux. I used Scapy (a Python program for generating network packets) to generate and send control packets from one desktop to another and tcpdump on the third desktop to monitor and analyze the wireless communication taking place. I was able to send the control packets and solicit an acknowledgment from the target mobile (Ubuntu desktop) without being directly connected to it.

However, there was a bug in the networking drivers of Ubuntu that generated acknowledgments even in cases where no acknowledgment was supposed to be sent by the target device. Currently, I am investigating the bug and trying to figure out the most suitable way forward. Through this research, I found that the process of distance estimation is more complicated than it seems. There are several variables and timing issues that need to be taken into account. In the future, I plan on finding a workaround for this bug, with the eventual goal of making this system usable in everyday life.

[1]https://www.rainn.org/statistics/campus-sexual-violence

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Holden Endowment Fund

Research Fellow: Emelei Klein (2019) **Concentration: Molecular Biology**

Faculty Mentor: Jason Meyers **Department(s): Biology; Neuroscience**

Title of Project: Control of Stem and Progenitor Cell Fate in Zebrafish Sensory Systems

Project Summary:

Zebrafish provide an excellent model to study stem cells because of their ability to regenerate. One of the systems that zebrafish are able to regenerate is their retina. The retina, located in the back of the eye, is made up of cells known as photoreceptors. These photoreceptors make it possible for the brain to process visual images. In humans, damage to the retina is permanent, but a population of cells known as the Müller glia can repair damage in the zebrafish retina. Zebrafish Müller glial cells possess stem cell-like characteristics, which allow them to replace damaged cells. How the Müller glia cells are able replace damaged photoreceptors is still under investigation. Two pathways have been linked to the Müller glia: Notch signaling and Wnt Signaling. Inhibition of Notch signaling has been found to cause Muller glia cells to start dividing and replace the lost photoreceptors. Activation of Wnt signaling is required to initiate the proliferation of the Muller glia during the regenerative process. The Meyers lab started to look how the two pathways interacted with each other, and this summer I continued to look at the interactions between these two pathways while also integrating a third signaling pathway, fibroblast growth factor (FGF) signaling.

My experiments focused on how inhibition of Notch and activation of Wnt signaling affects retinal response to light damage. I also examined how inhibition of Notch and inhibition of FGF signaling affects retinal regeneration. To carry out these regeneration experiments, the retinas were damaged using a light lesion protocol. Larvae 3 days post fertilization were exposed to intense UV light for twenty minutes. The fish were then placed different drug combinations, LY, PD and Az. LY is a Notch inhibitor and Az, is a Wnt activator. PD is an FGF inhibitor. To analyze the retinas, the fish were sectioned and labelled using immunochemistry. I used fluorescent antibodies to tag proliferating cells. The staining revealed that some cells are dividing in the control retinas, and they are localized mostly in the inner nuclear layer (Figure 1a). There is an overall increase of proliferating cells in the LY treated retina compared to the control retinas, and proliferation was especially strong in the outer nuclear layer (Figure 1b). It appears as if Muller glia have moved from the INL to the ONL. When LY was combined with the Wnt activator, Az, proliferation is still strong, but there are more PCNA labelled cells found in the INL than retinas in the LY treatments (Figure 1C). There does not seem to be as much proliferation in the ONL as with LY only treated retinas. The LY and PD drug treatments showed similar results of proliferation as the LY and Az treatment, but it showed a more noticeable decrease of ONL proliferation (figure 1d). Overall, this suggests that FGF inhibition might be migration of the proliferating Müller glia. However, further experimentation will be needed to determine exactly how FGF fits into Notch and Wnt signaling.

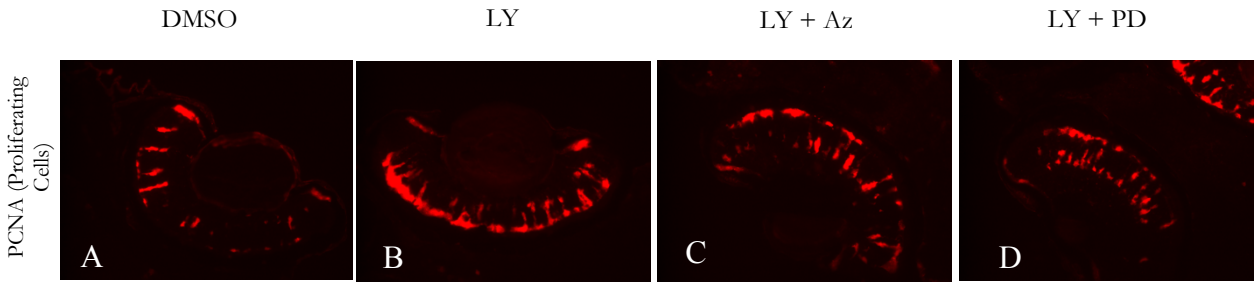


Figure 1: Simultaneous Wnt activation or FGF inhibition decrease Notch induced hyperproliferation in ONL after light damage A) 15 μM DMSO leads to some division of cells in INL to replace lost photoreceptors. B) Inhibition of Notch with 10μM LY leads to cells to proliferate mostly in ONL. C) Inhibition of Notch and Direct Activation of Wnt via 2.5 μM Az shows that proliferation in both INL and ONL. Slight decrease in ONL proliferation. D) Inhibition of FGF via 5 μM PD also shows both INL and ONL proliferation of Muller glia. Decrease in ONL proliferation.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Michael J. Wolk '60 Heart Foundation

Research Fellow: Chelsey Koren (2019) **Concentration: Biology**

Faculty Mentor: Frank Frey **Department(s): Biology; Environmental Studies**

Title of Project: Assessing Antibacterial Activity of Traditional Medicinal Plants used by Haudenosaunee Peoples of New York State

Project Summary:

The emergence of drug-resistant pathogenic bacteria has become a pressing public health concern. The widespread and frequent use of antibiotics has caused many common strains of bacteria to evolve the ability to resist them (Ventola, 2015). The antibiotic compounds found in some plant species may be useful in discovering new drugs. Various plant species local to New York are known to have been used traditionally for medicinal purposes by the Haudenosaunee (Iroquois) peoples (George-Kanentiio, 1995). Approximately 450 different species were used in their medicinal practices (Herrick, 1995). Depending on the species, the plant material used includes the leaves, stems, roots, and fruits. This research investigated the antibacterial properties of some plant parts in this pool of species.

Disc diffusion assay results for *Rhus typhina* leaves against *S. aureus*.

The goal of this research was to discover antibacterial properties in local plant species. Roughly 70% of all known antibacterial compounds were developed from natural products (Newman & Cragg, 2007). The use of traditional plants for medicinal purposes has been explored in various other studies scattered across the world (Djeussi et al., 2013, Ncube et al. 2011), and there is a rich history of traditional medicine grounded in centuries of experience in North America (Moerman, 1991). Local plant parts were identified and collected, dried out, and grinded into a fine powder to be prepared for extraction. A series of standard disc diffusion assays were performed on petri dishes to test for antibacterial activity. Sterile water served as the negative control while ampicillin served as the positive control. The following three types of bacteria were used: *Staphylococcus aureus, Enterococcus faecalis,* and *Salmonella typhimurium*. Three trials were performed for each type of bacteria. After the diffusions were set up, plates were placed in the incubator to be kept overnight.

Photographs of each plate were taken 24 hours after each diffusion assay. Images were uploaded to ImageJ32 software. The zones of inhibition were calculated for any extract that showed antibacterial activity. Results showed antibacterial properties for multiple plants tested. *Rhus typhina, Lythrum alatum, Cichorium intybus, Rudbeckia hirta,* and *Solidago* all had visible zones of inhibition against at least one of the bacteria.

Future research includes calculating the Minimum Inhibitory Concentration (MIC) of each extract that showed antibacterial properties and using differential extraction technique to narrow the class of active compounds in the extracts.

Citations:
Ventola, C. L. (2015). The antibiotic resistance crisis: part 1: causes and threats. *Pharmacy and Therapeutics*, *40*(4), 277. George-Kanentiio, D. 1995. How Much Land Did the Iroquois Possess? *Akwesasne Notes New Series* 1 (3&4): 60. Herrick JW. 1995. *Iroquois Medical Botany*. Syracuse: Syracuse University Press. Newman DJ and Cragg GM. 2007. Natural products as sources of drugs over the last 25 years. *Journal of Natural Products* 70:461-477. Djeussi, D. E., Noumedem, J. A., Seukep, J. A., Fankam, A. G., Voukeng, I. K., Tankeo, S. B., ... & Kuete, V. (2013). Antibacterial activities of selected edible plants extracts against multidrug-resistant Gram-negative bacteria. *BMC complementary and alternative medicine*, *13*(1), 164. Ncube, B., Finnie, J. F., & Van Staden, J. (2011). Seasonal variation in antimicrobial and phytochemical properties of frequently used medicinal bulbous plants from South Africa. *South African Journal of Botany*, *77*(2), 387-396. Moerman DE. 1991. The medicinal flora of native North America: an analysis. *Journal of Ethnopharmacology* 31:1-42

Source of Support: ☐ AHUM Div. ☒ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☐ Other (specify):

Research Fellow: Natalie Kozlowski (2019) **Concentration: Environmental Geology**

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

Title of Project: Polar Marine Radiolarians and Antarctic Paleoclimate

Project Summary:

Over the summer, I examined radiolarians in sediment samples from two sediment cores, NBP1402 MC45 and MC61, which were collected from the continental shelf of the Sabrina Coast in Antarctica, located around 66ºS 120ºE. Radiolarians are silica-shelled zooplankton; species are closely affiliated with specific water masses and are used as oceanic tracers. The radiolarian data will be used to reconstruct the history of Circumpolar Deep Water (CDW) incursions onto the East Antarctic continental shelf. CDW is relatively warm water that periodically makes it up onto the polar continental shelf, where it can come into contact with the grounding zones of ice sheets, resulting in basal melting. This process has been implicated in some of the current ice retreat observed today in Antarctica. The radiolarian abundance and assemblage data will help us determine the longer-term history of the cryosphere as related to the presence of CDW on the continental shelf.

The sediment samples were processed to make quantitative slides by following an approach provided by Kelly-Anne Lawler, a student collaborator from Macquarie University, Australia. A known mass of each sediment sample was placed into a 250 mL beaker. RO water and a 5% sodium metaphosphate solution were then added to the beaker, which disaggregated the sample. After sitting for 20 minutes, the sediment solution was placed on a hotplate set to 160ºC, and 10 mL of hydrogen peroxide were added to the solution. This eliminated the organic matter present in the sample, leaving behind radiolarians. After the reaction finished, the beaker was taken off the hotplate and allowed to cool. Once cooled, the solution was rinsed through a 45 μm sieve, and collected in a 60 mL Nalgene bottle, where the solutions are stored until made into a microscope slide.

To start the slide-making process, a 22 x 22 mm coverslip was coated with potato starch, which helps prevent a meniscus from forming on the coverslip. The coverslip was then placed on a hotplate set to 80ºC, and 0.8 mL of RO water is added to the coverslip using a pipette. Again using a pipette, 0.2 mL of the sample solution from the 60 mL Nalgene bottle is added to the coverslip, and allowed to evaporate. Once fully evaporated, the coverslip was removed from the hotplate and Norland Optical Adhesive was used to secure the coverslip to the microscope slide. The slide was placed under a UV light for 15 minutes to dry. During the counting procedure, which will be completed over the course of this academic year, ~400 specimens will be identified and tallied in each sample.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Hackett-Rathmell 1968 Memorial Fund

Research Fellow: Mark LaPan (2019) **Concentration: Geology**

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

Title of Project: Contact Metamorphism and Ore Formation During Intrusion of Adirondack Anorthosite

Project Summary:

Skarns of the northeast Adirondack mountains range from wollastonite + garnet + pyroxene rocks to pure wollastonite ore. Wollastonite is an industrial mineral that has currently taken the place of asbestos for uses such as insulation, and it is also used as a filler in plastics due to its fibrous crystal habit. The Adirondacks, where wollastonite has is mined, are comprised of rocks that are Proterozoic in age. These rocks have undergone deformation in the form of folding and tectonic mixing of several rock types. The result of this deformation has been four separate mines in the northeastern Adirondacks: the Lewis, Oak Hill, Deerhead, and Willsboro deposits. Samples for this study were taken from Lewis and Oak Hill. This study focused on the marbles that formed in the process of formation of the wollastonite were taken from these two localities. The main focus of this study was to understand the conditions of marble formation. To address this, I made thin sections and performed stable isotope analysis of marble samples. My examination of thin sections focused on determining minerals present and evaluating their textural characteristics. Additionally, I created mounts that would be used in Colgate's JEOL JSM636OLV scanning electron microscope (SEM). Stable isotope geochemistry was performed on hand-picked calcite and graphite grains from each sample. Caclite separates were dissolution with phosphoric acid in a vacuum flask and the C and O isotope ratio of the evolved gas was measured in a mass spectrometer. Preliminary data for modal mineralogy shows a high amount of calcite and diopside with some quartz, feldspar, and graphite and a small amount of an unknown pleochroic, high-relief mineral. For future work, the SEM mounts will be utilized to determine the unknown mineral. Also, the stable isotope data will be used to constrain conditions of calcite and graphite formation.

Figure 1. Marble sample taken from the Lewis mine in the Adirondacks (ca. 10 cm long).

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Doug Rankin '53 Endowment-Geology Research

Research Fellow: Marlene Lawston (2020) **Concentration: Molecular Biology**

Faculty Mentor: Jason Meyers **Department(s): Biology; Neuroscience**

Title of Project: Cavefish: A New Model Organism for the Study of Progenitor Cells

Project Summary:

The posterior lateral line system (pLL) in zebrafish allows for the study of underlying mechanisms behind development of a mechanosensory organ system. The lateral line consists of mechanoreceptive organs called neuromasts that allow for the detection of vibration in water (Chitnis et al., 2011). Moreover, the pLL shares significant homology with genes and cells found in the mechanoreceptive auditory and vestibular systems in humans (Shen et al., 2008). Zebrafish are unique in that unlike humans, they can regenerate sensory hair cells (Lush and Piotrowski, 2014). In humans, loss of sensory hair cells in the inner ear causes permanent hearing loss. Given the homology between the lateral line and the inner ear, it is hoped that by understanding signaling mechanisms that control progenitor cells during growth and regeneration we will gain a better understanding of potential mechanisms that could stimulate regeneration in the mammalian inner ear.

We propose to develop a new, possibly better model system to characterize the signaling mechanisms in lateral line progenitors by utilizing blind cavefish (*Astyanax mexicanus* - Mexican tetra). Populations of cavefish isolated inside caves have lost their eyes, pigmentation, and display a myriad of sensorineural adaptations as a result of visual stimulus loss (Rétaux et al., 2016). Notably, compared to surface populations cavefish populations display a significant expansion of the lateral line consisting of an overproduction of neuromasts that is concurrent with the degeneration of the eye (Rétaux et al., 2016).

The loss of eyes in cavefish has been well-studied, however, there has been little research regarding the growth and development of the expanded lateral line. Understanding the developmental mechanisms controlling the timing of neuromast organogenesis and the size of specific sensory organs is our first objective. At two months of age it is established that cavefish eyes are completely degenerated and there are clear differences between cavefish and their surface counterparts (Rétaux et al., 2016). Here, cave and surface fish between zero and two months of age were examined with the goal of comparing development and morphology of their lateral line neuromasts. So far, my findings suggest that there are differences in cave and surface fish neuromasts long before two months of age. Vital dye AM1-44 was used to label sensory hair cells in neuromasts. Interestingly, at just two weeks old cavefish displayed more pLL neuromasts than surface fish. Moreover, these neuromasts appear larger in cavefish than in surface fish. At three weeks old, fish were dyed with AM1-44 and Hoechst 3342 nuclear dye. Again, cavefish appeared to have more and larger neuromasts compared to surface fish.

Immunocytochemical detection of BrdU was used to compare location and distribution of dividing cell populations in surface and cavefish. At just eleven dpf and at three weeks of age, cell proliferation was more concentrated around neuromasts in cavefish compared to surface fish.

Our next steps include repeats of characterization experiments as well as examining neuromast regeneration in cavefish and surface fish populations via treatment with neomycin to kill hair cells then confocal microscopy to visualize and measure regeneration patterns and rates.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Beckman Scholar Program

Research Fellow: Linh Le (2018) **Concentration(s): Chemistry; Physics**

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

Title of Project: Bifunctional Catalysts for the Hydrogenation and Dehydrogenation of Polar Bonds

Project Summary:

Ester hydrogenation is an important reaction in organic chemistry, as it is widely used in the chemical industry to produce goods like fragrance and soap, as well as in chemical research to synthesize new compounds. Traditional methods of ester hydrogenation involve the use of compounds like $LiAlH_4$, which is both inefficient and environmentally unfriendly because of the generation of a large amount of inorganic waste containing Li or Al. In contrast, catalytic hydrogenation using H_2 gas is much greener, as a small amount of the catalyst can incorporate all the hydrogen atoms in H_2 into the ester substrate to give the alcohol product. Thus, there is a need to develop effective catalysts that speed up the reaction while used in very small amounts to reduce the hazardous waste produced.

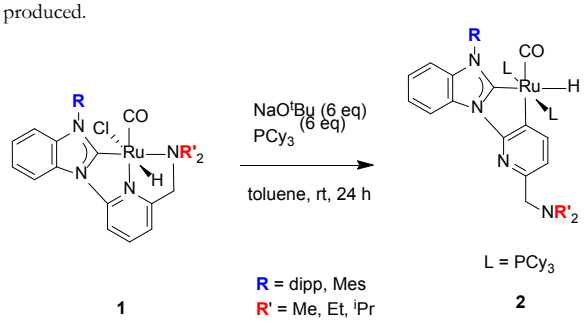


Figure 5: Rearrangement reaction between **1** and **2**

Our previous work indicates that complexes of type **1** are mild catalyst for ester hydrogenation in the presence of the strong base NaO^tBu. However, when NaO^tBu is mixed with 1 and excess PCy_3, rearranged complexes of type **2** (hereafter referred to in the form **2-R-R'**) form cleanly (Figure 1). These complexes can be isolated and also function as mild catalysts for ester hydrogenation. One significant difference is that **2** catalyzes ester hydrogenation in the absence of a strong base, which may be useful in reactions where the substrate cannot tolerate highly basic conditions.

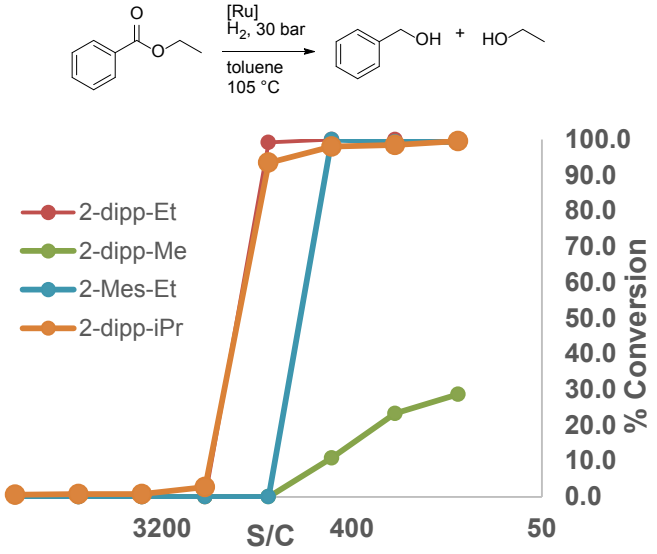


Figure 6: Ester hydrogenation using **2** with ethyl benzoate substrate

Four complexes of type **2** were studied (Figure 2) using ethyl benzoate as the test substrate, with varying substrate to catalyst ratios and in the absence of base. From this, we found that bigger R groups like dipp lead to better catalysts, and R' = ^{i}Pr and Et give similar activities while R' = Me greatly diminishes the catalytic activity. This finding is strikingly similar to our observations from the original complexes **1**, where the R and R' substituents have the same effects. Given the position of the amine arm containing R' in **2**, which is very far from the Ru center, the influence of R' on the catalytic activity of **2** may suggest a similar reaction mechanism that both **1** and **2** undergo. Current work aims at finding a plausible mechanism for **1** and **2** by computational and experimental methods to account for this structural effect.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): National Science Foundation Grant

Research Fellow: Linh "Christine" Le (2019) **Concentration(s): MAEC; International Relations**

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

Title of Project: Humanitarian Intervention in Failed and Fragile States Post-Cold War: What Works, What Doesn't?

Project Summary:

Failed states are countries whose central authorities have ceased to function in a substantial part of their territories. They are ridden with conflicts, and their governments incapable of delivering basic political goods - security, freedom, healthcare, education, etc. While some foreign interventions have succeeded in recovering failed states, others have either suffered early defeat, or only managed to withhold the conflict as long as their forces are present on the ground. My research project aims at identifying a set of factors most correlated with the success of humanitarian military interventions to revive failed states, with a focus on the medium-run political stability trend of the post-intervention society.

My population of interest contains states that have experienced government collapse, which motivated at least one humanitarian intervention into them at some point since 1945, and the intervention concluded early enough that I could observe their pattern of post-conflict (in)stability. I then selected four cases which represent a range of success to failure: Sierra Leone (1997-2002), Bosnia & Herzegovina (1991-2002), Burundi (1993-1996), and Somalia (1992-1995), respectively. I observed what happened in each case using the International Military Interventions (1946-2005) dataset, documents published by the United Nations on each peacekeeping operation, history records, public polling results, newspaper articles, and reports from non-governmental organizations, among others.

Two factors correlating with the highest prospects of success of the peace mission are political will of the interveners, and the design of the peace agreement. The intervener's willingness to bear the cost of intervention is determined by a combination of its calculation of the target state's strategic significance, public opinion, and concern over its reputation both domestically and internationally. In Sierra Leone, significant political will from the United Kingdom impelled United Nations (UN) to send a large peacekeeping troop, and a well-designed peace agreement led to a pattern of sustainable peace after the intervention has concluded. In Bosnia, the NATO-led coalition managed to end humanitarian atrocities, but the peace agreement strengthened rather than solved Bosnian Serb-Croat-Muslim ethnic tensions, hampering long-term stability. In Burundi, an overall lack of interest both regionally and internationally led to lukewarm intervention efforts from the African Union and the UN, and a poorly designed agreement that ceased the Hutu-Tutsi conflict for less than five years. In Somalia, success of the United States limited humanitarian mission led them, along with the UN, to embark on a much more ambitious operation without having the actual will to bear the cost, and the intervention ended up a grave failure. In all cases, social divisions (ethnic, class, religious, tribal, etc.) tend to act as a catalyst to the outbreak and escalation of conflicts. They also complicate the process of nation-building in the post-conflict society.

Altogether, these findings imply that state governments and multilateral organizations should only consider intervening in failed states if it is willing to commit considerable time and resources to cease the open conflict and negotiate a well-designed peace agreement that pays careful attention to the social complexity of the target states.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): David Hubbell Colgate Dennis Fund

Research Fellow: Esther Lee (2020) **Concentration: Molecular Biology**

Faculty Mentor: Jason Meyers **Department(s): Biology; Neuroscience**

Title of Project: Control of Stem and Progenitor Cell Fate in Zebrafish Sensory Systems

Project Summary:

Zebrafish are a useful model organism for looking into cell regeneration. In particular, they possess mechanosensory hair cells that allow them to detect water movement. These hair cells are homologous to those in the human inner ear but are unique in that they are able to regenerate these cells after damage. The hair cells of zebrafish are a part of sensory organs, called neuromasts, which also includes support cells and mantle cells. Connecting the neuromasts are interneuromast cells, which extend out from the anterior and posterior ends of the mantle cells. Support cells surround hair cells and differentiate into hair cells when renewal is required, allowing for the regeneration of hair cells. Mantle cells, which form the outer layer of the neuromast, also aid in regeneration by differentiating into support cells. Overall, what is known is that mantle cells and support cells can renew themselves, mantle cells can renew support cells, and support cells can renew hair cells. In addition, interneuromast cells are able to regenerate a whole neuromast after complete ablation. Therefore, regeneration is known to move in a forward direction. However, what is still unknown is whether regeneration can go in the other direction – if support cells can regenerate mantle cells. Due to this, my two main research questions are: can INM cells regenerate mantle cells when hair and support cells are still present? Can regeneration go backwards; can support cells regenerate mantle cells?

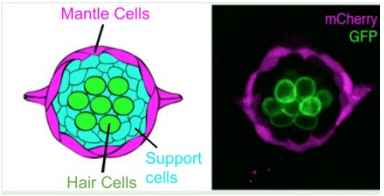


Fig 1. A neuromast comprised of an outer layer of mantle cells, support cells, and hair cells. Interneuromast cells extend from either side of the mantle cells and connect it to other neuromasts.

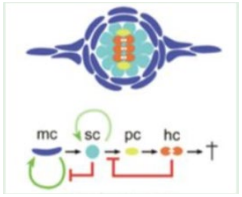


Fig 2. Known regeneration pathways of cell subgroups that make up a neuromast.

In order to answer these two questions, I used a confocal microscope to selectively ablate patterns of cells in larval fish (3-4 days old) using a laser. There were two patterns I focused on: whole mantle cell ablation and whole mantle cell + anterior/posterior interneuromast ablation. After ablation, I tracked cell regeneration over a 7 day period. What I found was that, mantle cells begin to regenerate within a week after complete mantle cell ablation. However, mantle cells do not appear to regenerate within the same time period after mantle cell and a/p interneuromast ablation. In the future, I would like to track the second ablation pattern over several weeks to see if regeneration ever occurs and when.

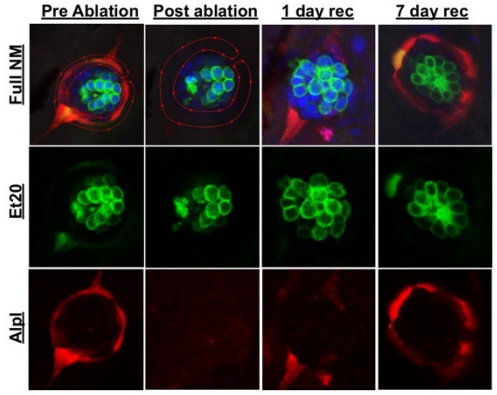


Figure 3. Complete mantle cell ablation pattern appear to show some regeneration over a 7 day recovery period. Ablation pattern is outlined in red dotted line. Et20 and Alpl labeling MC are shown separately to better track regeneration.

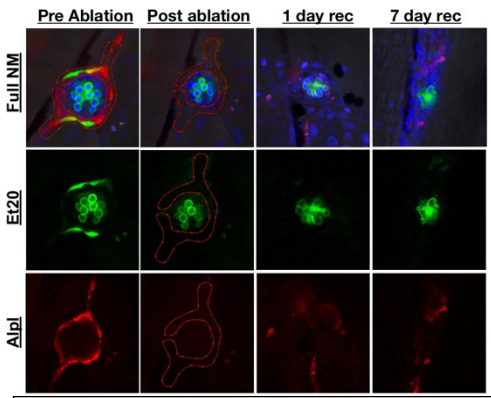


Figure 4. Complete mantle and anterior/posterior interneuromast cell ablation pattern appear to show no regeneration over a 7 day recovery period. Ablation pattern is outlined in red dotted line. Et20 and Alpl labeling MC are shown separately to better track generation

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Michael J. Wolk '60 Heart Foundation

Research Fellow: Laura Leonard (2019) **Concentration: Physics**

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

Title of Project: Inflationary Physics with the Higgs Boson

Project Summary:

Our universe contains 13.7 billion years of cosmic evolution. The early years were hot and dense, and matter was made of free electrons, protons, and neutrons. The Big Bang left an after glow of microwave radiation which is observed at a uniform temperature of 2.7 K in all directions. However, slight variations are reflections of density variations in early matter, which ultimately led to the formation of galaxies, stars, planets, and other cosmic phenomena. To understand galaxy stability and how large structures formed, dark matter is an essential element to consider because dark energy is necessary to explain that the universe is accelerating. As you look out into our universe, you will notice that it becomes increasingly simpler. In cosmology, we approximate and say that the universe is perfectly isotropic and homogeneous. Isotropy refers to how the clumpy distribution of galaxies is independent of direction and homogeneous speaks to the independence of position. This leads to what is known as the cosmological principle: the idea that we do not occupy a special place in the universe, or that the universe looks the same in all directions regardless of the position of the observer.

The cosmological principle is essential because of it restricts the form of the space-time metric, which leaves only one unknown dynamical component: the scale factor. Thus, the primary focus of this research was to understand the Friedman- Robertson- Walker Metric and its consequences in cosmology.

$$ds^2 = g_{\mu\upsilon}\mathrm{dX}^{\mu}\mathrm{dX}^{\nu}$$

In general relativity, the metric does depend on when and where the observer is at the instant the measurement is taken: $g_{\mu\upsilon}=(t,x)$. The spacetime dependence in the metric is a result of the incorporation of gravity and the position dependence comes about from matter and energy distribution. If matter were arbitrary within the universe, finding the metric from Einstein's equations would prove very difficult, if not impossible; however, as seen in the matrix below, the universe is symmetrical.

$$g_{\mu\upsilon} = \begin{pmatrix} 1 & 0 & 0 & 0 \\ 0 & a^2(t) & 0 & 0 \\ 0 & 0 & a^2(t)r^2 & 0 \\ 0 & 0 & 0 & a^2(t)r^2sin^2(\theta) \end{pmatrix}$$

Thus, the question arises of how particles move in curved space time? Particles not under the influence of forces other than gravity will follow geodesics. In simple terms, geodesics are curves that give particles their relative actions. This concept is fundamental in general relativity because classical mechanics and Newton's laws of motion are no longer satisfactory. Gravity causes space-time to curve and particles travel along the curved paths. Greater amounts of gravity result in more dramatic curvature.

The Friedmann equations are another key factor to understanding the beginnings of cosmology. Utilizing the assumptions from the cosmological principle, the Friedmann equations model the expansion of the universe. They come as a result of incorporating the metric into the Einstein equations and assessing the 00 and ii components.

Now with an understanding of the basic elements of cosmology, this project will begin to investigate inflation as a continuation of this project. Big Bang cosmology neglects to explain why the early universe was very flat, and so physicist Alan Guth theorized that the universe must have expanded by many orders of magnitude in a very short period. There is evidence from the cosmic microwave background that does support this claim; however, there was no particle that could be responsible for inflation until the Higgs Boson was discovered. The future goal is to now understand how specific properties of the Higgs particle can be used to explain inflation.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Justus '43 and Jayne Schlichting Student Research Fund

Research Fellow: Brynn Lewis (2020) **Concentration: Biochemistry**

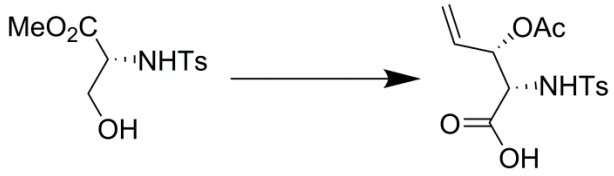
Faculty Mentor: Ernie Nolen **Department: Chemistry**

Title of Project: Synthesis of Glyco Amino Acids for Biomedical Studies

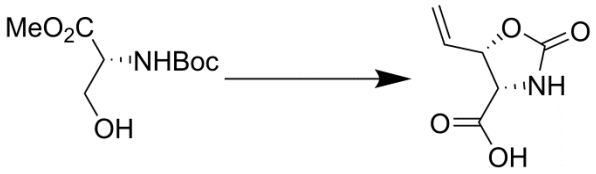
Project Summary:

Human cells are lined with proteins to help with movement, differentiation, and growth among other functions. These proteins have long chains of carbohydrates attached to them to denote their function. Tn antigen is a truncated version of one of these proteins with only one carbohydrate attached. It is strongly associated with many different types of cancers. As an antigen, this protein is supposed to generate an immune response, however, there is not a strong response to the antigen and thus cells with it are not targeted by the immune system. The purpose of our project was to create a mimic of this protein that had a carbon linkage with a hydroxyl group attached as opposed to the natural oxygen linkage so that it would be more stable while still retaining the ability to hydrogen bond. The purpose of the mimic is to use it for medical studies related to cancer vaccine development.

My portion of the project was to produce an amino acid that was to later be used in an esterification with the carbohydrate. The initial approach to the target molecule was to protect the amine with a tosyl group, convert the methyl ester portion of D-serine into a vinyl group and an acetate group, and oxidize the hydroxyl group into a carboxylic acid.



Unfortunately the initial target molecule was not going to work with the desired esterification and I began working towards a new molecule that differed from the old one in that the nitrogen and oxygen were attached by a carbonyl, forming a ring structure. The synthetic approach to producing this molecule involved using a Boc protecting group instead of tosyl. The Boc was needed in order to form the ring closure by providing the carbonyl to connect on the nitrogen to the oxygen, closing the ring. I tried this reaction multiple times with sodium hydride and potassium tert-butoxide and while a product was formed it was a mixture of isomers, as result of a prior, non-stereoselective Grignard reaction during the introduction of the vinyl unit.



Currently I am working towards the same molecule but am back to using the tosyl protecting group instead, because good stereoslectivity is achieved during the vinyl addition via the Grignard reaction. The Tosyl group will be removed to allow for ring closure.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): National Institutes of Health (NIH) Area Grant

Research Fellow: Zhongwen "Kevin" Lian (2020) **Concentration: Computer Science**

Faculty Mentor: Michael Hay **Department: Computer Science**

Title of Project: DPComp: Realistic Data Mining Under Differential Privacy

Project Summary:

Project Summary: The aim of the research project was to come up with an easy way to implement better data privacy (in the form of differential privacy) in a data analytics platform called MacroBase.

Differential privacy: Differential privacy is a strong, mathematical definition of privacy in the context of statistical and machine learning analysis. The goal is to achieve a state where whether a particular privacy object's (i.e. the entity whose privacy we are trying to protect) data are included or not does not affect the result. Differential privacy can be attained in multiple ways, often including adding a calculated amount of noise to the output of the algorithm. An algorithm $\mathcal{M}$ is ϵ-differentially private if for any two datasets D1, D2 that differ by one record,

$$\frac{Pr(\mathcal{M}(D_1)=O)}{Pr(\mathcal{M}(D_2)=O)} \leq e^{\epsilon} \text{ for all O} \in \text{Range}(\mathcal{M}).$$

MacroBase: MacroBase is data analysis platform implemented in Java. The core concept behind MacroBase is simple: to prioritize attention, an analytics engine should provide analytics operators that automatically classify and explain fast data volumes to users. MacroBase executes extensible streaming dataflow pipelines to explain groups of points by aggregating them and highlighting commonalities of interest. Many settings where MacroBase can and has been applied contain highly sensitive data (e.g., telemetry data from mobile devices) yet Macrobase offers no privacy guarantees to participants in the database.

We implemented differential privacy in MacroBase using the sample and aggregate method. Instead of running the MacroBase pipeline on all the data at one, the data were partitioned into samples based on the privacy object (each object's data points are hashed to the same sample) and the MacroBase pipeline runs on each sample, resulting in a collection of 'Vector Explanations'. These explanations are then aggregated resulting in a singular Vector, to which noise is added resulting in the final output of the differentially private MacroBase pipeline.

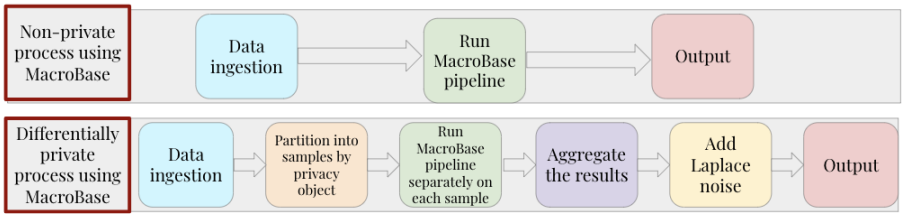


Figure 1 - Change in workflow to make MacroBase private

Sample and Aggregate: As mentioned above, sample and aggregate is an implementation of differential privacy. It will partition the original dataframe into several smaller sampled dataframes (the number of samples is determined by user). All records with the same privacy object are grouped into the same dataframe so that the modification of a specific privacy object could only affect one of the dataframes. Due to the uncertainty of the definition of privacy object for every setting, sample and aggregate provides a hash function interface that every pipeline should implement. The sample and aggregate pipeline provides a default hash function that takes several columns as privacy object. Sample and Aggregate requires that the result of the pipeline must be of type Vector Explanation, which is an Explanation containing a vector of double values. The Sample and Aggregate pipeline provides differential privacy via adding Laplace noise to the values within the Vector Explanation.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): National Science Foundation Grant

Research Fellow: Kayla Logar (2020) **Concentration(s): Economics; Mathematics**

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

Title of Project: Adirondack Foundation: A Survey of Gaps and Overlaps in Adirondack Philanthropy

Project Summary:

This summer, I conducted research as an Upstate Institute Summer Field School Fellow with Adirondack Foundation. This community foundation, based in Lake Placid, NY, works directly with both donors and nonprofit organizations to thoughtfully distribute donations from generous members of the community to nonprofit organizations through grantmaking to support the causes about which donors are most passionate. The foundation also leads a coalition of other funders such as private foundations that support Adirondack nonprofits.

As a research fellow with the Foundation, I focused on understanding the gaps and overlaps in philanthropic funding of the nonprofit organizations that provide essential and enriching services to Adirondack residents and visitors. This project was inspired by questions of funders at the 2017 Adirondack Funders Coalition. In order to address the question of Adirondack nonprofit funding, I gathered information from nonprofits in the Adirondack region with an online survey and through phone and in-person interviews. I collected these results from organizations throughout the Adirondack region representing various program areas. 124 organizations received the survey and 54 completed the survey to a satisfactory degree (by completing all required questions), resulting in an overall response rate of approximately 44%.

After closing the survey, I analyzed the results to see if there were any notable trends in the data. Some of the most clear conclusions that I was able to draw from the responses were that unrestricted funding is incredibly valuable to nonprofits and there is a large need for general operating funds. The former is largely apparent in the responses to the statement "Given the choice, our organization would rather have a $20,000 unrestricted grant than a $25,000 restricted grant." When asked to either strongly disagree, disagree, neither agree nor disagree, agree, or strongly disagree with this statement, 67% of respondents either agreed or strongly agreed, thus indicating a willingness to sacrifice $5,000 for the flexibility of unrestricted funding. The importance of operating funds was emphasized when a majority of 59% of the organizations responded that general operations area their most pressing need and the most challenging funding area was identified to be general operations by 35% of respondents. I had the opportunity to share these results, along with the remainder of the survey feedback, with funders at the 2018 Adirondack Funders Coalition. As a result, the voices of Adirondack nonprofits were heard while funders began planning their next steps to create positive change in the region.

Through this work, I have gained a wealth of knowledge regarding the functioning of nonprofits, with a particular focus on their funding and the various forms which it takes. As a member of the Foundation's staff, I participated in weekly staff meetings, went on site visits, attended conferences, analyzed funds, and researched local nonprofit work in addition to my main research project. Together, these tasks allowed me to glimpse a more holistic picture of the nonprofit world. I had the opportunity to see people combine their passion for helping others with their experiences and knowledge to work towards and achieve positive impacts in the broader community. With this, I also discovered the breadth and depth of need in the area. While struggles such as homelessness are most often associated with urban regions where they are more visible, several community leaders that I spoke with described the plights of the impoverished and homeless in the local area. Being surrounded by people who are passionate about a wide variety of things and are able to channel all of these areas to improve some aspect of the world around them has helped me to see that the most important thing that I can do moving forward is pursue a path that I am passionate about, and there will surely be an opportunity for me to use my experience to help others along the way.

Thus, as I continue my studies at Colgate, I will continue to let my passion for mathematics drive my path forward. Along the way, I have the opportunity to be aware of applications of the knowledge that I am acquiring that may be able to make a positive impact, whether it is through direct service or work that creates a more indirect impact. This also ties in to my studies in economics, through which I hope to gain greater insight into how the economy impacts people in all walks of life. Overall, my summer with Adirondack Foundation has provided me with a great opportunity to gain a greater understanding of the nonprofit sector and some of the economics that drive its funding.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Upstate Institute

Research Fellow: Rishi Lohar (2021) **Concentration: Undeclared**

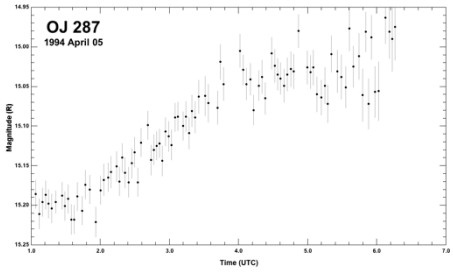
Faculty Mentor: Thomas Balonek **Department: Physics and Astronomy**

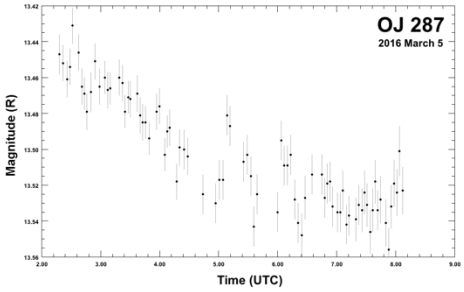
Title of Project: Optical Variability of Quasars and Stars at the Colgate Observatory

Project Summary:

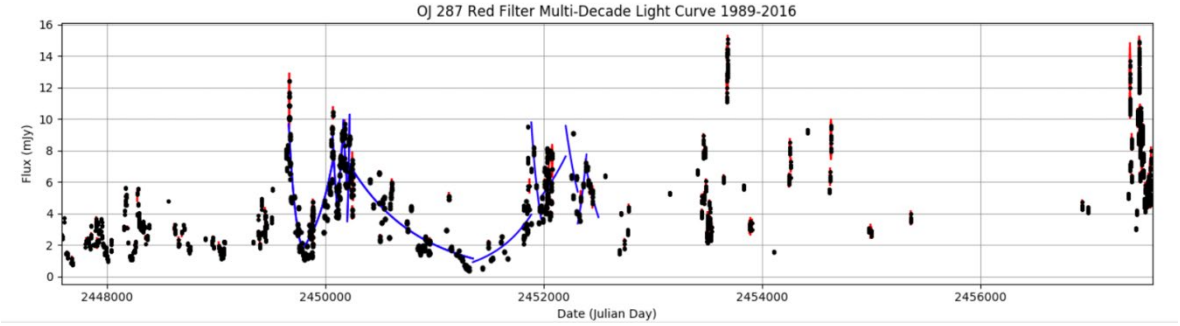
This summer, under the direction of professor Thomas Balonek, I and several other students studied quasars at Colgate University's Foggy Bottom Observatory (FBO). Quasars are a special type of supermassive black hole and are a subset of a more general phenomenon known collectively as active galactic nuclei (AGN) characterized by their unparalleled energy outputs and distance from us, these objects are theorized to occupy the centers of all galaxies and are presumed to have immense accretion disks of ionized matter (mostly gas). These massive disks of heated matter then carry an electrical charge that induces magnetic currents that produce high energy jets perpendicular to the accretion disk. We can observe these jets as electromagnetic radiation ranging from low frequency radio waves to visible light and high energy x-rays. These are among the oldest and most energetic objects in the universe. At the FBO we observed a dozen or more of these objects nightly taking two-minute exposures with our 16-inch telescope and 15" by 15" CCD camera in a red filter (only red light was observed).

Aside from observing, our main objective was to analyze and display archival data of the blazar OJ 287. (A blazar is just a special case of a quasar in which the jets are directed more-or-less directly at earth). Because of OJ 287's orientation towards earth, we are able to observe drastic changes in apparent brightness and flux of particles on scales from hours, to weeks, and years. My focus was to look at the shortest scales of variability, a phenomenon we call intraday or intranight variability. This type of variability is exactly as it sounds: noticeable changes of brightness within a single night. In order to be sure that these changes in brightness were real and not just a consequence of atmospheric disturbances or haze, we designated three comparison stars adjacent to OJ 287 that we used to calculate differences in magnitude. Since we crossed checked these stars with one another, we have become increasingly certain that the comparison stars themselves are not variable. Another characteristic we look for is the presence of multiple inflection points; the rate at which the magnitude changes is in fact changing. The graphs to the right from 1994 and 2016 both illustrate clear intranight variability.





I also dedicated my time into creating a code in Python that could accurately and efficiently fit exponential curves to the rise and decay of quasar outbursts in flux. Using a least-squares fit, I was able to fit exponential curves to the 1994 outburst and subsequent fluctuations as demonstrated in the figure below. Although not yet perfected, it is a useful way to examine the fluctuations and variability of blazars.



Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Justus '43 and Jayne Schlichting Student Research Fund

Research Fellow: Iona MacKillop (2020) **Concentration: Neuroscience**

Faculty Mentor: Ann Jane Tierney **Department: Psychological and Brain Sciences**

Title of Project: The Effects of Serotonin and Serotonergic Ligands on Feeding and Satiety Behavior in Crayfish

Project Summary:

The involvement of the neurotransmitter serotonin in animal feeding behavior has been widely researched however the mechanisms via which the drug affects feeding is not fully understood. Since animals are incapable of describing their bodily functions, researchers are unable to determine whether feeding inactivity is due to neurological changes that naturally induce satiety or other adverse physiological manipulations which result in a reduced appetite, such as nausea. A study by Halford et al. (1998) identified the Behavioral Satiety Sequence (BSS) in rats, which was described as ordered behaviors transitioning between eating, grooming and resting following complete satiation. The identification of this sequential pattern of behaviors enables the researchers to recognize inconsistencies in the BSS and thus determine which mechanisms are being impacted upon by exogenous drugs. This research is significant as understanding how serotonin may reduce appetite is important in the development of drugs to tackle obesity and other eating disorders. In addition to this, the research further reaches into the realms of environmental protection of crayfish in the wild who could be affected by serotonin leaching into water systems. My research was designed to follow up on previous research on serotonin agonists (5-HT) and antagonists (methiothepin) on feeding behavior in *Procambarus clarkii*. Furthermore, the research was designed to examine whether these crayfish demonstrate an identifiable BSS and if so how the aforementioned drugs affect these behaviors. The hypothesis was that serotonin would reduce overall feeding and the serotonin antagonist would have the opposite effect, increasing feeding. It was further hypothesized that the crayfish would display a pattern of behaviors following satiety and would not show this pattern when satiety was not achieved.

To test the hypotheses, two experiments were conducted, both of which utilized repeated measures. The first experiment was designed to compare the behaviors of crayfish that received food and were able to achieve satiety, to crayfish that received a control solution that simulated the presence of food. Prior to feeding, each crayfish was permitted a 48-hour period to acclimatize to their isolated environment. The treatment group received 50 pellets of Purina trout food pellets, and their behavior was recorded for an hour following the introduction of food to their tank. The control group received 3mL of a solution that was made from 20mL of dechlorinated water infused with 50 food pellets. The solution was injected into the water in front of the animal, following which their behavior was recorded for an hour. Following the experiment, the control group were fed 50 pellets, so that over the course of the repeated measures experiment they were receiving the same amount of food as the treatment group. The number of pellets consumed by the crayfish were counted. The videos were later analyzed to produce a feeding and satiety behavior assay; each video was assessed in five-minute increments during which the time spent performing each objectively defined behavior was measured.

The second experiment was also designed with repeated measures, with each crayfish receiving three different treatments with a 48-hour period separating each test. The treatments were 100 μL of 5-HT ($1x10^{-4}$M), 100 μL of methiothepin ($5x10^{-5}$M), and 100 μL of a control saline solution. The experiment was carried out blind so that the identity of the solution injected into the animal was unknown during the experiment and video analysis. After receiving the injection, the animal was allowed a 10-minute recovery period after which it received 80 pellets of food; the animal's behavior was then recorded for an hour. The number of pellets eaten by each crayfish was counted. The results of these experiments supported the hypothesis that injections of serotonin would decrease the overall amount of food consumed whilst methiothepin tended to increase feeding behavior and pellets consumed more than the serotonin and control saline treatments. The results also showed that there was a pattern of behavior and that over the course of the one hour behaviors such as walking and feeding decreased, while grooming and leg-waving increased. The evidence suggests that 5-HT did affect this pattern but it is unclear whether this was due to satiety or other non-specific serotonergic effects; this was also the case for methiothepin. A future direction and improvement of this research could be to include a control saline solution group that received no food pellets.

Source of Support: ☐ AHUM Div. ☒ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☐ Other (specify):

Research Fellow: Chloe Mansell (2019) **Concentration: Geography**

Faculty Mentor: Adam Burnett **Department: Geography**

Title of Project: Oxygen and Hydrogen Isotopes in the Hydrologic Cycle

Project Summary:

Over the course of the summer, Professor Burnett and I collected and analyzed the stable isotopic composition of water samples taken weekly from North Leland Pond, an input stream, and two output streams. Local precipitation was also collected at Professor Burnett's house in Cazenovia, New York. We were most interested in obtaining the ratio of ^{18}O (heavy oxygen) and ^{16}O (light oxygen), and hydrogen and D (Deuterium) levels of the water samples. We used Colgate University's LWIA (Liquid Water Isotope Analyzer) in order to obtain the isotopic levels of each water sample.

We hypothesized that the summer precipitation samples would be more enriched in ^{18}O than the winter precipitation samples. During the summer months, the air temperature and dew point are higher than in the winter, which leads to warm air masses containing enriched water that falls as precipitation. As an air mass moves over land or water, the air mass has the potential to condense and create precipitation. ^{18}O is the first to precipitate out of the cloud because it is heavier than ^{16}O. This means that the first few precipitation events from an air mass will often be enriched with ^{18}O. The majority of the precipitation that we collected over the summer was enriched in ^{18}O. Figure 1 shows the $\delta^{18}O$ levels for every precipitation event during the summer. There was a range of values, the most depleted in ^{18}O (-11.649‰) precipitation on June 5th and the most enriched in ^{18}O (-2.096‰) precipitation on July 24th. The standard value for ocean water VSMOW (Vienna Standard Mean Ocean Water) for both ^{16}O and ^{18}O is 0.0‰. We compared our ^{16}O and ^{18}O levels to VSMOW, which means the closer the ^{18}O level gets to 0, the more the water is enriched.

Upon first starting our North Leland Pond, input stream, and output stream sampling, we hypothesized that water below the thermocline would experience little to no change in the ^{18}O levels. However, we soon found out that the ^{18}O levels are changing greatly, even below the thermocline. Figure 2 shows the $\delta^{18}O$ levels for each collection day at every depth we took a water sample. When comparing Figure 1 and Figure 2, the explanation of the changing $\delta^{18}O$ levels above the thermocline is explained by evaporation (which removes 16O) and precipitation. In order to confirm that evaporation was affecting the $\delta^{18}O$ levels, we sampled an input stream and two output streams. The $\delta^{18}O$ levels of the output stream where more enriched than the levels in the input stream. ^{16}O is the first to evaporate out of water because it is the lighter isotope. As more ^{16}O evaporates out of the water, the remaining water becomes enriched in ^{18}O. Variations below the thermocline are most likely related to ground water inputs, but this requires additional research.

Moving forward with our research, we will continue to collect precipitation and water samples from North Leland Pond, the input stream, and two output streams. As summer ends and winter approaches, we are hopeful to document the lake turnover, which occurs in late fall.

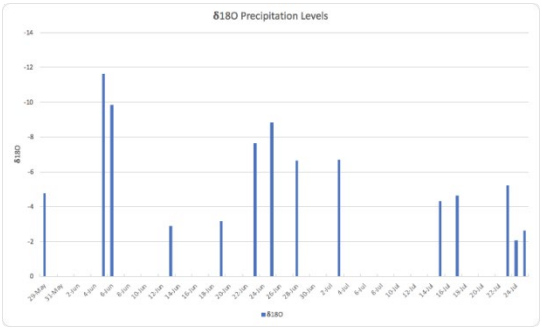


Figure 1: $\delta^{18}O$ levels for each day of precipitation

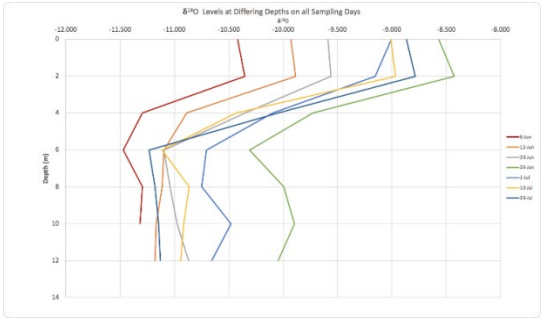


Figure 2: $\delta^{18}O$ levels for every depth and sampling day

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☒ SOSC Div. ☐ UNST Div.
☐ Other (specify):

Research Fellow: Levan Mekerishvili (2020) **Concentration: Molecular Biology**

Faculty Mentor: Jason Meyers **Department(s): Biology; Neuroscience**

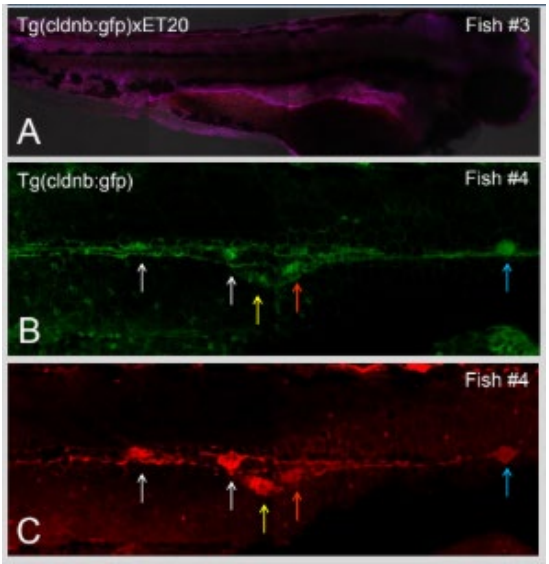
Title of Project: Control of Stem and Progenitor Cell Fate in Zebrafish Sensory Systems

Project Summary:

Zebrafish larvae are transparent and develop quickly. This makes zebrafish an excellent model organism to study various biological processes. One such process is regeneration. Zebrafish readily regenerate organs and tissues. Interestingly, regenerative ability allows zebrafish to regenerate sensory organs too - something humans and mammals, in general, cannot do. One such organ with regenerative ability in zebrafish is a neuromast, a sensory organ that senses the water movement and vibrations and helps fish swim, navigate, predate, and escape the predators. Neuromasts located along the posterior lateral line in zebrafish make an excellent system to study regeneration for two main reasons. One, neuromasts are located on the surface of the fish just under the epithelium which makes it easy to study and observe using transgenic lines that selectively label certain cell types in the neuromast. Two, neuromasts comprise of the sensory hair cells that are homologous and very similar to human inner ear hair cells which makes this research very important. It enables us to get insight into the regenerative process of hair cells, (interactions between different signaling pathways that coordinate cell fate to understand why the damage incurred in human sensory organ induces permanent deafness, whereas zebrafish regenerate their sensory organs in 3 days.) which would potentially have direct implications on treatments and health care for deafness in humans.

In addition to hair cells, support cells and mantle cells make up the whole neuromast. Numerous researchers study the roles of each cell types and their roles in the regeneration of hair cells. Not much research has been done on the regenerations of the whole neuromast. I did my research on the regeneration of the neuromast in embryos that did not develop neuromasts during development to begin with. In normal fish, a cluster of cells called primordium deposits 7-8 neuromasts as it moves along the lateral line of the fish from head to tail. It is known that the FGF signaling pathway in the trailing end of the primordium promotes the formation and deposition of the neuromasts. By inhibiting the FGF signaling pathway in zebrafish embryos at 1 dpf (when primordium starts to move) through treatment with PD166866 (5μM) for one day primordium migrates to the tail without depositing any neuromasts. I found that zebrafish develop new neuromasts 2 dpt on the anterior side. The fish that were left in PD166866 treatment for longer (up to 3 days) also developed neuromasts 2dpt.

To make sure that the neuromasts showing up in fish are not neuromasts deposited by the second primordium, I examined fish at 1dpt (when neuromasts should be starting to form) through the confocal microscope. In the figure, the yellow arrows in panels B and C point at second primordium as it moves from right to left in fish #4. Neuromasts indicated by white arrows show newly appeared neuromasts located on the main lateral line suggesting that these neuromasts are regenerated neuromasts.



Next, to show that regenerative process starts after the pharmacological treatment, I performed immunostaining of fish 0 dpt (Panel A) and 1 dpt (Panel B) for sox2 transcription factor that is believed to be present in pluripotent stem cells. The figure shows that there are no sox2+ cells in fish 0dpt whereas cells that are differentiating into neuromast in fish 1dpt are positively stained for sox2.

In summary, I have found that new neuromasts appear after the PD166866 treatment and at least some of those that appear are not deposited by Prim2. Additionally, these neuromasts appear 2dpt regardless of the length of the PD166866 treatment. This shows that PD166866 could be inhibiting the regenerative process suggesting the possible involvement of FGF signaling in the regeneration. Finally, this treatment may be holding cells in a progenitor state that becomes sox2+ only later at 1dpt.

Source of Support: ☐ AHUM Div. ☒ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☐ Other (specify):

Research Fellow: Rachel Meyne (2021) **Concentration: Undeclared**

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

Title of Project: Polar Marine Diatoms and Antarctic Paleoclimate

Project Summary:

This project examined a sediment core taken from the Southeast Indian Ridge, an understudied area of the ocean that is thought to contain thick sediment sequences that record glacial to interglacial climate and ocean variability over the last several million years. Given the region's remote nature, few ships have collected materials from the area. However, legacy core materials, collected over 50 years ago, are stored at Lamont Doherty Earth Observatory. We traveled to the core repository, where we sampled the core, taking a 2-centimeter sample every 5 centimeters, using a saw and hand tools. The samples were brought back to Colgate where I prepared samples for oxygen isotope work. This process included disaggregating the sample and sieving into it into 3 size fractions, (less than 63 microns, 63 to 150 microns, and greater than 150 microns). This process is done to separate out the Foraminifera that will be picked for later isotopic analysis. Foraminifera are single-celled organisms with a calcium carbonate shell.

To study the climate of the past, we must look to the palaeoceanographic records left in sediments. The cores that are being examined contain records from the Pliocene through the Pleistocene. The goal of this research is to gather sediment, geochemical, and stratigraphic information that will help characterize changes in the oceanographic setting in the Southeast Indian Ocean. With these data we hope to identify sedimentary cycles pertaining to glaciation during the Pleistocene.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Norma Vergo Prize

Research Fellow: Olivia Miller (2020) **Concentration: Anthropology**

Faculty Mentor: Elana Shever **Department: Anthropology**

Title of Project: Making Mesozoic Meaning: People and Dinosaurs in the American West

Project Summary:

This summer I assisted Professor Elana Shever in her project "Making Mesozoic Meaning: People and Dinosaurs in the American West" which analyzes how dinosaurs are being used to understand what it means to be human (and non-human) in the United States. She has conducted ethnographic fieldwork at sites in the American West where people regularly engage with dinosaurs. I transcribed and coded part of her data along with films made about various aspects of paleontology in order to examine the connections that humans share with dinosaurs both emotionally and personally. I hypothesized that cinematic representations of American paleontology reflect the emotional and personal connections that people in the United States form with dinosaurs. While each film has a differing focus—from uncovering a scientific mystery that stumped the experts to the political and financial aspects of paleontology—each shows how people are intrigued by dinosaurs and form strong emotional connections with them.

I found evidence of the varying types of people's emotional and personal connections to dinosaurs through four distinct films: *Dinosaur 13*, *T. rex Autopsy*, *The Thornton Triceratops*, and *The Day the Mesozoic Died*. *Dinosaur 13* is a documentary film that tells the story of Sue, the largest Tyrannosaurus Rex skeleton ever found. The federal government seizes the skeleton, claiming Peter Larson and his team stole it from federal land. As the film progresses, Sue is almost always referred to in human terms. Kristin Donnan, Peter Larson's wife at the time, puts it well when she says, "Through the pendency of the custody case, Pete's way of managing stress was to work. He was extremely sad. It was as if, often, he was in mourning." Though there is no actual funeral, there is an overwhelming theme of sadness because of the loss of Sue. Sue's seizure by the federal government meant mourning from everyone in the community. While *Dinosaur 13* displays sadness, *T. rex Autopsy* displays the pure awe of the four scientists in the film. A fictitious documentary, *T. rex Autopsy* follows four scientists as they perform an autopsy on a recreation of a life-sized T. rex to try and figure out its cause of death. Matthew Mossbrucker, an experienced paleontologist describes his first reaction to seeing the specimen, "When I first saw the T. rex, I was overwhelmed. I just nearly wept. It was just so beautiful." Matthew's physical reaction is similar to the other three scientists. There is an overwhelming sense of awe and amazement towards being able to see a life size T. rex. Similar to *T. rex Autopsy*, the people in *The Thornton Triceratops* are incredibly connected to the discovery which shows itself through intense excitement. As the narrator describes the emotions and excitement over the discovery, he states, "Next, the Thornton Triceratops reveals a massive secret uncovering a mystery hidden below the surface and changing everything scientists thought they knew about the discovery." This is a sentiment repeated throughout the film, and causes people to become captivated and to wonder/speculate about what the outcome of the discovery is going to be. People from all walks of life—the paleontologists, construction workers, town officials, and kids—are all excited by the discovery of a dinosaur in their own backyard. At the end of the film, scientists reveal that it is not, in fact, a Triceratops, but a much rarer Torosaurus that has been discovered. Finally, *The Day the Mesozoic Died* follows the path that scientists went through to understand where and how the extinction of the dinosaurs occurred. There is an inherent competitiveness that seems to drive all the scientists in the film to be the one to uncover the truth about the extinction of the dinosaurs. Richard Muller explains, "Louis Alvarez got very frustrated when the paleontologists didn't say, 'Yes sir, thank you for solving our problem.' But many of the paleontologists just looked on him as someone who didn't know their field and was stepping into this just because it was such a big, important, famous problem." As the most scientific of the films, *The Day the Mesozoic Died* focuses on the drive of the scientists and the competitiveness that came of this.

Ultimately, throughout this research process, the films shined light on the strong and distinct emotions that humans form to dinosaurs, ranging from sadness to elation. This affective connection is not only seen in cinema. These films break the stereotype that science is detached and emotionless. Emotions are apparent in the films as well as in the interviews and shadowed tours that Professor Shever has participated in throughout her field work in and around the Denver area, which I transcribed and coded this summer. Volunteers and professionals alike seem to bring up the excitement that kids have along with the fear of dinosaur because of their sheer size. In effect, people relate to dinosaurs as if they are still alive, not just the fossilized bone, or more technically, rock, that stands in front of them, but an actual, real-life dinosaur. They connect with the skeletons and transform them into living beings.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☒ SOSC Div. ☐ UNST Div.
☐ Other (specify):

Research Fellow: Mostafa Mohamed (2021) **Concentration: Undeclared**

Faculty Mentor: Timothy "Tim" McCay **Department(s): Biology; Environmental Studies**

Title of Project: Studying Invasion by Exotic Crazy-Worms and Distributions of Native Earthworm Species in the Northeast

Project Summary:

Over the last decade, exotic earthworms have invaded habitats in North America that were previously free of worms. These exotic and invasive species came from Asia and Europe. Earthworm communities in North America have been studied to better understand their ecological impact on the different environmental factors. Earthworms play a crucial role in their habitats since their ingestion and digestion impacts the soil pH, soil structure, and nutrient cycling, which in turn affects the surrounding plants and animals. Earthworm species are classified based on their migration domains. The three types of earthworms are epigeic, endogeic, and anecic. These worms either live on the soil litter surface, live in the soil and migrate horizontally, or burrow vertically, respectively. The different species and classification influence their impact on the environment. While researchers have identified their significant impacts on their environment, earthworm communities have not been extensively studied. The Ecological Research as Education Network (EREN), created by Dr. Timothy McCay, was established to collaboratively compile earthworm data to further understand earthworm communities.

In order to further investigate the significance of the invasive earthworms, we collaborated with twelve researchers across the country. The collaborators provided earthworm lengths, masses, identification, and the coordinates of the sites. These sites were in New York, Rhode Island, Vermont, Pennsylvania, Minnesota, Ohio, Michigan, and Kansas. Each researcher was required to use the EREN Protocol to collect and identify worms at their given location. The EREN protocol requires researchers to collect worms in 0.36m^2 quadrants, spaced 5 meters away from the center point. A total of 3,708 worms were documented from 49 sites provided by the collaborators.

The sites and species names were systematically converted into four and six character codes, respectively. We recorded the frequency of the various species collected in each site. Across the 49 sites, 43 different species were identified. An ash-free dry mass (AFDM) was calculated for each earthworm, using different logarithmic equations specific to each species. The ADFM total (biomass densities) were calculated for each species in the sites they were found in. After the abundances and ash-free dry masses were tabulated relative to their species and sites, the abundance densities and AFDM densities were calculated for each species in all 49 sites. The abundance and AFDM densities varied based on the site location. The 49 sites coordinates were converted into decimal degrees and compiled onto a single google map.

One way to further understand species distributions across the country is by figuring out the nestedness. Nestedness looks at the colonization patterns of the different species in their respective habitats, nestedness analysis was used. We created presence-absence matrixes to analyze nestedness using the NODF program. Three matrices were made based on their earthworm classifications: all species, endogeic species, and epigeic species. In the presence-absence matrix, a "1" represents species presence while a "0" represents species absence. In order for the program to properly accept the matrix, the site names were converted to numbers, "sitenumber" was placed into the first cell, all of the commas were replaced with a space, and the files were saved as a .txt file. The NODF metric quantified nestedness in the three matrices made. The NODF and expected NODF values were calculated using the NODF program, written in Fortran 85. The NODF program yielded values ranging from 0-100, complete nestedness being 100 and no nestedness being 0. The values were obtained for each species across the 49 sites (Figure 1).

	NODF Average	**expNODF Average**
All Species	94.933	94.614
Endogeic	77.111	74.285
Epigeic	83.234	79.032

Figure 1. The NODF and expNODF values obtained using the NODF program for the three matrices: all species, endogeic, and epigeic. The all species matrix was composed of all 43 species observed across the 49 sites. The endogeic and epigeic matrices were composed 15 and 20 of the species, respectively. The remaining species were unknown.

Source of Support: ☐ AHUM Div. ☒ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☐ Other (specify):

Research Fellow: Julieanne Montaquila (2021) **Concentration: Biology**

Faculty Mentor: Timothy "Tim" McCay **Department(s): Biology; Environmental Studies**

Title of Project: Studying Invasion by Exotic Crazy-Worms and Distributions of Native Earthworm Species in the Northeast

Project Summary:

My research focused on native earthworms of the Northeast of the U.S., specifically looking at populations in upstate New York, and in one instance, Vermont. Two species, *Eisenoides lonnbergi* and *Sparganophilus eiseni*, were studied.

Most of my research focused on *Eisenoides lonnbergi*, which is found in wetland areas of the Northeast. There are many questions about this species to tackle, all centering around one question: How has *Eisenoides* endured in the North East among invasive competitors while many of its other native counterparts were unable to survive? *Eisenoides* is unique among earthworms with its high tolerance for acidic environments and its prevalence in wetlands. While there are already records of *Eiseoides* living in habitats with a soil pH as low as 3.4 and as high as 8.5, most other earthworms in the same region stop being found at habitats below a pH of 4.4. I wanted to find out whether *Eisenoides* preferred those more acidic environments or had been forced into them by competitors. To test whether they enjoyed or simply tolerated acidic soil as a necessity of competition, I designed an experiment using a pie tin left empty in the middle and filled on the outside with soil, divided into three sections based on pH. We collected a stock of mineral-based acidic Adirondack soil from the Town of Webb and homogenized it through sifting. In order to raise the pH of the acidic soil to also have a neutral and basic batch, I used sodium carbonate, a relatively safe salt that acts as a very efficient buffer. Finding the exact ratio of sodium carbonate to soil to get the correct pH was a major hurdle in the experimental design, which was finally worked out at the end of summer, leaving the testing ready for the fall of 2018. I decided to test the preference of *Eisenoides* as well as the most recent invader of the North East, "jumping-worms," part of the Family Megascolecidae, and an older and better established European invader, *Lumbricus rubellus*. Testing these species as well will give us data to use both as a control and to compare two different types of invaders to one of the few native earthworms which has survived.

We also spent a significant amount of time this summer searching for *Eisenoides* at new sites that would expand their known distribution, the limits of which exist northward and westward. We went out into the field to a few places closer to the Adirondacks and to sites near Honeoye, NY. I determined these places as good search sites by looking for common themes of *Eisenoides* habitats, specifically wetlands, relatively flat areas, and not too far from previous records. At a local site, we found cocoons of *Eisenoides lonnbergi*. There are almost no records of this species' cocoons, so this was quite significant. We gathered about twenty and took them back to the lab to monitor as they developed and record further observations. We were able to obtain footage of the unhatched *Eisenoides* inside their egg casings moving.

We found a second native species, *Spargonophilus*, an abnormally long and thin worm that often coils itself up in mud, for the first time at different sites our lab sampled. *Sparganophilus* was found in Madison County for the first time on June 19th, 2018 in a stream. We also discovered *Sparganophilus* at the 9-mile-swamp while kayaking upstream in search of *Eisenoides*, which we also found living there. At Taylor Marsh, a part of the Bergen Swamp Preservation Society, we came upon a muddy area that was saturated with these worms. Most notably, our lab found the first record of *Sparganophilus* in all of Vermont, living at Dead Creek. This was on the way back from a trip to Burlington to meet with fellow earthworm researchers at the University of Vermont.

Our work on native earthworms as well as invasive worms will continue. With more research on native earthworms, we hope to be able to make a case for the conservation of wetland sites and also to simply better understand these unique organisms as part of our natural history.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Picker Interdisciplinary Science Institute

Research Fellow: Elizabeth "Lizzy" Moore (2020) **Concentration(s): PCON; Geography**

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

Title of Project: Agricultural Economic Development in Madison County: Marketing Techniques and Consumer Education for Farmers' Markets

Project Summary:

Cornell Cooperative Extension of Madison County addresses public needs by providing non-formal higher education and learning activities to farmers, ranchers, communities, youth, and families. Their programming covers five primary mission areas: Agriculture, Community, Environment, Nutrition, and Youth and Families. CCE of Madison County provides educational resources for people interested in starting an agricultural enterprise, or farmers and ranchers looking to innovate and remain viable. The agency runs the local 4-H program, which engages youth in agricultural and STEM activities. CCE of Madison County also creates events and informational materials to educate the general community about local agriculture and environmental issues.

The goal of my project was to increase consumer flow to local farmers' markets. I worked with a pilot farmers' market to help them develop brochures, social media advertising, and a consumer satisfaction survey, in order to promote their market effectively. By the end of the summer, I was able to create a guidebook for farmers' markets, which can be given out to any market in the county, that details everything from creating a social media account to designing print advertising to developing a survey. My materials created for the pilot farmers' market have been included in the guidebook as examples. This guidebook will be added to the educational materials distributed by CCE of Madison County in order to support local agriculturists.

The consumer satisfaction survey that I developed for the guidebook will serve as a template for new or existing farmers markets that seek a better understanding of their consumers and their wants. I helped the pilot farmers market with interpreting the data of the survey in order to promote the market to potential vendors and to make changes to the market that benefit their consumers. This particular market found that most of their consumers came to the market weekly--information that could be used to attract vendors to the market. The survey also showed that 70% of customers who took the survey felt that the limited variety of produce at the market was a challenge when shopping there. This market can use this information to target produce vendors specifically and make this adjustment so that their customers are happier.

I have learned that this community is generally very supportive of local agriculture and their farmers' markets. Everyone that I asked was willing to take the survey and all of the respondents took a lot of time to write out their thoughts about how the market could improve. When interviewing the managers at farmers' markets across Madison County, I learned that the towns in this area vary greatly, which presents a unique set of challenges and goals for each farmers' market. This fellowship helped me to understand how rewarding it can be to serve the community. I truly enjoyed working with local agriculturists and entrepreneurs and it has made me consider this as a possible field of work post-graduation.

This project was much more independent than anything I've ever done before. I was allowed to create my own designs for marketing materials, choose what questions were asked in the survey, and decide what to put in the guidebook. I think this will prepare me for my upper level classes, where students are given much more liberty than in introductory classes.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Upstate Institute

Research Fellow: Anupama "Annie" Motee (2020) **Concentration: Physics**

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

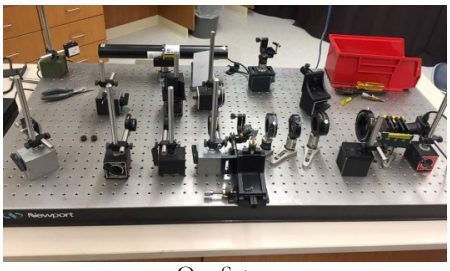
Title of Project: Liquid Crystal Optics

Project Summary:

We studied the effects of passing polarized light through a cell filled with liquid crystal molecules. Liquid crystal molecules are uni-axial, meaning they have one molecular axis longer than the other two. Because of this feature, they have two different indices of refraction for light, hence producing the phenomenon of birefringence. This introduces a phase difference in the relative polarizations of a light beam passing through the LC cell, thereby changing the polarization of the light. We investigate how the different patterns of anchoring in the LC cell affect the resulting polarization patterns.

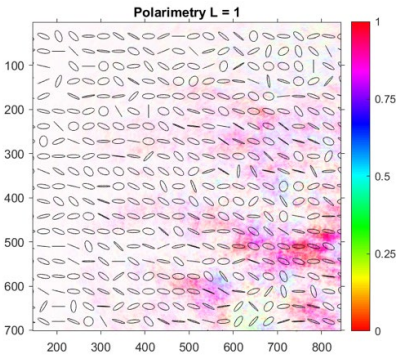
To create an LC cell, we coat an indium-tin oxide glass slide with a polymer solution. The slides are then heated at 150 degrees in a vacuum oven, and the patterns are subsequently created by passing the glass slide over a piece of velvet cloth repeatedly. The scratching method varies depending on the pattern we want to create within the cell. Two glass slides are then glued together, and filled with the liquid crystal. The cell is then heated at a 35 (degrees c) which allows the LC molecules to arrange themselves in a uniform way throughout the cell, and at the same time aligning with the pattern etched on the inside of the cell.

The setup consisted of a laser beam that passed through a beam expander, a polarizer (which provided the input polarization), the LC cell, a series of waveplates, a few filters and finally a camera. To determine the polarization, the camera captured six different images of the intensity of the resulting beam, with the waveplates set at different settings. These settings measure the different components of polarization. The images are then fed into a MATLAB program which generated a single image representing the beam's polarization.

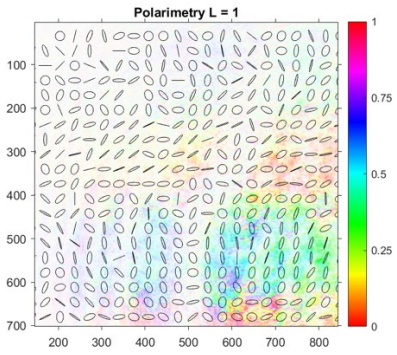


Our Setup

Some of the cells had very uniform patterns of polarization, while others had no discernible pattern whatsoever. On the right image below, the cell was created such that two slides had patterns perpendicular to each other. When light with a horizontal polarization was passed through, the resulting polarization was vertical, and vice versa. In creating a cell with a circular pattern, we slightly misaligned the slides so that the centers of the two circles were not directly on top of each other, creating a flawed pattern. The image below (left) shows the polarization pattern of this cell, with the image taken approximately at the center of the cell. As can be seen, the pattern is focused around two focal points created by the two centers of the slides. For future work, we need to develop better ways of creating the cells, such that errors such as this might be minimized, and more uniform patterns created.



LC cell with input polarization vertical



LC cell with circular pattern

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Justus '43 and Jayne Schlichting Student Research Fund

Research Fellow: Austin Movinski (2019) **Concentration(s): Economics; Political Science**

Faculty Mentor: Richard "Rick" Klotz **Department: Economics**

Title of Project: Who Benefits from Cleaning Up Ocean-Based Trade? The Impacts of Emissions Control Areas on Air Pollution and Transport Costs

Project Summary:

Cargo ships, carriers, and other large shipping vessels are significant contributors to air pollution, ozone depletion, and other environmental degradation. This primarily stems from the low quality, high sulfur-content fuel that they opt to use. In response to the environmental concerns, various jurisdictions have adopted policies regulating the quality of fuel that these vessels are permitted to use. California was among the first to do so. In 2009, California's Air Resources Board (CARB) implemented the Ocean-Going Vessel Fuel Rule, which regulates the quality of fuel vessels are permitted to use inside of 24 miles of California's coast. This was then amended in 2011, lowering the legally acceptable level of sulfur content in the permitted fuel. The United States, specifically the EPA, later adopted one of these policies of their own in 2012. This policy, deemed the North American Emission Control Area, extends 200 nautical miles off of the U.S. coast and has similar fuel quality requirements as the California Fuel Rule. The key difference, however, is that the EPA allows for exhaust gas cleaning systems (i.e. scrubbers) in lieu of cleaner fuel, as these also serve to reduce emissions. California does not permit this, contending that there is a lack of research and experience with these systems. These policies raise a multitude of questions that I sought to answer. First and foremost, given that enforcement seems difficult, are vessels actually complying with these policies? Second, because these policies mandate vessels to use cleaner (more expensive) fuel, is there a noticeable increase in the charges to ship goods?

I first reviewed the regulatory documentation of the California OGV Fuel Rule in order to ensure that the policy was actually impacting vessels. The concern was that if enforcement were lacking or nonexistent, vessels would ignore the policy and therefore I would observe none of its expected effects. In general, I found that CARB's policies are being enforced rather thoroughly. This is demonstrated by the large fines that CARB is imposing and the fact that they are not shying away from shipping industry titans, such as MSC, who was recently fined $350,000 for four of their vessels operating in California waters with non-compliant fuel. Another shipping company, China Navigation Management, was fined $129,500 for one of its vessels failing to switch to compliant fuel when entering California waters.

After confirming the enforcement of the policies, I turned to our data for analysis. I used the Census Foreign Trade Data, which contains data on a per shipment, per commodity basis and includes the exporting country, district (ports) of unlading, value of the shipment, the charges incurred to ship, weight of the shipment, and 10-digit commodity codes. I used data from 2005 to 2012 in order to thoroughly analyze trends pre and post policy implementation. The commodity codes were grouped together into 22 sectors in accordance with the Harmonized Tariff Schedule, the official document that the U.S. uses to categorize imported merchandise. In order to mimic an experiment, I began by assessing whether it would be appropriate to consider California ports as a treatment group and other West Coast (non-California) ports as a control group. For this to be true, California and other West Coast ports would have to have a similar composition of imports and have similar characteristics, with the only substantial difference being California having the OGV Fuel Rule. Generally, I found this to be true. California and other West Coast ports are similar in what commodity sectors they import (and to what degree) and which exporting countries hold the largest share of imports. Additionally, key variables such as aggregate value and weight trend rather similarly. Once this was confirmed, I began running difference-in-difference fixed effect regressions. I ran regressions with year-by-month, sector-by-country and country-by-year-by-month fixed effects in order to address endogeneity. A number of controls were also tested. These included a variable interacting crude prices with a country-district pairing (as a proxy for distance) and a variable interacting a quadratic time trend with district (to control for differing trends across different ports).

The results were relatively consistent across a number of regressions with varying fixed effect and control specifications. Moreover, they were statistically significant at a 1% level in nearly all of the regressions. On average, our results indicate that the implementation of the Fuel Rule in California raises the charge-to-value ratio by 3.5% relative to other West Coast ports, holding all else equal. These results suggest that vessels do incur additional charges from the policy, as suspected. As such, this policy likely raises the prices of imported products for all consumers, but its pollution benefits will accrue only to those on the coast. Lastly, it is suspected that the increase in charges will be more substantial for the North American ECA, given that it extends much further off of the coast than the California policy.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☒ SOSC Div. ☐ UNST Div.
☐ Other (specify):

Research Fellow: Mackenzie Murphy (2018) **Concentration: Neuroscience**

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

Title of Project: End of Life Care with Hudson Headwaters Health Network

Project Summary:

Hudson Headwaters is a nonprofit organization made up of 17 Federally Qualified Health Centers in the Adirondack region. The Adirondacks are medically underserved, as there are few primary care providers for an aging population, and Hudson Headwaters provides a majority of the care for the large region it encompasses. With this in mind, Hudson Headwaters' mission is to provide excellent, comprehensive healthcare and access to health services to everyone who needs it. Doctors in the Hudson Headwaters Health Network provide primary care with specialty services to people of all ages and had upwards of 391,000 patient visits throughout their network in 2017.

This summer, I worked with Hudson Headwaters's Palliative Care team, made up of registered nurses, care managers, and doctors, to create a Palliative Care patient satisfaction survey. Palliative Care is holistic care that prioritizes maximizing quality of life for patients with a serious chronic illness and their families. Support is team based and holistic: it includes managing symptoms that cause a patient distress, like pain, nausea, and anxiety; engaging in important conversations regarding care, and working with patients' families to ensure open communication and planning. Hudson Headwaters provides a vast majority of Palliative Care services in their expansive region, but had never investigated how satisfied patients were with the care they had received. Results from the survey will allow Hudson Headwaters to implement changes that are data driven, as well as advocate for the success of their program with confidence.

While I was unable to be part of the data collection portion of the Palliative Care patient satisfaction survey, it was easy to see the multiple areas that would be addressed with the results. Hudson Headwaters's Palliative Care team will be able to see what areas of care their patients are most satisfied with, as well as those that require adjustments and improvements. Additionally, patient feedback will give caregivers fuel for new ideas and innovations. In a broader scope, the Population Health Team at Hudson Headwaters will be able to utilize the results of the survey to gather data on overall patient satisfaction levels, patient demographics, and any potential healthcare savings that are connected to Palliative Care services at Hudson Headwaters.

My time at Hudson Headwaters showed me first and foremost the passion that those working in rural healthcare delivery have for their work and communities. There are many barriers to promoting a healthy population in rural settings, but those who work at Hudson Headwaters are optimistic and unyielding in their work. I learned tactical skills like how to build a survey based on research, address low levels of health literacy, and work within multiple teams. Creating the survey was also an opportunity to use many of the skills I learned throughout my time at Colgate in a field setting where I am working professionally.

I graduated in 2018, so I am excited to have been able to take what I learned at Hudson Headwaters and apply it to my current position. I am working at a reproductive health nonprofit in Syracuse where many barriers to population-wide health are similar to those in the Adirondack region. Although I am stationed in the Syracuse office, my current employer has locations in Watertown and Canton and services the Adirondack park and greater North Country. I plan to use my knowledge of the Upstate New York population, public health, and the importance of data to continue my career in the public health sphere.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Upstate Institute

Research Fellow: Revée Needham (2018) **Concentration(s): Environmental Studies; Geography**

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

Title of Project: Adirondack Council: The Future of Adirondack Forest Preserve Stewardship

Project Summary:

This summer I was partnered with the Adirondack Council in Elizabethtown, nestled near the High Peaks region of the Adirondack Park. The Adirondack Council is a nonprofit that is dedicated to preserving water, air, and wildlands in the Park. We envision large wilderness areas surrounded by vibrant communities, working forests and farms. To accomplish this, we educate the public and policy makers, participate in advocacy work, sponsor and publish research, and take legal action, if necessary, to uphold the New York constitutional protection of the Adirondacks.

Stewardship is an important issue for the Adirondack Council. The Adirondack Park continues to see an increasing number of visitors, with much of that use concentrated in the High Peaks Wilderness Complex. While such visitation is desirable and needed to support local economies, the concentration has led to degradation of natural resources. Currently, the carrying capacity of specific trails is managed by the parking lot capacity. However, this has not been well-enforced, as many cars are parking illegally on the shoulder of the road. This poses a safety hazard to hikers, bikers using the shoulder, and vehicle traffic. In addition, the maintenance of trails has lagged behind the usage. While the sheer number of visitors poses an issue, it is also the experience level and behavior of the users that makes an impact. A small group of misinformed and uneducated hikers can damage a trail much more so than a larger group of educated hikers. While the State has taken some steps to address the overuse of the High Peaks, more needs to be done.

To address trail overuse, I helped develop a survey for hikers that I am currently conducting. In the survey, we gauge user knowledge of trail overuse, experiences with trail overuse, and support for possible state land management actions to address the issue. Hopefully, the results of the survey will show that there is user support for managing overuse, even if that means restricting use to certain trails during peak weekends, for example. Anecdotally, hikers and other organizations are glad to see that this research is finally happening. To capture more of the users of the Adirondack Park, my fellowship has been extended into the fall, when visitation to the Park peaks. In addition to the survey, I am researching stewardship best practices and writing a report on how the Adirondack Park can learn from and apply theories on carrying capacity and management to better address trail overuse. This report will be distributed to relevant stakeholders and ideally will inform future management of the High Peaks.

I graduated from Colgate in May with my degree in Environmental Studies and Geography. At the beginning of the summer, I didn't envision myself working for a conservation organization or nonprofit in my future. However, my time with the Adirondack Council has changed my mindset. The skills I learned working at the Adirondack Council (literature review, social science research, community engagement, and public outreach) will all serve me in whichever field I end up working. Wherever I end up, I will carry with me an appreciation for environmental advocacy and the beautiful wilderness of the Adirondack Park.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Upstate Institute

Research Fellow: Susan "Susie" Ness (2019) **Concentration: Sociology**

Faculty Mentor: Jacqueline Villarrubia **Department: Sociology**

Title of Project: Social Determinants of Teen Pregnancy in Rural Northern Michigan

Project Summary:

This summer, I completed a research project with a fellowship awarded by the Lampert Institute of Civic and Global Affairs. My research focused on rising teen pregnancy rates in rural areas, concentrating on three counties in rural northern Michigan. Adolescent pregnancy and young motherhood in the United States widens the wealth, social capital, and life chances gap between marginalized youth and their more advantaged counterparts. Teen pregnancy has negative social and economic effects for the mother and her child, producing lifelong consequences that often dictate the prospects for the future of the young family. Lower educational attainment, wages, and home stability are all negative outcomes of those who give birth at a young age as opposed to their childless peers. These factors have many personal and societal consequences, such as anxiety, stress, perpetuation of poverty, stigma, and social isolation. While the national birth rate for teen pregnancy is declining and has reached record low levels, a disproportionate share of teen births occur in rural areas and the rate in many rural areas continues to rise.

Taking a sociological approach to studying health outcomes, my research question asked how individual, micro-level circumstances - individual, personal, or small group interactions - and risk factors interact with the macro-level community and culture in which an individual resides. Specifically, I examined how barriers present in a rural community can exacerbate the negative consequences of individual risk factors such as poverty and family conditions. I hypothesized that young women in rural communities have limited access to birth control and information on reproductive health, making it difficult to obtain and effectively use contraceptives. This barrier specific to rural areas may interact with other macro-level circumstances, as well as individual risk factors to adolescent pregnancy as identified by previous scholarship to strengthen the likelihood of pregnancy. I utilized qualitative interviews with healthcare professionals familiar with various aspects of women's healthcare and teen pregnancy, as well as in depth interviews with women who had children at a young age in the area of study identified above.

While my initial hypothesis expected to find access to birth control to be a major impediment to teen contraceptive use in rural areas, interviews with both mothers and professionals revealed that the patterns show many of these teens have access to and are using contraceptives. However, I found an aggravational, reciprocal relationship between micro level individual determinants and the macro level context of location and community in which a teen resides. Specifically, results showed that barriers of rural living, such as transportation, limited access to healthcare and reproductive services, and access to information, exacerbate and strengthen the negative effects of individual risk factors, such as sexual abuse, unstable families, poverty, and homelessness. Conversely, these risk factors or events strengthen the negative aspects of living in a rural area, such as feelings of isolation, homogenous social ties, and diminished resources. One individual factor that I found to be a particularly strong predictor was a young woman's Adverse Childhood Experiences (ACE); this measure was first identified by a study done by the Center for Disease Control and Kaiser, and identified certain traumatic experiences and stressors to be particularly damaging to long term health outcomes. The interviews with young women and professionals strongly emphasized the consequences of both social norms and childhood trauma in shaping a young woman's life. To these mothers, a child is viewed as an escape from the bleak opportunities they see for themselves, as stated by one participant when asked about positive impacts of motherhood: "Changing me, helping me, if it weren't for them I definitely wouldn't be here." This research shows that vulnerable groups who are marginalized through societal means face a higher adversity to negative health outcomes, increasing healthcare inequality and perpetuating cycles of abuse and poverty. I am hoping that more research is conducted about how to teach resilience to young children in these types of negative situations. My summer research not only illuminated predictive factors of adolescent pregnancy, but also revealed the important ways in which an individual's environment interacts with their circumstances on a much wider scale.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Lampert Institute for Civic and Global Affairs

Research Fellow: Justin Newman (2020) **Concentration: Economics**

Faculty Mentor: Robert "Bob" Turner **Department(s): Economics; Environmental Studies**

Title of Project: Contingent Choice Surveys of American National Parks

Project Summary:

I had the honor of being chosen to help Professor Turner in his research concerning Contingent Choice valuation methods and its application for allocating different park uses in national parks. I helped during the first four weeks of the summer, with other students continuing afterwards. There were parallels between research and *Public Lands: Managing Complexity,* a course Professor Turner and Professor Pinet taught spring 2017 semester. I really enjoyed being here over the summer and I hope that I was able to provide some value in the brainstorming phase of the research process.

Most time was spent reading management plans for different parks around the country. Even within an individual park, there was often so much variation in the environment that different zones had their own management plans. Furthermore, one zone would affect others, like people who drive cars to come swim in the water and may leave trash on the beach. As such, it was a little bit overwhelming as to reconcile all of the conflicting uses between and within management zones.

Also important to the group's research was then figuring out how different parks may be analyzed within the same framework. Please consider the United States: there is as much of a variety in national parks as there is land in the nation. As such, preserving a mountain in one area may entail keeping it untouched by humans to preserve its existence value, trail management there for hiking, or clearing certain areas of the mountain of one manages scenic vistas. Therefore, it became even more difficult to interpret different park management choices within the same paradigm as each manager deals with the particular contingencies of their park.

The solution is to use like parks for analysis, so that keeping a trail clear, for example, in one park, would be due to the same management policies of a similar one. I believe that there was a later/ongoing part of designing surveys and the various considerations in making unbiased surveys, but I unfortunately unable to be present for that part of the research.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☒ SOSC Div. ☐ UNST Div.
☐ Other (specify):

Research Fellow(s): Anh "Julie" Nguyen (2018) **Concentration(s): EDUC; Mathematics**
Ha "Jenny" Nguyen (2019) **Concentration(s): PSYC; International Relations**

Faculty Mentor: Margaret "Meg" Blume-Kohout **Department: Economics**

Title of Project: Effects of the National Science and Mathematics Access to Retain Talent (SMART) Grant on STEM Degree Completion

Project Summary:

US policymakers have implemented numerous programs to increase participation and diversity in science, technology, engineering, and mathematics (STEM)-related fields. One such effort is the SMART grant program, which provided a financial incentive for lower-income college students to pursue STEM degrees. Our project employs administrative data from a large, Hispanic-Serving public university to examine the effects of the SMART program on graduation rates and STEM persistence, considering possible differences in effects by gender, race/ethnicity, and first-generation college student status.

In effect between the fall of 2006 and the summer of 2011, the SMART grant was a need-based federal grant of maximum $4,000 a year. Students were eligible for the grant if they were US citizens, full-time undergraduate students in their junior or senior year, eligible for the Pell Grant, and majoring in a SMART-eligible field (a STEM or critical language) with a GPA of at least 3.0. We used a linear probability model to examine whether the grant had its intended effect—that is, were students more likely to graduate with a STEM degree while the SMART grant was implemented than after its termination?

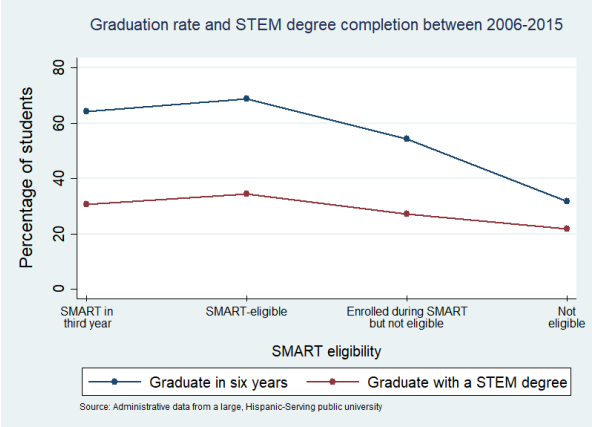


Figure 1.

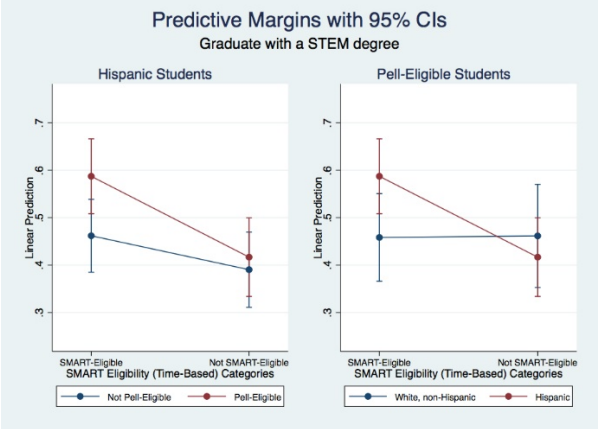


Figure 2.

Overall, we find no significant effect of the SMART grant on STEM degree completion. However, when we consider differences by race/ethnicity, we find the SMART grant does help close the gap, especially for Hispanic students, and diversify the STEM field. **Figure 2** shows the marginal effects of the SMART grant on the probability of a student in the sample completing a STEM degree. Even though the 95% CIs slightly overlap, among Hispanic students, the SMART grant seems to help those who were eligible for the Pell grant to complete a STEM degree, compared to both those who were not eligible and those who were enrolled after 2010 when the SMART grant was terminated. Similarly, among those who were eligible for the Pell grant, Hispanic students seem to benefit more significantly from the SMART grant in completing their STEM degree than their white peers and other Hispanic students who were enrolled after 2010.

This material is based upon work supported by the National Science Foundation under Grant Nos. 1546725 and 1735883.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): National Science Foundation Grant

Research Fellow: Chau Nguyen (2019) **Concentration(s): Educational Studies; Sociology**

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

Title of Project: Urban Development in a Transitional Economy: Understanding the Effects of City Transformation on Vietnam's Street Vendors

Project Summary:

Doi Moi, translated to "changing new" or renovation, is an economic reform that was created as a means of transforming Vietnam's centrally-planned economy to a market-oriented economy. The implementation of the Doi Moi policy has led to more than a decade of rapid economic growth. Vietnam has become one of the fastest growing economies in Southeast Asia; it has witnessed an increase in economic growth and a decrease in poverty throughout the years. Alongside economic growth, there has been rapid urbanization. Cities are changing with new industrial projects and population movement from rural spaces.

With macro-level changes involving urbanization and economic development occurring at such rapid paces, questions surrounding its micro-level effects arises. According to a survey carried out by the World Bank and the Vietnamese Institute of Labour Science and Social Affairs that measured perceptions of inequality, eight out of 10 Vietnamese residents worry about disparities in urban living conditions. In Vietnam, many people living in poverty turn to street vending as a source of income. Street vending plays an important role in urban Vietnamese commerce as it allows for the employment of large groups of people and generate low priced goods which in turn, feeds and clothes low income individuals. With the development of urban spaces, more and more policies are being implemented that restrict street vendors. Vietnam's Doi Moi economic reforms aimed at creating a modern country, and therefore, street vending was viewed as the opposite of modernity. News about banished street food vendors and violence against them have increasingly been covered. Street vendors carry lived experiences that indicate larger societal issues related to policy and policing of targeted bodies.

My study is a portrait of three Vietnamese cities: Hanoi, Ho Chi Minh City, and Da Nang. I spent two weeks in each city. Using ethnographic observations and qualitative interviews, this paper attempts to illustrate how Vietnam's city spaces are changing in ways that may have an impact on street vendors' lived experiences. Vietnam's urban landscapes are rapidly changing in ways that prioritize modernity and development through new infrastructure and policy. Modernity has created an illusion of what civilization looks like in ways that exclude bodies such as street vendors. The change in different spaces such as parks and "open" spaces are interconnected with the lives of street vendors. Although they are considered "public" spaces, certain places have become a mix of public and private as policing of targeted bodies renders it inaccessible to all. The sidewalk and street, some of the most basic public spaces, is the place for vendors to conduct business but they are progressively being displaced from their business.

As these places are increasingly changing under the goal of development, street vendors have to learn how to navigate those changes. Findings indicate that street vendors face surveillance and policing as a result of the changing city. They navigate spaces differently due to bans against street vending that makes them both invisible and hyper-visible, but find ways to conduct their business as usual. They utilize mobility and different areas of the city to their benefit. Utilizing mobility and other alternative spaces such as alleyways help to keep themselves distant from police. Older vendors understand that their age acts as an impairment to mobility, but they are able to use their age as an advantage, knowing that they will not be targeted as often. These are examples of the numerous ways in which vendors protect their livelihoods and embody their own agency.

The hyper-surveillance and sense of threat that street vendors experience is a testament to a disparity in citizenship. Citizenship affords people certain undisputed rights in the country that their citizenship is assigned to. Yet, street vendors are not afforded the same rights as everyone. Bans against street vending are essentially a ban against street vendors and their existence if their survival is predicated on their job. However, street vendors are not victims to the changing market, they are agents to their own survival. Rather than depicting them as susceptible to market reforms and changes in policy, we must understand the ways in which they advocate for themselves. This is not to be confused with rhetoric that portrays minoritized groups as "super humans who have overcome all odds" but it is the reality of their situation. Due to existing structures of poverty and inequality, street vendors must be their own strongest advocate.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Lampert Institute for Civic and Global Affairs

Research Fellow: Phuong "Alicia" Nguyen (2020) **Concentration: International Relations**

Faculty Mentor: Jennifer Hull **Department: History**

Title of Project: Colgate Bicentennial: Rewriting the History of International Students, 1924 -1969

Project Summary:

To prepare for the Colgate Bicentennial in the 2018–2019 academic year, the Colgate bicentennial history project aims to introduce new perspectives to the traditional history of Colgate through small independent projects which include videos, articles, and papers. During this summer, I worked on the presidential biographies and wrote the article on Moung Kyaw, one of the first Asian students at Colgate. The latter work consequently led me to start my independent project which shed light on the trend of the number of international students at Colgate from 1924 to 1969 and how this trend corresponded to policy changes, outer circumstances, and conditions at school.

My hypothesis was that the number of international students increased in response to the changing policies that Colgate implemented over the years. The timeline of the research was divided into three periods: from 1924 to 1945, from 1945 to 1964, and from 1964 to 1969. Though international students made their first appearance at Colgate in the nineteenth century, the research started the first period with 1924 to obtain consistent data because records of foreign pupils in the previous years were largely dispersed. Meanwhile, the second phase (1945-1964) signified a post-war time with the increase in the number of foreign students and the implementation of new policies and committees. Eventually, the third period (1964-1969) revealed a surge in the number of international students as a consequence of new policies and improved American foreign relations.

One insight the research gained was that the average number of foreign students each year underwent an eventual growth from 1 (1924-1945) to 4 (1945-1964) and finally 13 (1964-1969). Though these quantities were only estimated considering the lack of certainty from the data, in general, the trend was upward: international students went to Colgate in greater numbers, especially from the 1964 period. However, the distribution trend came out as a surprise. Colgate had a separate category for a group of international students called "bona fide foreign students", who were admitted outside of normal procedures, in need of financial aid, non-Western, and below par in English. As the total number of foreign students increased, the quantity of "normal" foreign students grew at a faster rate than that of the "bona fide" foreign students.

To understand the reason for the slow growth of "bona fide" foreign student body, the research examined a number of elements. The first element was the way the University recruited foreign students in the past: since the College Board English proficiency test and contact through intermediary organizations were prerequisites, "bona fide" foreign students were generally at a disadvantage. The second element was the funding for international students upon acceptance. Colgate lacked funding when it came to this matter, and thus, "bona fide" students who were qualified but required financial aid often missed the chance to study at Colgate. Third, the final element that possibly contributed to the slow growth of "bona fide" international pupils was the operation of resources for foreign students. The implementations of bodies such as the Committee on International Education and the Foreign Student Advisor cut into the fundings for international students and left a further negative impact on the granting of scholarships for "bona fide" foreign students.

Although the original hypothesis of the research was proven true, the insight into the distribution of the foreign student body was surprising and might be helpful for future research. Finally, the paper concluded with a table that summarized the important information throughout the school years, including the number of foreign students, policies introduced at Colgate, and nationwide comparison. When all the years were placed together, they shed light on a pattern that the readers might find interesting.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☒ SOSC Div. ☐ UNST Div.
☐ Other (specify):

Research Fellow: Erin O'Connor (2019) **Concentration(s): Biology; Spanish**

Faculty Mentor: Ana Jimenez **Department: Biology**

Title of Project: Oxidative Stress in Resident Birds

Project Summary:

As the impacts of global climate change intensify, the intimate linkage between many avian species and their habitat allows them to serve as important bio-indicators of environmental degradation and the success of restoration efforts. Most studies have thus far focused on the neotropical region, while examining birds in the temperate region may provide valuable answers as to how resident species are able to thermoregulate effectively in the face of extreme thermal fluctuations. Exposure to high temperatures often produces oxidative stress, an imbalance of radical oxygen species that can result in damage to proteins, lipids and DNA within cells. My project focused on the changes to muscle fiber structure that accompany heat shock, as muscle fiber size is closely linked to whole body metabolism. The pectoralis major muscle group in birds in particular is extremely important for rapid escape from predators and an upregulation of metabolism to compensate for increasing temperatures results in a diminished defense response. We hypothesized that heat shocked birds would contain more capillaries in their cells, which would further facilitate oxygen diffusion. We also wanted to explore the concept of environmental mismatch, meaning that we heat shocked fall, spring and summer-acclimated birds in order to determine if those acclimated to higher temperatures are better able to deal with thermal extremes.

We examined the effect of heat stress on pectoralis muscle fiber structure in year-round passerine species: Columba Livia (rock pigeon) and Poecile atricapillus (black-capped chickadee). Birds were collected using mist nets and live traps and were assigned to 1 of 6 groups: (1) acute heat shock, in which they were heat shocked at 33℃ for 9 hours (2) acute control, (3) chronic heat shock, in which they were heat shocked for 6 hours daily for a total of 5 days, (4) chronic control, (5) acute heat shock with recovery, and (6) chronic heat shock with recovery. To analyze muscle fiber structure, we fixed pectoralis muscle tissue from individuals of both species in 4% paraformaldehyde and then sectioned the muscle to 30 μm using a cryostat. Sections were then stained with Wheat Germ Agglutinin (WGA) Alexa Fluor 488 to highlight the sarcolemma membrane, Griffonia lectin (GSL) to highlight capillaries, and DAPI to highlight nuclei. We imaged these fibers using a confocal microscope and then traced muscle fibers following WGA staining using Image J. We measured fiber diameter, capillary density, number of nuclei, myonuclear domain, and cross-sectional area for 45 fibers per individual black-capped chickadee and then averaged across each individual. For rock pigeons, the same data was collected for 20 small and 15 large fibers. Statistical analysis has not yet been completed, but the implications that this data carries for understanding the physiological impacts of heat stress on avian species are very exciting and will likely influence conservation efforts in the future.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Oberheim Memorial Fund

Research Fellow(s): Akosua "Pomaa" Ofosuhene (2018) **Concentration: Biochemistry**
Veronica Switzer-Poplar (2019) **Concentration: Biochemistry**

Faculty Mentor: Ephraim Woods **Department: Chemistry**

Title of Project: Reactive Transients in Atmospheric Photochemistry

Project Summary:

The purpose of this research was to study the ultraviolet absorption spectrum of the charge-transfer-to-solvent (CTTS) band of interfacial aqueous iodide. Studying this spectrum provides information about the photochemistry that occurs on aerosol particles, which has important implications in understanding the role of solvated electrons in atmospheric chemistry. These aerosol particles are important in the atmosphere as they can influence radiation and climate, as well as play a role in many chemical reactions that impact the composition of the atmosphere. This type of chemistry can also be observed on sea spray particles, which have halogen ions including some iodide. Measuring the spectrum of aqueous iodide and calculating the relative photoionization yield allowed us to study the reactions that take place on its surface.

The CTTS transitions in aqueous solution occur when an electron is transferred between the solute and the solvent, in this case from iodide anions to the surrounding water molecules. We measured the spectra for CTTS transitions of different solutions of iodide. Each solution was atomized to produce an atmospheric-pressure flow of aerosol particles containing the soluble components of iodide. We used solutions of 100% KI, a 1:20 KI:NaCl solution as well as a KI and NaNO3 solution.

The CTTS transitions were measured by observing photoelectric charging of the aerosol particles, which occurs when ultraviolet light from a laser photoionizes molecules of the particles' surfaces, leaving a net positive charge on the particles. We measured this charge in the flow following ionization using an electrometer. The amount of charge created is proportional to the surface concentration of analyte (aqueous iodide) molecules.

For each spectrum, we calculated the relative photoionization yield at wavelengths from 215-260 nm. To do this, we measured the current generated by the charged and uncharged particles from the electrometer. This ratio of charged:uncharged current was divided by the power of the laser to obtain the relative photoionization yield.

We found that the wavelength that produced the peak maximum yield was often around 245 nm. This result was statistically different from results published by Rizzuto et. al (2016), which suggest that the maximum yield should occur around 230 nm. To examine reasons for this discrepancy, we performed several experiments. We first conducted several power dependence measurements in which we varied the power of the laser pulses to determine if the ionization process of the aerosol particles uses one or two photons. We also blocked out the visible light from the laser (425-520 nm) in order to only measure the ultraviolet wavelength. This was done to see if the visible light had an effect on photoionization. Lastly, we altered the relative humidity of the aerosol flow, thus changing its ionic strength to see if this affected the wavelength of the maximum yield. Using the spectra of CTTS transitions of aqueous iodide will allow us to understand more about how it reacts in photochemistry. From these experiments, we found that there are both one and two photon processes occurring with the purely iodide solutions. The one photon process is the direct ejection of electrons from surface iodide, while the two-photon process is the CTTS excitation, followed by the ionization of the solvated electron by another photon, such as visible light as shown in Figure 1 below. Future research should work to separate these two processes.

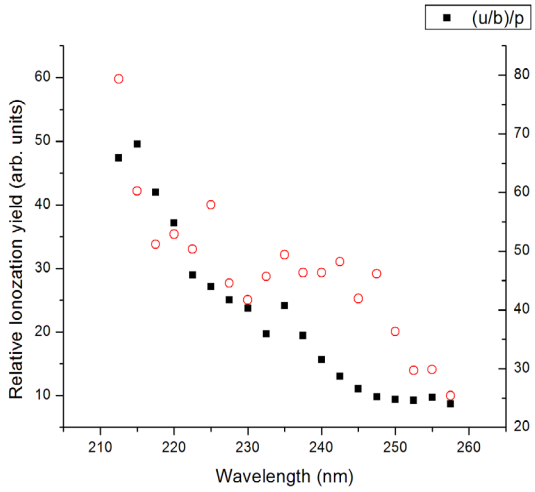


Figure 1. Spectrum for 1:20 KI:NaCl in 66% relative humidity. Black squares are blocked visible light and red circles are including visible light. This suggests a maximum photoionization yield of aqueous iodide at a wavelength of ~245 nm with visible light and ~235 nm with blocked visible light.

Source of Support: ☐ AHUM Div. ☒ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☐ Other (specify):

Research Fellow: Yunhee Oh (2020) **Concentration(s): International Relations; MAEC**

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

Title of Project: The Role of International Sports Festival in Dyadic Hostile Relations

Project Summary:

This research started from the controversy whether the 2018 Pyeongchang Winter Olympics could work as a mechanism to promote peace in the Korean peninsula. There are many papers that have investigated how sports festival played important roles in reconciling conflicts within the nation (Armstrong, 2007; Hoglund & Sundberg, 2008; Giulianotti, 2011 a&b). However, I felt that there is a need to shift the focus form national level to interstate level and to explore the mechanism underlying the process in which sports festival consolidate the lasting peace in this level.

There are two general hypotheses of economic factors that reduce the level of hostility in dyadic hostile relations. First, high levels of overall trade between the two countries reduce the likelihood of militarized disputes (Polachek, 1980; Pollins, 1989a, b; Mansfield & Pollines, 2001). Second, States that are highly dependent on each other for a strategically important good are less likely to have militarized disputes (Benson, 2004; Bohmelt, 2010; Li & Sacko, 2002).

Combining such general hypotheses and presence of international sports festival, the research conducted regression analyses to observe whether sports events contribute to reducing the level of hostility. It also conducted case studies to find conditions under which those sports events more successfully facilitate the lasting peace than others.

Regression Analyses
I evaluated 25 cases that featured sports festivals. Each case was divided into six subsets, three of which came before the event and the rest were after the event. In order to determine the level of hostility between nations, this paper chose to optimize two famous datasets from Militarized Interstate Dispute (MID) and Global Database of Events, Language, and Tone (GDELT). The amount of trade was utilized to test the general hypothesis I; the variable that measures how big the portion the partner country takes with respect to total export was utilized to test general hypothesis II.

The regression analyses of those economic variables on the level of hostility with the presence of the sports festival suggested the following. Combined with the presence of the festival, the amount of trade between two hostile relations seemed to reduce the level of hostility while the level of economic interdependence seems to barely increase the level of hostility. The overall conclusion can be explained in terms of substitution and opportunity cost. Dense bilateral trade links between a fighting dyad are characterized by high opportunity cost since it would be more expensive to seek alternative markets and creating trade links to other parties than simply maintaining the benefits of the already existing ties. Therefore, they have incentives to limit their hostile behavior and ultimately to seek mediation. The latter part of the conclusion was somewhat contracting but can be explained by the diminishing marginal effect of the sports festival. When the level of economic interdependence is already high, the impact of sports festival could be negligible. However, the research had to acknowledge that the short of observations and the wide 95% confidence intervals for the coefficients questioned the validity of such quantitative analyses.

Case Studies
The wide range for the coefficients suggested that the impact of international sports festival on reducing the level of hostility is inconsistent. In other words, there were cases that were particularly more successful than others. The purpose of case studies was to identify what made certain events more successful than others. The case studies of 1971 Ping-Pong Diplomacy between the United States and China and 1991 North-South Korea table tennis joint team identified two specific conditions under which sports festival successfully contribute to reducing the level of hostility in dyadic hostile relations: the appropriate selection of the sport and matching political needs behind the event. There should be a colossal gap between two nations in terms of skills and interests in the sport. Otherwise, the international sports festival becomes a somewhat serious competition between nations and thus creating a negative atmosphere between the two nations. One exception of this condition is forming a joint team, a condition that makes two hostile countries share a sense of brotherhood. The great success of the 1971 Ping-pong diplomacy and North Korea's intent to withdraw from Nonproliferation Treaty (NPT) in 1994 after World Table Tennis Championship in 1991 testified the second condition.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Lampert Institute for Civic and Global Affairs

Research Fellow(s): **Marisa Olavarria (2019)** **Concentration:** **Environmental Studies**
Abagail "Abby" Sotomayor (2020) **Concentration(s):** **ENST; Biology**

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

Title of Project: **Role of Plant Functional Traits in Structuring Epiphytic and Terrestrial Fern Communities**

Project Summary:

During this summer, our research consisted of two different projects: the first was focused on cycad physiology and the other centered around fern reproduction. The initial piece to our research consisted of two weeks of field work in Coral Gables, Florida at the Montgomery Botanical Garden. The Montgomery Botanical Garden has the largest collection of cycads in the United States and one of the largest in the world, making it a beautiful and coveted place for researchers. At the garden we collaborated with Chris Krieg, a 2015 Colgate graduate and a PhD candidate at the University of Florida, to collect data on cycads, a group of plants whose biology is poorly understood. Our team consisted of postdoctoral fellow Courtney Campany (Colgate University) and undergraduate Zack Zeller (University of Florida), and our goal was to collect data on the majority of cycad species in the garden collection. Cycads are one of the most phylogenetically basal seed plant lineages and is composed of some of the most endangered plant species on the planet. Little is known about their physiology; therefore, the information we will receive from this study will be important in the study of cycads and will likely influence their conservation.

During our time on the project, we collected and processed leaf samples from many different cycad species measuring leaf area and mass as well as xylem samples to understand physiological similarities in hydraulic function between different species. We measured the gas exchange (photosynthesis and respiration) in the leaves of over 1000 individual plants from dozens of species to understand similarities in photosynthesis rates. To do this, we used the LI-COR LI-6400XT, which allowed us to manipulate abiotic factors such as light and CO2 concentration.

After these two weeks, we brought the samples back to campus for future analysis and shifted projects to ferns. For this project we were interested in fern sperm physiology, specifically how pH impacts sperm longevity and velocity. To do this, we placed gametophytes on a depression slides, added 15 mL of a specific pH solution, and recorded videos at the point where sperm were released. We then used LoggerPro software to track the sperm and calculate their velocities. This work largely focused on comparative physiology of epiphytic and terrestrial ferns. Epiphytic ferns thrive in an environment that is slightly more acidic than terrestrial ferns; therefore, the effects of pH on the sperm of both types of ferns could reveal important aspects of how these species partition their niche space.

Source of Support: ☐ AHUM Div. ☒ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Science and Math Initiative-SMI (NASC Division)

Research Fellow: Jolene Patrina (2019) **Concentration: History**

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

Title of Project: Oneida County History Center: The Mohawk Valley in the Great War

Project Summary:

This summer I had the wonderful opportunity to work at the Oneida County History Center (OCHC) through the Upstate Institute Field School. OCHC works to collect, preserve and make available the history of Oneida County and the Upper Mohawk Valley. This nonprofit organization, located in an old Christian Science church, houses a research library, a 5,000 sq. ft. exhibit space, and thousands of collections including artifacts, manuscripts, artwork, and more. With many of these materials, I created an exhibit titled "World War I Centennial: Oneida County and New York in the Great War," commemorating the 100th anniversary of the United States' entry into the first World War by focusing on the American experience and local history of the war. Exhibits are usually up for two years or more; OCHC currently contains six exhibits of all different sizes on local history, all of which are open to the public.

OCHC serves the local community in preserving and exhibiting a wide variety of local history. It is often difficult to complete this mission as both archival and exhibit work is largely completed on a volunteer basis, and there is only one full-time employee, Brian Howard, who rarely has time to work on curation.

This summer I curated a large portion of the exhibit space with my World War I project, which will help OCHC in its goal of sharing local history and attracting visitors. Specifically, I looked through the OCHC's manuscripts and artifacts pertaining to World War I, conceptualized an exhibit from these items, and designed and implemented the exhibit. This process involved working closely with artifacts, such as military uniforms, weapons, gear, and technology, all of which were over a century old and very delicate. Similarly, I worked with fragile documents such as posters, photographs, and newspapers, and often had to encapsulate (i.e. laminate by hand) many of these items. This work culminated in my exhibit that includes topics such as New York's efforts to fund the war and conserve resources, technological innovation and its impacts, women in the war, and certain Uticans' experiences during the war. Ultimately, this exhibit will help to preserve and present local history in an interesting and comprehensible way to the surrounding community, and hopefully attract more visitors to OCHC.

My first summer as a Field School Fellow has been both educational and exciting, as I was given the opportunity to create something substantial largely on my own, and was able to contribute to both preserving and making accessible local history. This project enabled me to work hands-on with fascinating materials and added a meaningful component to my studies as a History major. Furthermore, I was introduced to curation, work that I have never done before but am now extremely interested in pursuing as a career. In addition to my wonderful experience with curation, working in Utica allowed me to connect with a local community that I otherwise would not have encountered, and added depth to my understanding of and appreciation for Upstate New York and the local communities it fosters. Ultimately, I have gained invaluable experience in both history and curation, while also forming connections with and learning about the local community.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Upstate Institute

Research Fellow: Liam Peng (2020) **Concentration: Computer Science**

Faculty Mentor: Madeline E. Smith **Department: Computer Science**

Title of Project: Eye Tracking Based Nystagmus Compensating System

Project Summary:

My project over the summer was to determine the viability of a system that uses real time eye tracking to move a display on a screen to match the involuntary eye movements caused by Nystagmus with the hope of creating a still image for the user. Nystagmus is a visual condition that affects between 1 in 1000 and 1 in 3,000 people, it is characterized by rapid, uncontrolled, and repetitive eye movements, usually negatively affecting visual acuity and depth perception. The two most common types are infantile, the individual was born with the condition and is not conscious of the movement although it still has the same negative effects on vision, and acquired, the individual acquired the condition later in life and is conscious of the movement. The eye movements can be vertical, horizontal, or rotary (in a circular motion). The waveforms created by the movement can either be jerk or pendular. Jerk Nystagmus is characterized by a slow drift away from where the user is trying to look (slow phase), followed by a fast re-foveating eye movement back to where the user is trying to look (fast phase)(Figure 1). Pendular Nystagmus is characterized by a sinusoidal back and forth eye movement with foveation usually occurring at one end of the pattern (Figure 2).

I started by conducting a literature review to learn more about Nystagmus and to find similar research. Specifically I looked for information about Nystagmus waveforms and foveation periods within those waveforms. This is important because in order to calibrate an eye tracker to a user with Nystagmus, the program must know where the user is trying to look.

I met with Dr. Jonathan B. Jacobs at the Daroff-Dell'Osso Ocular Motility Laboratory at Case Western Reserve University in Cleveland to discuss the potential benefits and limitations of the project from a neurological perspective and learned how to get good eye data from individuals with Nystagmus. I also attended the American Nystagmus Network's Regional Gathering in St. Louis to discuss with people with Nystagmus, the potential usefulness of a device like this.

I started by attempting to test the basic concept that moving an image along with the eyes of someone with infantile Nystagmus will allow the individual to see with greater visual acuity. The experiment involves the subject looking at a letter on a screen, with one eye covered, then the program moving the letter as a reaction to the movement of the eyes in order to have the individual always looking at the letter. I attempted to test the experiment on myself using the EyeLink 1000, however, the software did not allow a custom calibration that is needed to calibrate to eyes with Nystagmus. To compensate for this I moved to a Pupil Labs eye tracker. The prototype is run on a macbook pro with a Pupil Labs eye tracking headset attached. The program uses a custom calibration plugin, written in Python, to calibrate, then, while the letter is being displayed, data is sent to and analyzed in real time in Matlab. The display is created and adjusted using Psychtoolbox. The testing on myself was inconclusive, sometimes I felt it improved visual acuity, other times I did not. I plan on testing this prototype on other individuals with Nystagmus.

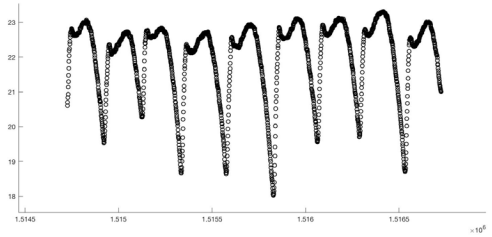


Figure 1. Jerk Nystagmus waveform collected using Eyelink 1000 and created in Matlab, each dot represents 1/1000th sec. time on x axis, position on y axis.

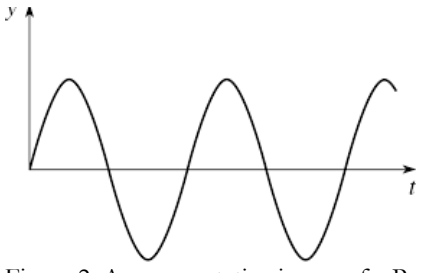


Figure 2. A representative image of a Pendular Nystagmus waveform, time on x axis, position on y axis.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Holden Endowment Fund

Research Fellow: Madison Perez (2019) **Concentration: Environmental Biology**

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

Title of Project: Assessing the Effectiveness of the Adirondack Center for Loon Conservation's Educational Exhibits, Outreach, and Donor Satisfaction

Project Summary:

The mission of the Adirondack Center for Loon Conservation is to promote the conservation of the Common Loon in and beyond New York's Adirondack Park. This organization seeks to fulfill this mission through independent research and outreach to visitors from its location in Saranac Lake, New York. From this location the center manages a storefront, exhibit space, and a center of operations for field staff conducting research in the Adirondack Park. The store front and exhibit space address the local community and seasonal visitors by offering loon-themed merchandise, local art, and educational displays to educate the public at large about loon biology, migration patterns, and dangers to the species as a whole. In the realm of academics, the center also conducts loon banding and mercury testing, and releases publications of their findings for the broader scientific community.

While the purpose of this partnership was initially to assess visitor satisfaction by means of surveys, my position has shifted into creating educational displays, interacting with visitors as an educator, and participating in field work. I have participated in the annual loon banding process as a spotter, aided in the rescue of loons entangled in fishing line, and have been assigned territory with mated pairs to monitor on a weekly basis. Additionally, I have designed educational displays to be shown within the center, created brochures for events, and worked as an educator, answering any questions they may have about loon biology or our efforts as an organization.

Working with the Adirondack Center for Loon Conservation has been a valuable experience in my academic career. This fellowship has filled in gaps that I have perceived in Colgate's education regarding field work, particularly centered around working with animals and other environmental organizations toward a common goal. While the purely academic nature of a Colgate education is inherently valuable, I find myself grateful to be able to work in a more hands on fashion and access alternative forms of education accessible only through working in a hands-on capacity.

The most important piece of knowledge I have gained is the power a community has on the work of an organization such as this. Every day visitors come in and tell us how much they love loons, relaying stories of their experience and supporting local artists who create beautiful works of art of an animal they love. Every visitor who enters the store, loon lover or not, leaves with a greater love of this sentinel of the Adirondacks. Without the support from the local community, the Adirondack Center for Loon Conservation would not exist, nor would it do all the important conservation work within the Adirondack Park.

Through this experience, I have rekindled my love of field work and reaching out to the community through a love of animals. By experiencing the ups and downs of working for a nonprofit, I have learned what I want out of a future career. This is of incredible importance to me: as a member of the class of 2019 I need to quickly learn what I wish to do after graduation. Through my work I have become more confident in what I wish to do in the future and gained valuable contacts for my future and a rekindled love of animals and spreading that love to anyone willing to accept it.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Upstate Institute

Research Fellow: John Pham (2020) **Concentration(s): Mathematics; Chemistry**

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

Title of Project: Ruthenium Catalysts for Ester Hydrogenation

Project Summary:

Over the summer, under Professor Chianese's guidance, I synthesized a newer Ru-CNN pincer catalyst for the Chianese lab and experimented with this catalyst in order to better understand the mechanism for ester hydrogenation. In previous years, the Chianese lab developed and worked with CNN-pincer ruthenium catalysts including Ru-dipp-iPr and Ru-dipp-Et. This summer, I worked on the Ru-dipp-Me CNN-pincer.

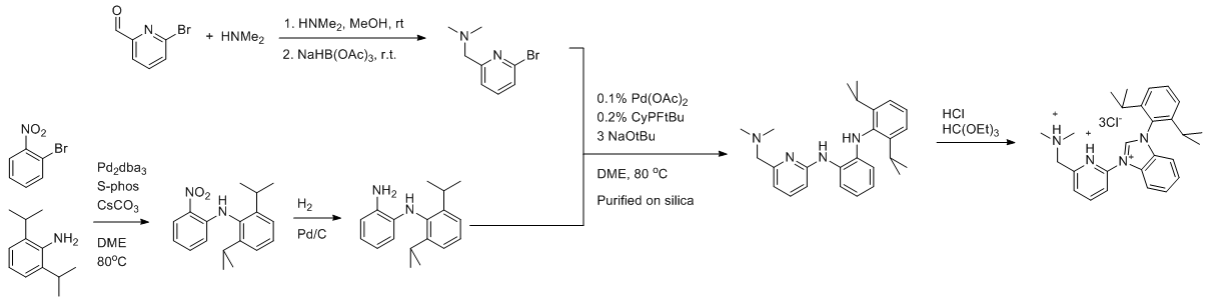


Figure 1. Synthesis of Ru-dipp-Me

In synthesizing this CNN-pincer ruthenium catalyst, as shown above, methods such as reductive amination of an aldehyde, arylation, and palladium catalyzed hydrogenation were used on the starting material. The two products formed then underwent palladium catalyzed coupling. The third step in the synthesis involved the cyclization of the molecule.

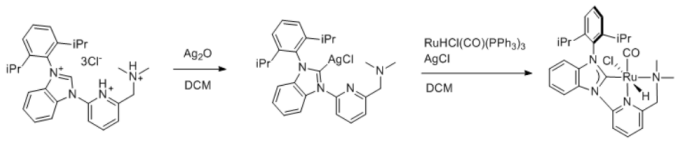


Figure 2. Synthesis of Ru-dipp-Me

A base was then applied and a transmetalation reaction was performed where the silver was replaced by a ruthenium carbene and the Ru-CNN pincer catalyst was formed. NMR spectroscopy was used to identify the desired product along each step and to assure that no unwanted byproducts formed.

After synthesizing Ru-dipp-Me, tests with different substrates, as well as different loadings and temperatures, were done using this CNN pincer catalyst. However, some of these experiments resulted in with NMR data that was unable to identify or interpret the product, or several other byproducts that would form and the desired product not able to be isolated. This catalyst should continue to be studied in the future in order to further understand the mechanism of ester hydrogenation.

Source of Support: ☐ AHUM Div. ☒ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☐ Other (specify):

Research Fellow: Annina "Anna" Pluff (2020) **Concentration: History**

Faculty Mentor: Raymond "Ray" Douglas **Department: History**

Title of Project: Re-education Camps in Postwar Vietnam: Understanding Lines of Internment

Project Summary:

In 1975 after the fall of Saigon, the Communist forces of North Vietnam completed their conquest of South Vietnam and the Vietnam War drew to a close. The new regime sought to recreate Vietnam as a unitary socialist state. The Communists saw any forms of political opposition as one of the most significant barriers to this goal. To diminish this threat, the Communist Party of Vietnam (CPV) set about purging the old order. The purge was carried out by means of a network of re-education camps, aiming at *cai tao*, or thought-reform. Under the Lampert Institute for Civic and Global Affairs, my project involved gaining a broadened perspective on the context in which re-education camps developed in post-war Vietnam as well as an understanding of the political and social implications of camp development.

This archival-based research project was conducted at the Vietnam Center and Archives at Texas Tech University in order to examine the camp structures and overall camp life. The use of extensive archival research sought to gain greater insight into Communist regime that emerged in Vietnam. To fully evaluate the extent of Communist control within the camp context, the research required specific attention to prisoner -guard relations, a phenomenon that in many ways mimics the power structures of postwar Vietnam. This research not only gained greater insight into the context in which these camps developed, but also to achieved a better understanding the psychological relations that emerged between inmates and guards. How this relationship conformed or retaliated against camp expectations was an interesting aspect of the study. After spending five weeks in the archives, the rest of the summer was spent supplementing this research with secondary literature and memoirs of former prisoners.

The research was dependent upon extensive organization and analysis of archival materials, which mostly ranged from newspapers, unclassified reports from both Vietnam (translated) and the United States, reports from humanitarian agencies, pamphlets, and journals. The use of these sources worked to evaluate the paper's central question: To what extent did Vietnamese re-education camps achieve—or were intended to achieve—their stated purpose, in contrast to serving as carceral facilities to separate "dangerous" elements from the social and political experiment in which the new Communist régime was engaged? While there is no debate that the camps were never truly established as humanitarian measures, as advertised, the attempts at separation hardly yielded greater control.

However this does not imply that camp life was not arduous and demoralizing. Military authority seeped into every aspect of camp life and became excruciatingly difficult to endure, both physically and psychologically. This authority was established through a variety of methods that included variations in the supply of food rations, taunts, rhetoric, torture, and the manipulation of truth. The most interesting aspect of the prisoner-guard relationship was how these methods were used to wage a psychological battle between the prisoners and the cadres—a dynamic that can be clearly seen in the examination of interactions between internees and guards at numerous camp sites. Further research revealed the complicated dynamics between a life of internment that existed within the camps and the life of internment "without fences" that existed in the larger Vietnamese society. Under the CPV many South Vietnamese were forcibly sent to New Economic Zones (NEZ) where they often perished without a means of escape. The larger reflections of camp life in society became a disturbing connection that emerged from this research.

The research culminated in a 13,000-word paper that further detailed these findings, along with others, and the fellowship culminates in a research symposium with other Lampert Fellows to share our summer projects.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Lampert Institute for Civic and Global Affairs

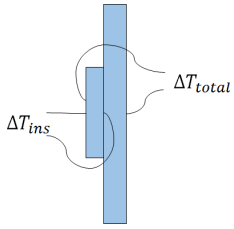
Research Fellow: Cheeranjeev Purmessur (2020) **Concentration: Physics**

Faculty Mentor: Beth Parks **Department: Physics and Astronomy**

Title of Project: Measuring Building Insulation

Project Summary:

Building insulation is important to energy conservation, but most owners do not know the insulation levels in their buildings. Insulation levels can be estimated by an energy auditor, but very few people hire one. This research ultimately aims to create an inexpensive device that can accurately measure the insulation levels of buildings, which could help owners conserve energy.



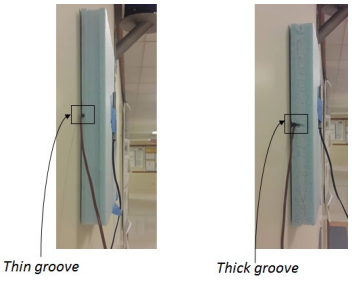
Insulation square placed against a

Our insulation measurement device makes use of an insulation square with a known R-value (insulation level) that is placed against a wall. Temperature differences between the sides of the insulation are measured, and the R-value can be calculated using: $R_{total} = \Delta T_{total} R_{ins} / \Delta T_{ins}$

When the device was tested on a house it gave a higher R-value than expected. Our goal for the summer was to understand this problem, and we began by identifying different possible causes for this behavior. The main issue had to do with the non-zero thickness of the thermocouple wire that is used to measure temperature differences. Ideally, we would like to fit the thermocouple wire exactly in between the square and the wall but this is not possible because of this non-zero thickness.

Experiment 1

We carve out a groove from the square to accommodate the thermocouple wire. Experiment 1 explores the possibility that the depth of the groove might influence the ratio of the temperature differences and hence on our measured R-value. In this experiment, we used two insulation squares of the same dimensions but with different groove depths. We put both squares next to each other on a wall and measured the R-value of the wall using the two different squares. The results on average gave almost the same R-value for the wall with both the shallow and deep groove, meaning that the depth of the groove does not influence the measured R-value. This makes sense because the groove consists of trapped air and this air has around the same R-value as that of the square.



Setup for Experiment 1 with a differently sized groove on each square

Experiment 2

Next, we tested for the position of the thermocouple. We used two squares for this experiment. One square had a groove and the other did not; instead, for that square, the groove was made on the wall. When placed inside the groove, the thermocouple is displaced by around 1-2 mm from the point where the square meets the wall. This represents 8-16% of the width of the square. We hence have one square with the thermocouple 8-16% closer inside the square and another square with the thermocouple 8-16% further away from the square. The results show that the ratio of the temperature differences for the square with the groove is 10 % greater than our expected value and for the square, without the groove, it is 13 % less. This makes sense since for the square with groove we take the temperature difference across a smaller thickness, ΔT_{ins} is smaller, making $\Delta T_{total}/\Delta T_{ins}$ larger and similarly for the square without the groove ΔT_{ins} is larger hence $\Delta T_{total}/\Delta T_{ins}$ is smaller.

Improvements

From the results, if the thermocouple is not properly centered we obtain inaccurate measurements for the R-value. To improve on the position of the thermocouple we attached the thermocouple to a metal plate and inserted the plate between the square and the wall. In this way, the metal plate is in the right position and conducts heat onto the thermocouple. Initial tests show that this method significantly increases our accuracy to around 3 % off the expected value. This is sufficient for the level of accuracy we want in the device. The outcome of our project has brought us one step closer to our final product but there are still more tests to be conducted on the house with this particular set up to confirm the device's accuracy and reliability.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Justus '43 and Jayne Schlichting Student Research Fund

Research Fellow: Yingsi Qin (2020) **Concentration: Physics**

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

Title of Project: Singularities in Optical Beams

Project Summary:

Our research studies helically phased beams that carry orbital angular momentum. Unlike normal beams that we see in our daily lives, these beams do not diffract for a certain distance; we call them the orbital angular momentum (OAM) beams that are propagation-invariant beams.

OAM beams travel with helical phases and their transverse shapes and magnitudes remain constant for $z < z_{max}$ (figure 1) [1]. This non-diffracting property makes OAM beam a very useful tool in data transmission, information processing, optical imaging, optical tweezer, medical imaging and surgery, and laser machining etc. Research done on these beams alone involves theoretically deriving the functions for their electromagnetic wave fields, computationally visualizing their behavior, experimentally generalizing their phase and amplitude, and engineering interference patterns. The Bessel beam as a symbolic representation of OAM beams has been thoroughly studied. In our research, we aimed to study the Mathieu beam and the Pendulum beam, computationally visualize their behaviors, and experimentally manipulate them.

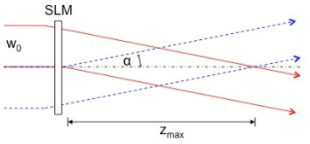


Figure 1.

In our experimental setup (figure 2), we expanded a laser beam and cropped out the top of its Gaussian profile to a Hamamatsu's programmable spatial light modulator (SLM). We programmed the SLM using MATLAB to generate the OAM beam upon reflection, which we then sent through a 4f lensing system and to a sliding camera along the z-axis.

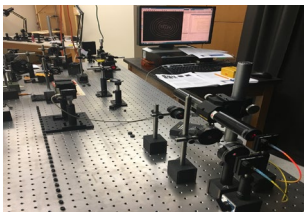


Figure 2.

We tested our setup by experimentally generating the Bessel beam, whose intensity profile picture is shown in figure 3. Bessel beam is the solution of the Helmholtz wave equation expressed in circular cylindrical coordinates. Then we studied the Mathieu Beam, which is the elliptical solution to the Helmholtz wave equation. They occur in applications involving elliptic geometries and in problems involving periodic motion, such as the mechanics of the quantum pendulum. The Mathieu function comes in two parts: the angular and the radial, with four different combinations (classes) of even and odd orders. The radial solution can be expressed as a sum of Bessel functions. The computationally visualized amplitude and phase of a Mathieu beam are shown in figure 4 and 5. Figure 6 shows the intensity profile picture of a Mathieu beam that we experimentally generated, and figure 7 shows the Fourier transform of the Mathieu beam in figure 6.

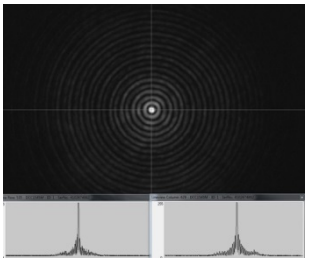


Figure 3.

Moving on from the Mathieu beam, we studied the pendulum beam, which is an adapted version of the Mathieu beam in higher orders of q. The quantum pendulum eigenfunctions are given by Mathieu functions in azimuth [2]. The pendulum beam exhibits three different regimes of motion of the quantum pendulum: rotational motion, vibration motion, and an asymptotic approach to a single angular deflection of 2pi. The solution to the Schrödinger equation admits an exact solution using one class of Mathieu functions. By manipulating the Mathieu beam using our MATLAB program, we generated the Pendulum beams.

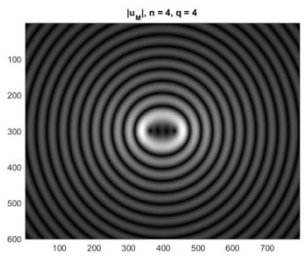


Figure 4.

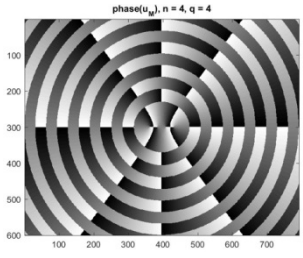


Figure 5.

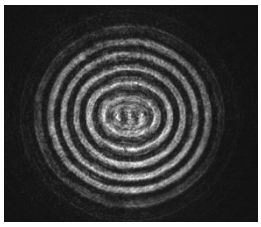


Figure 6.

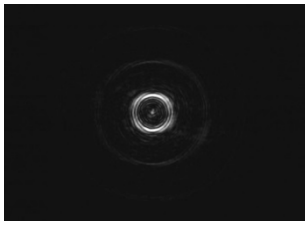


Figure 7.

[1] E.J. Galvez, "Complex Light Beams," pp 34.
[2] Mark R. Dennis, "Propagation-invariant beams with quantum pendulum spectra: from Bessel beams to Gaussian beam-beams", July 30, 2013

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): National Science Foundation Grant

Research Fellow: Nicholas Quinn (2020) **Concentration: Geography**

Faculty Mentor(s): Heather Kropp **Department: Geography**
Michael "Mike" Loranty **Department: Geography**

Title of Project: Investigating the Relationship Between Leaf Temperature and Water Stress in Local Shrub Populations

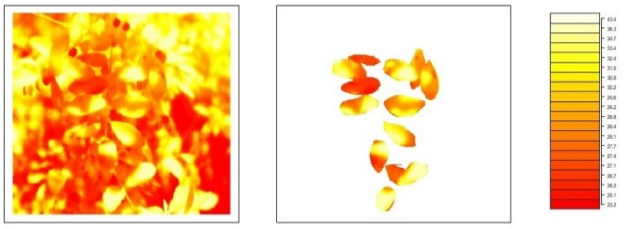
Project Summary:

Studying the relationship of photosynthetic activity has been a primary focus of ecologists across the country. Plant leaves convert incoming solar radiation into energy, through the process of photosynthesis. As leaves absorb sunlight, they also convert Carbon Dioxide to diatomic Oxygen and release water vapor. Two products of this reaction, Oxygen gas and water vapor, must be released by the plant back into the atmosphere. In order to do so, plants open and close myopic pores on their leaves known as stomata. Scientists have discovered that through studying the rate of stomatal opening and closure, also known as stomatal conductance, the rate of photosynthesis can be discovered due to the requisite emissions of water vapor and oxygen gas. As the stomata release water vapor, the temperature of the leaf falls. This is due to, in part, the water vapor cooling down the surface of the leaf. Thus, through discovering the temperature of plant leaves, the photosynthetic rate can be calculated through complicated equations.

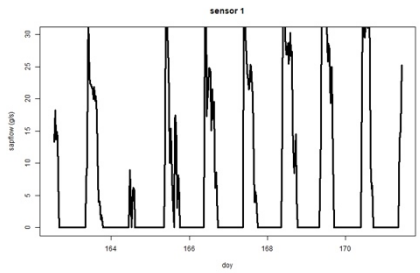
This summer, over the course of 10 weeks, this relationship was analyzed through thermal imaging, aerial thermal imaging via drone flights, and measuring sap flow on 5 different branches of honeysuckle bushes located at the Bewkes Reserve. Sap flow measures the amount of water moving through a plant at a given time. Given the amount of water flowing through a plant directly corresponds to the amount of water being released by a plant, sap flow is a useful measurement to verify the calculated stomatal conductance. Through utilizing a thermal camera fixed to a drone, and ground level thermal images, leaf temperature was obtained and calculated to discover the rate of stomatal conductance. Utilizing sap flow measurements then added a layer of triangulation to the data, allowing for a relationship between sap flow and temperature to be obtained. This research found a tight coupling of temperature and sap flow data on one occasion, yet this link was not verified on a second test date. The second test date's lack of coupling may have resulted from distorted leaf temperatures due to the presence of liquid water, and hysteresis, a time lapse between stomatal conductance and sap flow due to factors such as water stress, and meteorological conditions. More research will continue this fall to better establish reasons for error in this research.

A large part of this research involved establishing methods for aerial thermal photography. Utilizing a DJI Phantom 4 Advanced and FLIR Duo R thermal camera, the photography was able to be achieved. Through the help of colleagues at University of Alaska, Fairbanks, a new mount was created utilizing a custom-fitted steel plate which was then attached via zip-tie to the back of the drone. Removed from all sensors, this attachment successfully allowed for thermal imaging to take place at 1 second intervals. However, due to the low resolution of the camera, ground level photographs taken at 15 minute intervals proved more useful to compare temperature data to sap flow measurements, which were aggregated into 30 minute intervals (bottom right). Utilizing this temperature data proved useful in calculating stomatal conductance, which was corroborated by Sap Flow data.

In order to collect accurate measurements of leaf temperature, ground level photographs were processed using ImageJ, a photo-editing software. Within this software, individual leaves were highlighted in order to obtain exclusive temperature data from the leaves, and not incorrect measurements of air temperature (bottom left). Given photographs contained data from several leaves, each leaf was highlighted and the various temperatures were averaged in order to obtain a more comprehensive stomatal conductance of each branch. These stomatal conductance values were then used to identify a coupled relationship between sap flow and leaf temperature.



Ground level thermal image taken with TIM thermal camera (left) and the output of ImageJ selection (right)



Example sap flow data, created utilizing an R Script, highlights the changing nature of water content within a branch due to the vapor pressure deficit and water stress

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☒ SOSC Div. ☐ UNST Div.
☐ Other (specify):

Research Fellow: Ashlea Raemer (2018) **Concentration(s): Environmental Studies; Biology**

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

Title of Project: Wildlife Conservation Society: Climate- and Wildlife-Friendly Farming in the Adirondacks

Project Summary:

This summer worked with the Wildlife Conservation Society's Adirondack Program in Saranac Lake, New York through the Upstate Institute Summer Field School to promote wildlife-friendly farming practices in the Adirondack Park. The Wildlife Conservation Society is an international non-profit originally founded in 1895 as the New York Zoological Society. Today they are perhaps most known for the Bronx Zoo, but their mission to protect wildlife and wild places is implemented in priority regions across the globe. In the Adirondacks, WCS uses applied science and community-based conservation to link wildlife, wilderness, and human well-being through an interdisciplinary approach.

The WCS Adirondack Program was started in 1994 in recognition of the region's particular ecological significance. The Adirondack Park contains the southern reaches of boreal habitat, some of the largest intact temperate forests in the world, headwaters for five major watersheds, nationally-significant water resources, and Northern Forest biodiversity. WCS works within the Adirondack Park's unique conservation model that creates a patchwork of public and private lands. Historically, there has been conflict between conservation and economic development within the park. WCS Adirondack Program has worked to overcome this conflict and promote conservation by embedding themselves within the community through partnerships with local municipalities, state agencies, economic development groups, NGOs, land and wildlife managers, and recreational interest groups. WCS has built a reputation for being a source of objective information and applied science to guide management decisions in the park. Some of their current focus areas include community-based conservation, climate change, and wildlife connectivity in the Adirondacks.

This summer I worked with a team of interns on WCS' wildlife-friendly farming initiative, which is part of their focus on promoting wildlife conservation and connectivity on private lands within the Adirondack Park. One of our first projects was to define wildlife-friendly farming and characterize it with a set of specific practices. We divided these practices into strategies that create or retain habitat for wildlife species, and strategies for managing farm-wildlife conflict in a non-lethal manner. I worked to turn this list of practices into an evaluative framework for determining whether and to what extent a farm can be considered "wildlife-friendly." I then chose a set of farms that are doing particularly well at being wildlife-friendly as model farms for this initiative. My goal was to develop a document that communicates model farm practices in a way that can be used by other farmers as a guide for implementation. The wildlife-friendly farming project is an extension of a previous initiative focusing on promoting wildlife-connectivity in community planning and residential development. Each of these initiatives works to incorporate wildlife conservation into private land use within the Adirondack Park, which is important for the connectivity that benefits all species and is particularly necessary for wildlife, that are wide-ranging in their daily or yearly movements.

My work with WCS Adirondack Program marks my third summer with the Upstate Institute Summer Field School. I was initially drawn to the Upstate Institute because I was nearing the end of my second year at Colgate, still feeling disconnected from the surrounding community, and wanted to do something for the summer that would have a meaningful impact. I also looked forward to understanding how academic research could be leveraged to address a community's needs and goals. I have returned to the program (twice!) because I find community-based research to be a particularly fulfilling model that allows me to gain a deeper understanding of place, and see the tangible impacts of my work. In previous summers I have worked with Madison County Agriculture Economic Development on agritourism, and with the iServe Mohawk Valley program at Mohawk Valley Community College on food insecurity among students and among the greater Rome area. My project in this third summer allowed me to build upon lessons learned from previous projects while exploring the unique community character of the Adirondacks. I graduated from Colgate in May with a degree in Environmental Studies and Biology, and the combination of conservation science and food systems understanding required to complete my project with WCS provided an exciting opportunity to work at the intersection of these two fields.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Upstate Institute

Research Fellow: Lekshmi Rajagopal (2019) Concentration(s): Applied Math; Astronomy/Physics

Faculty Mentor: Thomas Balonek Department: Physics and Astronomy

Title of Project: Optical Variability of Quasars and Stars at the Colgate Observatory

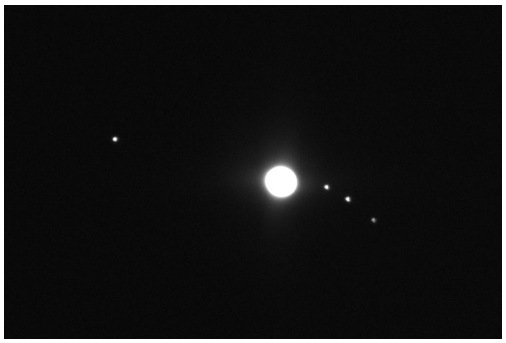
Project Summary:

Through years of observations, astronomers have deduced that a supermassive black hole exists at the center of most galaxies. Some of these have accretion disks with gaseous material falling into the black hole. As the gas falls into the black hole, huge amounts of energy are released in the form of electromagnetic radiation. Due to magnetic fields in the black hole, charged particles are also directed towards the poles and jets are observed being projected from the black hole. These jets have the ability to penetrate through entire galaxies. These systems are known as quasars.

My summer research project involved observing quasars such as 3C279, 1156+295, 1308+326, 1749+09, 3C345, OJ287, BLLac, amongst others. Observation was done between 9:30 pm and 4:30 am every clear night using the 16 inch telescope at the Foggy Bottom Observatory. We took 2 minute images of the quasars in sequences of 12 images and a dark and bias. A dark is an image taken without removing the cover on the telescope to zero the initial read out noise while a bias is an image taken with no exposure time in order to determine unwanted noise from the electronics. We also take an additional flat image every observing season which is an image taken of an area of the sky that is evenly illuminated to ensure that the lens is collecting light evenly. We use these three images; the dark, the bias and the flat, to calibrate our light images.

This summer we were not expecting any outbursts or any extraordinary activity from the quasars so we also dedicated time to observing some of the Jovian planets and their moons, using similar procedures. Because Saturn and Jupiter are both many times brighter than the quasars we observe, shorter exposure times were used for clearer images of the planets. However, we also included longer exposure times to allow us to see their respective moons.

We observed the four brightest Galilean moons of Jupiter: Io, Europa, Ganymede and Callisto. These have orbital periods of between 1.8 and 16.7 earth days, with Callisto's being the longest. By taking images over a couple weeks, we are able to see the orbit of these moons across the planet. On the right is a 0.1 second exposure of Jupiter showing the four Galilean moons.



In our observation of quasars, we usually observe in the R band using the red filter as this is the band that the quasars emit most radiation in. In addition to the red filter, we also used a methane filter to observe Jupiter and Saturn. As Saturn has a methane-rich atmosphere, we are able to clearly isolate the rings through a methane filter, as shown in the images below. The first image is taken through the R filter while the second image is using the methane filter.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Justus '43 and Jayne Schlichting Student Research Fund

Research Fellow(s): **Margaret "Maggie" Reed (2020)** **Concentration: Computer Science**
Abiy Tekle (2020) **Concentration: Computer Science**
Xianghong "Paul" Wu (2021) **Concentration: Computer Science**

Faculty Mentor: Madeline E. Smith **Department: Computer Science**

Title of Project: Design of a Smartwatch App for Long-Distance Affective Communication

Project Summary:

The goal of our summer research project was to make an app that facilitates long distance communication in a new way, in order to enhance closeness and convey emotion to support long-distance interpersonal relationship maintenance. Over the course of the summer, the app changed shape and direction several times, but we settled on an app in which two users can remotely update a drawing board simultaneously. This could be used as a notepad or for doodles, or any way that the user sees fit. The research we did brought us through a multitude of stages, including the initial brainstorming, a literature review period, interviewing, low fidelity prototyping, more interviewing, high fidelity prototyping, writing the code for the app, and eventually coming out with a version one for our app.

Figure 1: Logo

When we started this project, we had very little in terms of specifications for what we wanted to design. Because of this, we spent the first portion of the summer brainstorming both individually and as a team about what potential features we were going to implement. The literature review period that followed gave us a lot of information about topics ranging from emotions that are shared over long distance and how those are facilitated to what apps already exist and how they are used. Based on this review, we came up with a series of interview questions to ask potential users of our app about how they prefer to communicate over distance to see what might be lacking, or what is effective versus ineffective. Upon being granted IRB approval, we held the interviews, and used that information to specify our aim.

The prototyping for this app included many phases. To start, we drew prototypes (Figure 2) based on what we thought a final app could look like and what it might include. After getting feedback on those, we made more streamlined prototypes using Figma, an interactive prototyping site. After more feedback, we made a final prototype that was a paper replica of what we wanted to have as a final piece. After this process was complete, we were able to spend the remaining weeks actually writing the code for this app in Xcode.

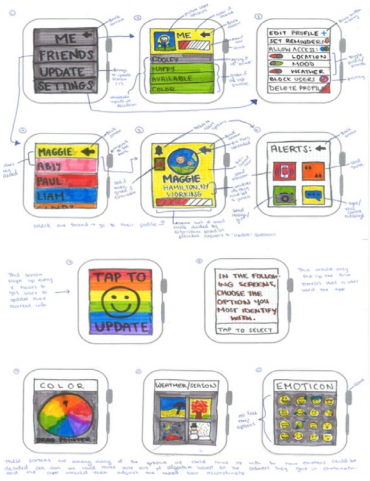


Figure 2: Paper prototype

We were able to complete a prototype app with basic functions of the proposed product. We used Xcode as the development environment and wrote the code in swift. In order for our app to function, we also needed a database to store the user data. We created a MySQL database on our Linux server and wrote the server-side application in PHP.

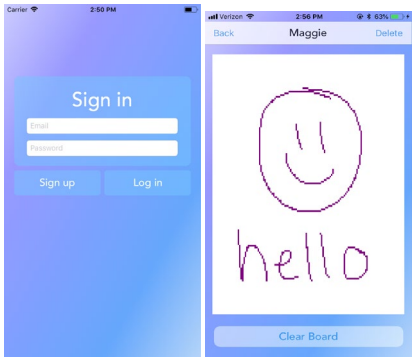


Figure 3: Sample screens

We have a few more steps left to implement for version one of our app. These are: optimizing the drawing board, adding a profile page for uploading pictures and editing personal information, creating a notification bar for new messages, and verifying an email address before you register a new account. We are planning to work on these tasks during our part time over the semester.

In our research this summer, we used Blogger, GitHub, Figma, PaperPile, Xcode and Adobe Illustrator. We also learned how to program in Swift, how to salt and hash passwords to create a secure app, and how to create a database and store information on a server.

Source of Support: ☐ AHUM Div. ☒ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☐ Other (specify):

Research Fellow: Kheytsun Rinchhen (2019) Concentration(s): Environmental Economics; GEOG

Faculty Mentor: Robert "Bob" Turner Department(s): Economics; Environmental Studies

Title of Project: Contingent Choice Surveys of American National Parks

Project Summary:

This summer, we worked with Professor Bob Turner from the Environmental Economics department to create contingent choice surveys relating to values for different park attributes of American National Parks. This type of survey is used for public goods and services that do not have an identifiable market, so as to get the benefits (in $) for the public good. Another goal for these surveys, although unlikely, was to determine if benefit transfers were justified, which would allow us to use the same findings (coefficients) from one park to another.

For the first half of the summer, we contacted park managers and examined information from a number of *General Management Plans* and *Environmental Assessment* reports published by Zion and Arches National Parks, which were selected for their similarity in topography, location, and management concerns. Through our research and our correspondences with current park management, we were able to narrow down the park attributes for both parks into six categories: 1) Wilderness Protection 2) Educational Efforts 3) Animal Species Protection 4) Plant Species Protection 5) Cultural Resource Preservation 6) Visitation. We then wrote concise descriptions with measurable units that identified the status quos for each park attribute to inform respondents before they participated in our choice experiment later in the survey. A tax description was added to learn about what the Marginal Willingness to Pay for the different attributes.

The survey itself was created using Qualtrics software and was divided by park. Qualtrics would control responses so that our respondents would represent the US population based on demographic information including gender, age, race/ethnicity, and educational attainment. The survey structure for each park consisted of attribute descriptions of current state and management goals regarding the 6 attributes. We added questions about *why* they think that attribute is important (which could be a combination of: because I use them, I want others to use them, I want to be able to use them in the future, or because I know they exist etc.) to get at whether they represent use, bequest, option, or existence values. Later in the choice experiment, survey respondents would be asked to select their most and least preferred combination of levels for each scenario. For example Scenario A could consist of 7% increase in acreage dedicated as wilderness, 15% decrease in educational programs, no change in animal species protection, 7% increase in cultural resources preserved in "good condition" and a $15 increase in tax contributions etc. Scenario A would be coupled with Scenario B and C, and different sets of scenarios were shown to respondents 12 times. By the end of the summer, we obtained 670 responses to our surveys. Data will be analyzed using a number of econometric techniques to learn about why people care for park attributes, and how much, in monetary terms. Similar surveys will be created for other NPS units like other National Parks as well as Battlegrounds.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☒ SOSC Div. ☐ UNST Div.
☐ Other (specify):

Research Fellow: Emily "Emmy" Ritchey (2020) **Concentration: English**

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

Title of Project: Improving Administrative Processes and Strategic Planning at the Midtown Utica Community Center

Project Summary:

This summer, I had the opportunity to work as an intern at the Midtown Utica Community Center (MUCC) through the Upstate Institute Summer Field School. MUCC defines itself as "multicultural and refugee-friendly place that serves all" and provides cultural and educational programming and assistance to the refugee and low-income communities in the city of Utica, New York. MUCC was founded in 2014 after Chris Sunderlin noticed a gap in the services provided to the refugee community of Utica. While many resources are available to help the refugees who call Utica their new home, MUCC gives refugees a place to gather and continue their cultural practices and helps the community connect with other agencies for further assistance.

Because MUCC is a small non-profit that serves a large group of people, my work for them was quite broad over the summer. I updated their website, assisted in proposal writing for a Community Foundation publication, and created their spring/summer newsletter. The biggest portion of my time was spent helping prepare and run their summer programming. MUCC partnered with Oneida County's Summer Youth Employment Program to have youth workers from the community come in and work at MUCC while learning about effective leadership skills. I created a database of required documents for the youth workers and supervised a group of eleven high school students as they cleaned the grounds of MUCC. I also maintained a database of prospective campers and counselors for their summer camp and helped reach out to possible donors.

During my summer at MUCC, I have learned more than I could have imagined about Utica's refugee community. Before starting this internship, I only knew that Utica had a large refugee population and nothing more. According to the Mohawk Valley Resource Center for Refugees, the refugee resettlement agency in Utica and the surrounding area, over 15,000 refugees have been resettled here since 1981. Currently, foreign-born refugees constitute 17.6% of Utica's population, and 26% of the city speaks a language other than English at home. With a refugee population of this size, a space like MUCC is essential to serve the cultural needs of the different groups settled in Utica.

Aside from the numbers, I also have had the opportunity to experience first-hand how multicultural the city is. I visited a multicultural dress exhibit at Utica's Munson-Williams-Proctor Arts Institute curated by MUCC's executive director and board president, observing the dress of the Karen, Bhutanese-Nepali, Bosnian, Somali Bantu, and Sudanese refugees who frequent MUCC and donated to the exhibit. I also had the opportunity to visit two Buddhist temples and learn more about the religion that a significant percentage of Utica's refugees practice.

After attending Sophomore Connections in January, careers in common good piqued my interest. After hearing about the Upstate Institute at Colgate, I thought a Field School Fellowship would be the perfect way to explore my growing interests in nonprofits while getting to learn more about the region around Colgate. As a creative writing major, I enjoyed working on proposals and am interested in taking the Colgate grant writing course in the future. My experience as a Field School Fellow was an excellent introduction to the world of small nonprofits.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Upstate Institute

Research Fellow: Carolyn Robb (2020) **Concentration: Molecular Biology**

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

Title of Project: Molecular Analysis of Development in C. elegans

Project Summary:

My lab studied how varying concentrations of diethylstilbestrol (DES) exposure in the parent generation affected the fertility, locomotion behavior, metabolism, and gene expression across multiple generations in *C. elegans*. Diethylstilbestrol (DES) is a synthetic estrogen that was given to millions of women from the 1940s to the 70s to prevent miscarriage and other birthing complications but instead created various health problems such as reproductive abnormalities and cancers in mothers and their children, who are commonly referred to as "DES Daughters". There is limited knowledge on how DES affects the third-generation granddaughters. Previous research has shown that varying concentrations of DES exposure have significant effects in fertility and gene expression in *C. elegans*. *C. elegans* is an important model organism due to its 3-day life cycle, large brood sizes, convenient handling, and because 40% of its genes are conserved in humans. There has been limited study on the multigenerational effects of DES on *C. elegans*. Therefore, we decided to look at how varying concentrations of DES affect expression of specific genes across multiple generations in *C. elegans*.

In order to determine how varying concentrations of DES affect gene expression in *C. elegans* across multiple generations, we synchronized *C. elegans* via egg prep and placed them on agar plates with different DES concentrations (0, 0.5, 5, 10, 20, 30 uM) and *E. coli* as their food source. The Parental (P) generation of worms was the only group directly exposed to DES treatment while the F1 generation was exposed in utero. To measure gene expression, we extracted RNA from the worms of all DES concentrations and generations, used the Nanodrop to calculate the RNA concentration in each sample, performed cDNA synthesis, and set up qPCR reactions for the P, F1 and F2 generations to measure the expression of Egg-4, Mes-2, and Vit-1.

Egg-4 is an egg gene required for the egg-to-oocyte transition and embryonic development in *C. elegans*. Previous research has shown that in the presence of DES, Egg-4 is downregulated in *C. elegans*. In our experiment, Parental, F1, and F2 generations were measured for Egg-4 gene expression using qPCR and show a decrease in gene expression for the Parental generation and varying changes in gene expression for F1 and F2.

Mes-2 is an MES gene required for normal germline development and during larval development in *C. elegans* and is also a member of a Polycomb-like chromatin repressive complex. The effects of DES exposure on Mes-2 gene expression are unknown. In our experiment, Parental, F1, and F2 generations were measured for Mes-2 gene expression using qPCR and show a decrease in gene expression for the Parental generation, an increase in gene expression for the F1 generation, and varying changes in gene expression for the F2 generation.

Vit-1 is a yolk protein gene involved with lipid transporter activity. Previous research has shown that in the presence of DES, Vit-1 is downregulated in *C. elegans*. In our experiment, Parental, F1, and F2 generations were measured for Vit-1 gene expression using qPCR and show a decrease in gene expression for the Parental generation and varying changes in gene expression for F1 and F2.

In the future, we plan to continue to analyze gene expression of Egg-4, Mes-2, and Vit-1 in the F3 and F4 generations and at a wider variety of DES concentrations, investigate the mechanism by which DES interacts with estrogen receptors, and analyze gene expression of important microRNAs associated with development.

Source of Support: ☐ AHUM Div. ☒ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☐ Other (specify):

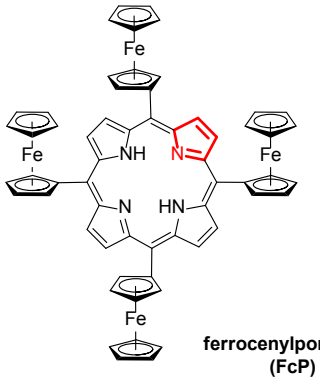
Research Fellow: Sara Robinson (2020) **Concentration: Chemistry**

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

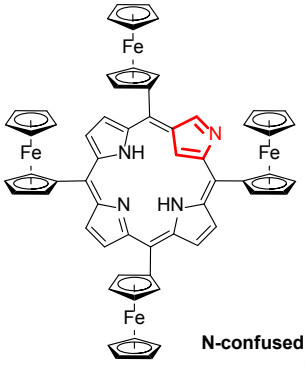
Title of Project: Investigation of the Synthesis of N-Confused Ferrocenylporphyrin

Project Summary:

Previous work by others found that porphyrin substituted with redox-active ferrocene groups has interesting electrochemical properties. Tetraferrocenylporphyrin (FcP) displays multiple, well-defined redox potentials indicative of electronic communication between the ferrocene substituents. This behavior can have applications in sensor technology and other industries. An isomer of this molecule, N-confused ferrocenylporphyrin (NC-FcP), differs by the orientation of one pyrrole ring (highlighted in red) which lowers the symmetry of the molecule relative to porphyrin. The effect of the lower symmetry on the redox properties of NC-FcP has yet to be investigated as the synthesis of the compound has not been reported. The goal of our work is to synthesize NC-FcP.

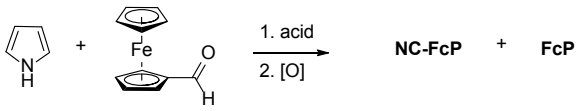


ferrocenylporphyrin (FcP)



N-confused ferrocenylporphyrin (NC-FcP)

A previous student in our group made a preliminary attempt to prepare NC-FcP using a procedure adapted from the published synthesis of an N-confused porphyrin with phenyl substituents. The student was able to isolate and characterize FcP from this reaction, but not the targeted NC-FcP. We began this summer verifying these results. This work was followed by a further survey of reactions conditions in an attempt to isolate some NC-FcP.



The choice of oxidant was one important parameter that we investigated. The mild oxidant p-chloranil is commonly used in the synthesis of ferrocenylporphyrinoids to prevent the oxidation of the ferrocene substituents. However, this oxidant is not convenient for analytical-scale reaction monitoring as heating for an hour or more is required. Thus, we examined the use of DDQ which is a rapid, room temperature oxidant. We found that DDQ is effective in the synthesis of FcP over a reasonable range of amounts, suggesting it may be suitable for the formation of NC-FcP. Next, we investigated different acid catalysts, acid concentrations, and reaction times via analytical-scale reactions with monitoring by thin-layer chromatography (TLC) and, in selected cases, UV-vis spectroscopy. We completed studies with two acid catalysts and we have one more remaining in our initial set of experiments. We observed FcP under a wide range of reaction conditions, but we have yet to identify a promising product with TLC and UV-vis properties consistent with those expected for NC-FcP. It remains to be determined whether the NC-FcP is not being produced or is not being identified.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Warren Anderson Fund

Research Fellow: Eric Roels (2021) **Concentration: Undeclared**

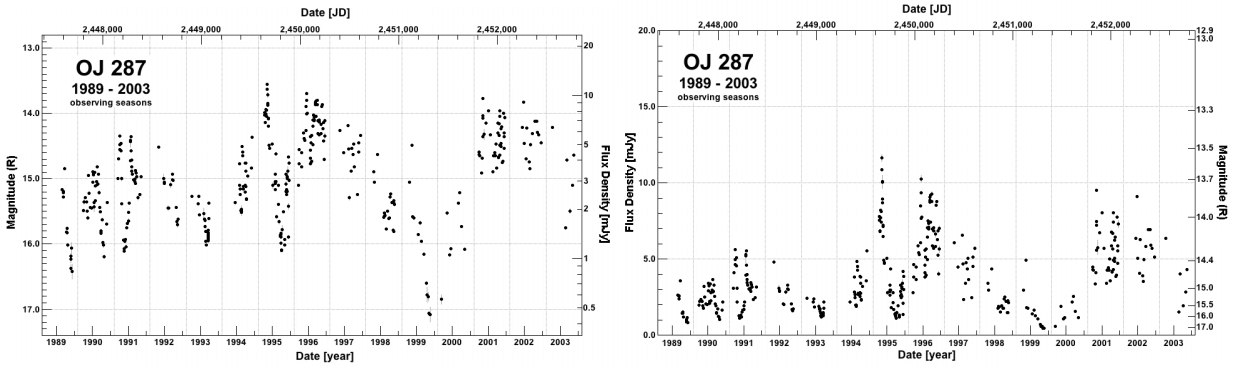
Faculty Mentor: Thomas Balonek **Department: Physics and Astronomy**

Title of Project: Long Term Variability of Blazar OJ 287

Project Summary:

This summer was spent adding to and analyzing the images collected on several different quasars using the 16-inch telescope and a mounted digital CCD camera at Foggy Bottom Observatory (FBO) in order to better understand and document their optically variable nature. A quasar is a type of active galactic nucleus, and is comprised of a black hole with a disk of gas spinning around it known as an accretion disk. The immense gravitational well created by the black hole spins the gas so quickly that the particles rub against one another, causing them to heat up and produce electromagnetic radiation in many wavelengths. In addition, the magnetic field of the quasar produces two large jets of charged particles along the axis of rotation of the accretion disk that radiate high-energy photons. Both of these phenomena produce an object that looks like any other star in our sky, despite being thousands of times farther away. A blazar is used to describe a highly-variable quasar, usually one whose jets are pointed towards Earth, like OJ 287. Quasars are known to vary in brightness over different timescales, from hours to years. I spent a lot of time going through the FBO archival data of OJ 287, now spanning 30 years from 1988 to 2018, and producing light curves of the data in order to better determine and understand how it varies in brightness on each of these timescales.

Graphs of the R-band filter data from OJ 287 were created using Kaleidagraph, which takes raw data tables and converts them into highly-customizable graphs with the use of a graphical user interface. I was able to produce graphs that include the entire 30-year light curve of the quasar, as well as yearly, weekly, and nightly graphs that show the microvariability characteristics of OJ 287. I plotted the data in two different ways, one displaying the brightness of the quasar in flux density (energy), the other showing the data in magnitude, a logarithmic scale of flux density. Flux density proved useful in highlighting and accentuating high-energy flares, while graphing magnitude preserved clarity in low-energy measurements, making it easier to identify variability. This is very important when studying microvariability, even when the quasar is faint. The difference between these two types of graphs is illustrated below, along with a second y-axis with separate scaling to help readers convert between the two measurements. I also included gridlines that display the "observing season" used by FBO, which begins and ends in early August of each year.



Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Justus '43 and Jayne Schlichting Student Research Fund

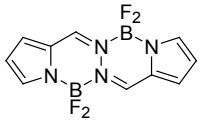
Research Fellow: Valerie Rome (2021) **Concentration: Biochemistry**

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

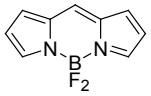
Title of Project: Investigation of Reaction Conditions for the Synthesis of BOPHY

Project Summary:

Fluorescent chromophores have broad applications in fields such as medical imaging and light harvesting. A new fluorescent chromophore named BOPHY was recently discovered by the Ziegler group that is structurally related to the well-known BODIPY fluorescent dye. However, the synthesis of BOPHY also produces a monoboronated product that can complicate the purification of the BOPHY. We are interested in refining the reaction conditions to decrease the amount of monoboronated product in the reaction mixture.

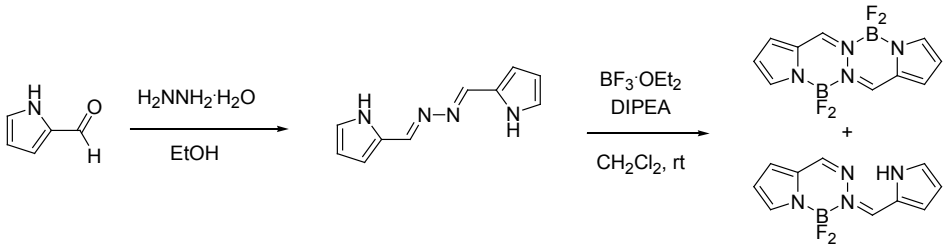


BOPHY



BODIPY

Previous students successfully prepared the pyrrole-diimine precursor to BOPHY, performed a small number of BOPHY syntheses observing a mixture of BOPHY and a monoboronated species, and developed an HPLC method for monitoring analytical-scale reactions for the distribution of BOPHY and monoboronated products.



The objective of the summer work was to systematically vary the amounts of $BF_3{\cdot}OEt_2$ and DIPEA to identify refined reaction conditions for the synthesis of BOPHY devoid of monoboronated byproduct. We began by repeating the preparation of the pyrrole-diimine precursor in a yield of 84% (0.82 g), and characterized the compound by ^{1}H-NMR spectroscopy and GC/MS. Next, we performed a series of control experiments to verify methodology developed by a previous student for monitoring analytical-scale reactions. We examined the individual steps associated with the sample preparation (quenching an aliquot in water and removal of polar impurities via elution through silica gel), and the reproducibility of the HPLC analysis (compound separation and peak areas). To correct HPLC peak area values due to differential absorption by BOPHY and the monoboronated compound in the UV-vis detector, we synthesized a sample containing a mixture of the two compounds, determined the ratio of the two compounds by ^{1}H-NMR spectroscopy, and determined the peak areas from HPLC analysis. A detector response factor was then calculated by comparing the compound ratio determined by ^{1}H-NMR spectroscopy to the ratio of the peak areas determined by HPLC. Finally, we have begun to systematically explore the effects of key reaction parameters on the amount of BOPHY and on the ratio of BOPHY to the monoboronated byproduct. Promising conditions have been identified that appear to provide a good yield of BOPHY accompanied by only a low level of the monoboronated compound.

Source of Support: ☐ AHUM Div. ☒ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☐ Other (specify):

Research Fellow: Michael Sakirsky (2021) **Concentration: Undeclared**

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

Title of Project: Molecular Analysis of Development in *C. elegans*

Project Summary:

This summer the Van Wynsberghe Lab researched the multigenerational effects of Diethylstilbestrol (DES) on physiological indicators of a terrestrial nematode species, *c. elegans*. DES is an endocrine disruptor that mimics endogenous estrogen. The drug was promoted by healthcare professionals as a fertility drug and eventually became administered as a supplement to women experiencing complications associated with pregnancy. However, the drug ended up causing much more problems than expected- particularly in the offspring of these "DES mothers". Children of DES mothers began to develop very peculiar deformities and tumor growth in their reproductive tracts. These devastating phenotypes proved that prenatal exposure to DES has clear effects on DES children. Our lab sought to emulate this situation by exposing *c. elegans* to DES at the parent generation and seeing how this effect carries out up to the F4 generation (DES was only exposed to the parent generation to observe potential epigenetic effects of the drug). *C. elegans* was the model organism of choice due to its 40% conserved genome, large brood size, and convenient handling.

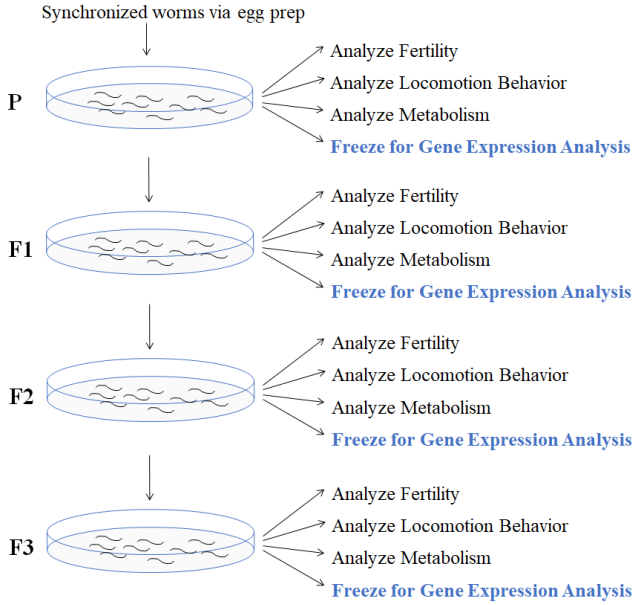


Figure 1. Schematic representation of various assays performed to analyze effect of DES on different physiological indicators in *c. elegans*. *C. elegans* were plated and grown on plates of varying concentrations of DES, but DES was only used at the parent generation. *C. elegans* were extracted from their culture and used for different assays as depicted by the diagram.

Assays were performed on *C. elegans* that tested fertility, growth (size), metabolism, locomotive behavior, and gene expression in response to varying DES concentrations, treated solely at the parent generation. My main focus for this research was metabolism. After harvesting the eggs of gravid adults ("egg prep" technique), 20-50 nematodes were situated into the wells of the 96 well plate. This was done for each generation. After the wells were filled, the plate would be loaded into the SeaHorse XF Respirometer and the machine would analyze metabolism with respect to Oxygen Consumption Rate (OCR). The results of the metabolism assay were variable- at some generations higher concentrations of DES would elicit a higher OCR, whereas the opposite could be true at other generations. Overall, effects of DES on metabolism would linger through more than one generation, but eventually the effects would be restored around the F3 generation.

Source of Support: ☐ AHUM Div. ☒ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☐ Other (specify):

Research Fellow: Leiya Salis (2019) **Concentration: Social Sciences**

Faculty Mentor: Sally Bonet **Department: Educational Studies**

Title of Project: What's in a Citizen? An Exploratory Study of the Effectiveness of England's Approach to Citizenship Education

Project Summary:

What does it mean to belong to a community? What does it mean to be a citizen, and what (or who) draws the boundaries of the definitions of citizenship and national belonging? Regardless of the fact that narratives surrounding belonging and community have become complicated through more nuanced understandings of the origins of social entities and personas like nation-states and citizens, fixed notions of citizenship and national belonging continue to persist globally. The citizen and nation-making projects of nation-states manifest in every aspect of the fabric of our society, from the seemingly mundane and banal ways in which we speak about our identities to the frameworks of our public and private institutions. At their core, our public and private institutions were "formed to realize particular societal values and...the constituent norms, beliefs, and regulations of particular institutions tended to derive from these core values" (Cummings, 1999, p.421). Theorists have argued that schools in particular are key sites for the nation building process, and are a space where multiple forms and forces of discourse operate in tandem with power to forge modern identities (Abu El-Haj et. al, 2017; Hall, 2004).

This qualitative study sets out to explore the ways in which nation and citizen making projects have been represented and embedded in the practices, ideologies and discourses in England's National Curriculum for Citizenship Education. This study dives into the ways in which the subject has been re-articulated over the years in response to changing social and political contexts of the nation. Through discourse analysis of the curriculums as well as the Department of Education's guidance documents on Fundamental British Values and the Prevent Duty against Terrorism, this study uses cultural productionism and feminist epistemologies as theoretical frameworks to unearth the hidden meanings and sensibilities that frame the citizen-making project and the notion of the "ideal citizen."

By interviewing three teachers and one teaching assistant from secondary schools of different types, this study is also able to understand the reality of implementing the curriculum in institutions with varying levels of and access to resources. Findings suggest that although the curriculum sets out to produce citizens who are socially, politically and economically conscious and savvy, in reality most schools do not have sufficient financial resources, trained teachers, specialist support and time to effectively teach the subject. The language used in the Department of Education's documents, when analyzed in relation to one another, reveals a curriculum that fails to be truly holistic, inclusive and socially and politically nuanced.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Lampert Institute for Civic and Global Affairs

Research Fellow: Sarah Sampson (2019) **Concentration: Molecular Biology**

Faculty Mentor: Geoffrey "Geoff" Holm **Department: Biology**

Title of Project: Mechanisms and Functional Consequences of Reovirus Innate Immune Responses

Project Summary:

Reovirus is a non-enveloped double stranded RNA virus that has 10 gene segments encoding 11 proteins. It is easy to manipulate in the laboratory, culturable, and is not particularly harmful to humans, which makes this virus an ideal model for research concerned with the mechanics of viral infection and host cell responses.

Cells respond to reovirus infection in a number of ways, but the two main responses include the upregulation of interferon to combat viral infection and the induction of apoptosis. Interferons are cytokines that provide the basis for a cell's innate immune response to viral infection. Interferons begin the cellular transition to an antiviral state by stimulating a specific selection of genes called interferon stimulated genes (ISGs), which vary by type and amount depending on the cell that is being infected. Many ISGs have yet to be discovered and the function of many others is unknown. It is known however, that not all ISGs have antiviral properties, so in keeping with this idea, a student in Professor Holm's lab last year ran a flow cytometry screen to identify some ISGs upregulated post-reovirus infection that were potentially antiviral in nature. The screen resulted in several promising candidates, three of which were called XAF1, C19, and ADAP2.

This summer, the goal of my project was to determine whether or not these three ISGs had antiviral effects on cells exposed to reovirus infection. This project began with the inclusion of these genes along with a GFP tag, a promoter, and an antibiotic resistance gene into separate plasmids. A control plasmid containing only the GFP tag, promoter, and antibiotic resistance gene was also created. These plasmids were then transfected into HEK293 cells grown in a 6 well cell culture plate. One day post-transfection, the cells were exposed to reovirus infection at a MOI such that about 70% of cells would be infected (TIL 40, T3D 50). Post-infection the cells were fixed and stained so that they could be viewed with immunofluorescence, after which they were quantified.

The results indicated that the ISG C19 was the most promising antiviral candidate due to a lower percentage of infection in cells transfected with the ISG plasmid. However, the results were not significant. This may have been due to the low levels of transfection that resulted from our experiment and thus a smaller number of data points than we had hoped. To improve future results, we began creating cell lines that would stably express the ISG plasmids, which would eliminate the problem of low transfection and improve our sample size. In addition, we have begun to create stable lines in cell types other than HEK293s, such as L929s and HeLas.

This summer was an amazing opportunity to learn about the techniques, trials, and rewards of research. I'm grateful to Professor Holm, Jeanne Hansen, and my lab-mates Kayla and Warren for their support, guidance, and help.

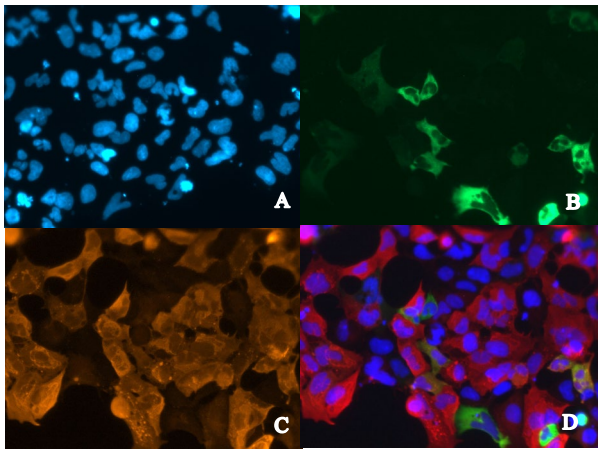


Figure 1. HEK293 cells transfected with ISG plasmids and infected with reovirus were fixed, stained, imaged, and counted. **A)** The nuclei stained with DAPI served as the total number of cells analyzed per field of view. **B)** The transfection efficiency of the ISG plasmids/control plasmid was determined via GFP fluorescence (GFP was included in all plasmids used). This photo shows cells transfected with ISG C19. **C)** The infection efficiency of the cells exposed to reovirus serotypes. This figure displays cells post-exposure to T1L and staining with Alexa Fluor 546. **D)** The merged image of DAPI, HEGFP (transfection), and Rhodamine (infection) filtered photos was created using ImageJ and used to quantify the cells of each type (total, GFP +, infection +, +/+, -/-).

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): National Institutes of Health (NIH) Area Grant

Research Fellow: Kayla Schacher (2020) **Concentration: Molecular Biology**

Faculty Mentor: Geoffrey "Geoff" Holm **Department: Biology**

Title of Project: Effects of Reovirus Infection on Cellular Metabolism

Project Summary:

Reovirus is a non-enveloped virus with a genome consisting of 10 segments of double-stranded RNA that encode a total of 11 genes. It infects most mammals but is non-pathogenic in humans, making it an ideal model for studying cellular responses to infection. In recent years, reovirus has also been implicated as a useful oncolytic viral therapy agent. Previous studies have shown that it preferentially infects and harms cancerous cells compared to normal non-transformed human cells.

Many cancerous cells have different metabolic preferences than normal cells. It has been observed that cancerous cells rely more heavily on aerobic glycolysis for energy production in contrast to normal cells that primarily utilize mitochondrial oxidative phosphorylation. This phenomenon is known as the Warburg effect. It is thus possible that the oncolytic nature of reovirus may be related to metabolic changes occurring in cells following infection.

This summer, I looked at whether reovirus infection has any metabolic effects or preferences in cells that may help explain its previously observed oncolytic activity. For this, both non-transformed cell lines (HEK293 and HeLa) and cancerous cell lines (HCT116 WT and HCT116 p53-/-) were infected with reovirus and subjected to Glycolysis Stress Test metabolism assays using an Agilent Seahorse XF Analyzer. Metabolic activity was analyzed 24, 16, and 10 hours post-infection.

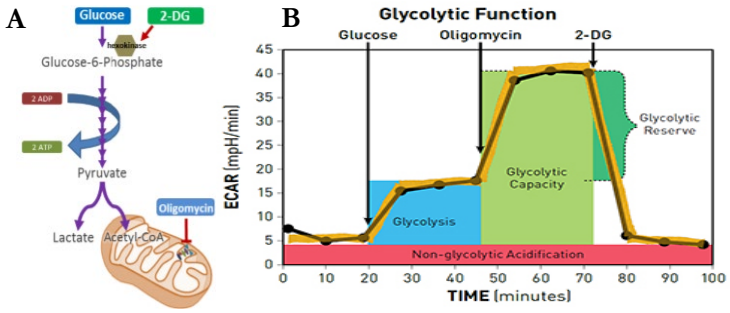


Figure 1: Agilent Seahorse XF Analyzer Glycolysis Stress Test
A) Schematic showing the role of each drug used in the assay on the glycolytic pathway. **B)** Example of the resulting extracellular acidification rate (ECAR) graph and how to interpret it.

The metabolic effects of reovirus infection were most prominent 10 hours post infection in all cell types tested. At this time point, there were slightly elevated extracellular acidification rate (ECAR) levels in infected HEK293 and HeLa cells compared to non-infected cells. This suggests a possibly slightly higher reliance on glycolysis in these cell lines following reovirus infection. The HCT116 WT cells showed a similar but diminished trend, while glycolytic activity in HCT116 p53 -/- cells seemed unaffected by infection. Both of the cancerous HCT116 cell lines had overall higher ECAR levels compared to the non-transformed lines too, consistent with the Warburg effect.

The results I obtained are not conclusive by themselves. Rather, they are being used as a baseline set of data for future research in Holm's lab. From here, the metabolic effects of reovirus infection can be further studied at different time points, in more cell lines, and in response to new Agilent Seahorse XF assays.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Michael J. Wolk '60 Heart Foundation

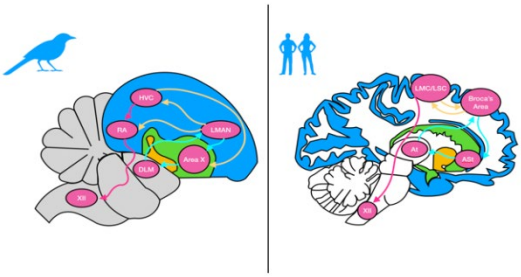
Research Fellow: Gillian "Gill" Schutt (2020) **Concentration: Neuroscience**

Faculty Mentor: Wan-chun Liu **Department: Psychological and Brain Sciences**

Title of Project: Identify the Genetic and Behavioral Mechanisms of Communication Disorder

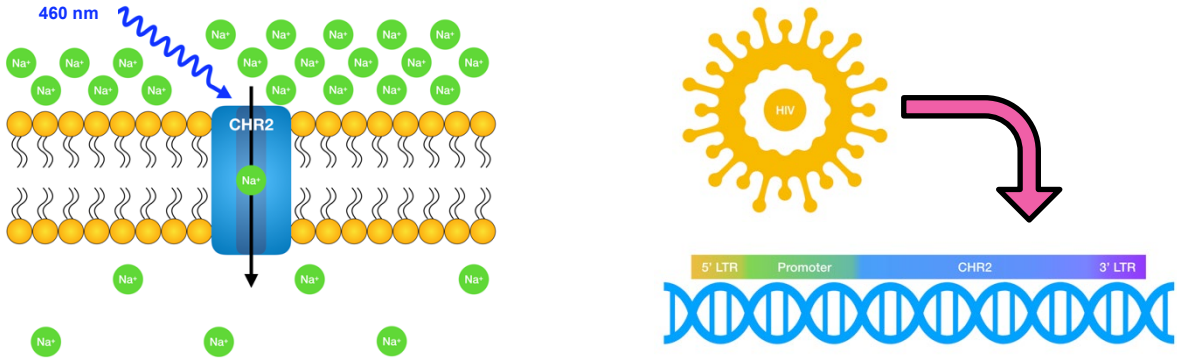
Project Summary:

The zebra finch (*Taeniopygia guttata*) is a species of oscine songbird. Their song is learned during their juvenile phase by studying and replicating a tutor's song. Song learning in the zebra finch is highly comparable with speech learning in humans. Juvenile finches experiment with tones and pitches as they learn to replicate their tutor's song similarly to how babies babble as they learn to copy the speech of their parents. The correlation in vocal learning of zebra finches and humans is shown within the neuroanatomy and neurological circuitry of the oscine bird brain and the human brain, specifically concerning correlations with the avian song motor pathway and the avian anterior forebrain pathway. As the neurological vocal learning mechanisms are conserved between humans and zebra finches, the study of these pathways in zebra finches can enable us to have insight into the correlated pathways in the human brain.



Oscine songbird brains and the human brain share similar neurological pathways concerning vocalization and speech learning.

During the summer of 2018, we attempted to create transgenic optogenetic zebra finches using channelrhodopsin-2. Channelrhodopsin-2 is a light activated ion channel protein that opens in response to blue light with a wavelength of around 460 nm. We injected the CHR-2 gene into the developing zebra finch embryo using a lentiviral vector. We then let the embryo develop and hatch. We collected feathers and tested them using qPCR to determine if the CHR-2 gene was successfully incorporated into the zebra finch DNA.



Channelrhodopsin-2 is a light activated protein stimulated by blue light. We attempted to incorporate the CHR2 gene into the zebra finch embryo using the HIV lentiviral vector.

If the CHR-2 is successfully incorporated into the zebra finch DNA and expressed, this will allow us to isolate specific areas of the avian brain for study by using a blue LED light to specifically stimulate certain neurons. In the future, we hope that the development of an optogenetic avian model will help provide insight into the mechanisms of vocal learning and into how it can be disrupted, especially concerning human speech disorders including autism. This could potentially aid in developing treatments for such speech disorders.

Source of Support: ☐ AHUM Div. ☒ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☐ Other (specify):

Research Fellow: Jacob "Jake" Scott (2020) **Concentration: Economics**

Faculty Mentor: Margaret "Meg" Blume-Kohout **Department: Economics**

Title of Project: Incentivizing STEM Participation: Evidence from the SMART Grant Program

Project Summary:

Our research explored the efficacy of the National Science and Mathematics Access to Retain Talent (SMART) Grant program, run by the United States Department of Education from 2006 to 2011. This program aimed to increase the number of college graduates majoring in science, technology, engineering, and mathematics (STEM) fields, focusing on the participation of lower-income students. We found that the program significantly increased the probability of earning a STEM degree among first-generation college graduates whose parents had some prior college experience. However, among graduates who were first in their family to attend college, we found no evidence of any effect.

To conduct our research, we used the 2015 National Survey of College Graduates, a nationally representative sample of non-institutionalized U.S. resident adults with a bachelor's and/or higher degree(s). Our outcome variable was a binary (0/1) indicator of whether the individual completed a SMART-eligible STEM degree. Our main explanatory variable was a triple interaction of whether the student was first generation (to proxy for Pell eligibility), whether the student used a grant to finance their education, and an indicator for whether the student in their 3rd, 4th, or 5th year during the program (since only 3rd 4th and 5th year students could receive the grant). Using these variables and several controls, we constructed a difference-in-difference model to compare eligible and ineligible students. We found a 13 percentage point increase in the likelihood of majoring in a SMART-eligible STEM field for eligible students whose parents had some college experience, but no effect on those whose parents had no college experience. Tests with logit and probit models found the same effect.

Our results reinforce a growing body of evidence regarding the financial aid process, evidence that suggests the opaqueness and lack of clarity surrounding financial aid makes information about and guidance with the process crucial, especially for low income students. We hypothesize that it is through this information and guidance mechanism that the pattern we observe emerges. Specifically, we hypothesize that students whose parents had some prior college experience got information and guidance from their parents, making them more likely to know about and thus adjust their behavior to take advantage of the program. Not receiving this information and guidance, students whose parents had no college experience were unlikely to know about and thus take advantage of the program. This has crucial policy implications, suggesting that the efficacy of grants and other affordability programs relies on clear information about and guidance with them.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): National Science Foundation Grant

Research Fellow: Carolyn Senneca (2020) **Concentration(s): Neuroscience; English**

Faculty Mentor: Wan-chun Liu **Department: Psychological and Brain Sciences**

Title of Project: Identify the Genetic and Behavioral Mechanisms of Communication Disorder

Project Summary:

Zebra finches are songbirds that learn to sing much like humans learn to talk, and have very similar neural circuitry. Therefore, they serve as a useful animal model for vocal learning. From 30-60 days old, male juvenile finches undergo a "sensitive period" in which their brain is primed to memorize and copy the mating song of a father tutor. The song of zebra finch juveniles while they are learning the mating song has been extensively studied, but their movement has not.

This summer in the Liu lab, we focused on developing a consistent method for recording the movement and sound of the birds. Two wild type juveniles, about 30 days old, were each placed in specialized cages with a foster father tutor. We used baby monitors to record movement for 12-hour intervals three days a week, and recorded sound continuously. The head of each bird was painted to allow for color marker tracking. The recorded video could then be analyzed using Ethovision, a specialized version of Matlab. Meanwhile, song was recorded in Sound Analysis Pro (SAP), a well-established program used in birdsong analysis. The song analysis of the juveniles is still ongoing, but in the future we will be able to measure how well the juvenile has copied the tutor song. After a month of recording, we have found that father tutors exhibit a consistent circadian rhythm that the juveniles lack. In the future, we hope to combine movement data with the sound data, to understand if the movement of the birds is related to how much they sing and how well they sing. Additional future directions include increasing our sample size as well as clipping the wings of some juveniles, to see whether or not restriction of movement will cause them to learn song less effectively. We hope that this research will allow us to better understand vocal learning in birds and how this can apply to humans.

Figure 1: Setup of the cages used to record movement and sound data of zebra finches. Cameras are positioned above the cage and a microphone is positioned on the side of the cage in a soundproofed cone.

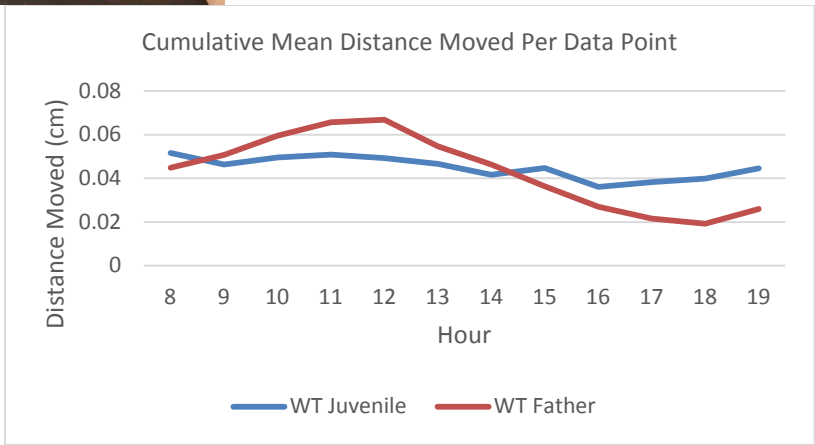


Figure 2: Movement data of Wild-Type Juveniles (n=2) and Wild-Type Fathers (n=2). Average movement is calculated per data point; sample rate is 28.89/sec. Data is over 8 days of recording.

Source of Support: ☐ AHUM Div. ☒ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☐ Other (specify):

Research Fellow: Allison "Ally" Shahidi (2019) **Concentration: Physics**

Faculty Mentor: Robert "Bob" McVaugh **Department: Art and Art History**

Title of Project: Documenting Colgate's Architectural Legacy

Project Summary:

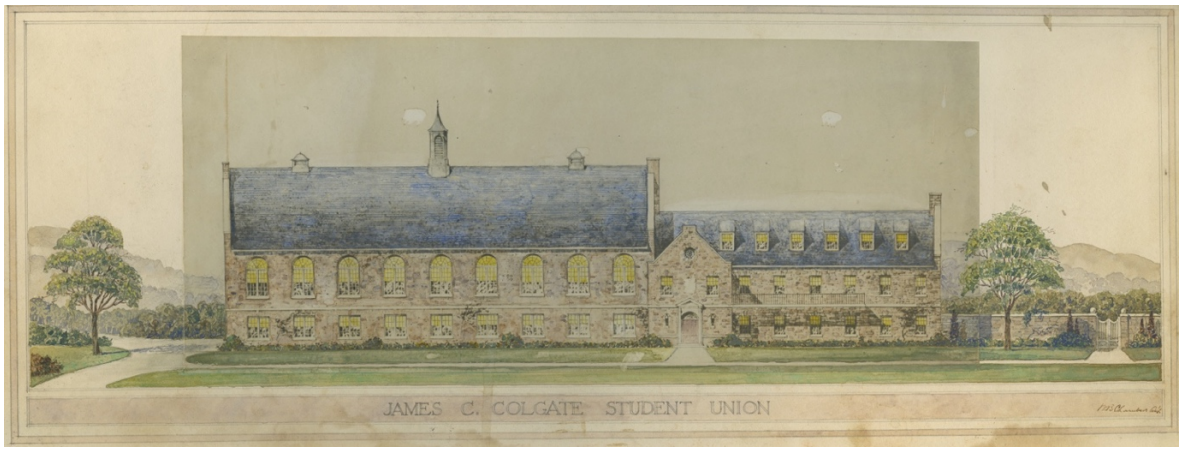
This summer I worked with Professor Robert McVaugh in the Colgate University Department of Art and Art History to develop and implement an organizational system and database for the documents in the university's Architecture Archive. The challenge was to create an organizational system that both allows visitors to the archive to find all materials relevant to their search and is able to seamlessly integrate new materials. These needs led me to develop a system based around the architect and subject of the documents. In this system, documents are organized into folders by architect, and in cases when an individual architect has too many documents for a single folder, the architect is given multiple folders, each dedicated to a given project. This system was determined to be the most effective method of organization as the documents must be accessible to both researchers and the university facilities department, each of which has varying needs and methods of approaching the documents. During the process I also worked with University Archives as well to assure smooth integration of the Architecture Archive into the University Archives' database in the future.

I spent each day in the architecture archive working hands on with the documents. Once I had determined the framework of the documents' physical organization within the archive, I shifted to the structure of the database entries. My goal was to create a database of entries which not only makes it easy to locate the objects within the archive but gives important and desirable information on each document such that research completed on the database is self-sufficient. For this reason, the system of documentation I created catalogs the documents at the item level, allowing for maximum detail to be provided in the database.

Based on my experience as a student researcher and conversations with the facilities department, I determined what fields should be included in the database. For each document, the architect, date, subject, number of sheets, medium, size, location in the archive, title of the sheets, and drawing number are indicated. While each of these categories is relatively straightforward, all of the information is not immediately available from the documents alone. In many cases, it is a challenge to identify the architect, date, or subject of the document. Clues such as the hand of the architect, details of the structure, and structures that are present or absent from the document were therefore very important to gathering this information.

As previously explained, one of the goals for the database is that it be self-sufficient. Many of the documents in the architecture archive are fragile, meaning the provision of a digital copy gives visitors access to documents they would not otherwise be readily able to handle. I therefore spent time taking high resolution photographs of many of the documents that will eventually accompany the entries in the database.

After finalizing both the physical and digital organizations of the Architecture Archive, I wrote a guide documenting my process. The first part of the guide is a detailed explanation of the system of organization of the Architecture Archive, both physical and digital. This explanation will allow future workers for the archive to properly maintain the system as new documents are added. The second part of the guide explains the syntax used for each category in the database. It is important for future workers of the archive to maintain consistency across entries so that database is as straight forward and as easy to navigate as possible. At the back of the guide is an up to date index of folders and their locations within the archive which is an important tool for both workers of and visitors to the archive.



An elevation of the James C. Colgate Student Union, this watercolor was rendered by architect Walter B. Chambers. While the painting itself is undated, it can be dated to 1936 based on comparison with other drawings from over the course of the lengthy design process.

Source of Support: ☒ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Career Services

Research Fellow(s): **Ruchit Shrestha (2020)** **Concentration(s):** **Mathematics; Computer Science**
Xiaolin "Owen" Sun (2020) **Concentration:** **Mathematical Economics**

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

Title of Project: **Finding Errors in Computer Network Configurations**

Project Summary:

Computer networks employ intricate configurations with thousands of lines of specialized instructions that dictate how devices in the network communicate. Naturally, these configurations tend to be painstakingly difficult for network operators to update and repair, thus leading to frequent errors. Our research focuses on developing a tool to automatically find errors in these complex network configuration files.

Prior research introduced a configuration verification tool, called Minesweeper (Beckett et al., SIGCOMM 2017), that models a network's behavior as a logical formula and uses a satisfiability solver to check desired policies. For example, we could verify that servers in McGregory Hall can always communicate with servers in Case-Geyer Library by asserting that no scenario exists where McGregory's servers cannot communicate with Case-Geyer's servers. Minesweeper combines this "reachability" policy with clauses that encode the filtering policies specified in configuration files and the algorithms used by network routers to compute paths through the network. A satisfying solution to this formula describes a scenario where the policy is violated.

We developed a system that leverages Minesweeper's network model to generate all scenarios in which a policy is violated. At this point, the formula becomes unsatisfiable—i.e., there is no other way to violate the policy—and the satisfiability solver produces an "unsat core." This consists of a subset of clauses in the original formula that cause the formula to be unsatisfiable. Intuitively, the clauses in the unsat core must be "good" clauses, because an unsatisfiable formula implies there are no more policy violations. Our most basic approach to fault localization is to assume all clauses that *do not* appear in the unsat core are "bad".

While this approach shows some promise in localizing faults for specific types of networks and errors, the precision and accuracy of this basic approach is below par. Consequently, we developed several possible options for tuning the set of clauses we flag. The first option flags all clauses related to "bad" clauses using a technique similar to program slicing. The intent is to increase the fraction of discovered faulty clauses. The second option incorporates unsat core minimization to find a minimal set of clauses that are unsatisfiable. By minimizing the number of "good" clauses we increase the pool of possible faulty clauses. Our third option splits multi-part clauses into smaller clauses. The intent is to improve the granularity of our fault localization system. Lastly, we introduced an option to exclude clauses in the formula derived from the network's built-in algorithms. Essentially, this option would limit the candidates to be modifiable clauses derived from the configuration files.

We created six different example networks and introduced seven different types of errors to each network. We then applied our tool with different combinations of the options to each broken configuration to explore how these options affect the precision of our system. As shown in the graph, the first and third options resulted in the most improvement in localization accuracy.

Our research lays the groundwork for developing additional mechanisms to increase the accuracy and precision of fault localization for network configurations. In the near future, we intend to add the ability to generate multiple unsat cores as well as perform analysis on real network configurations.

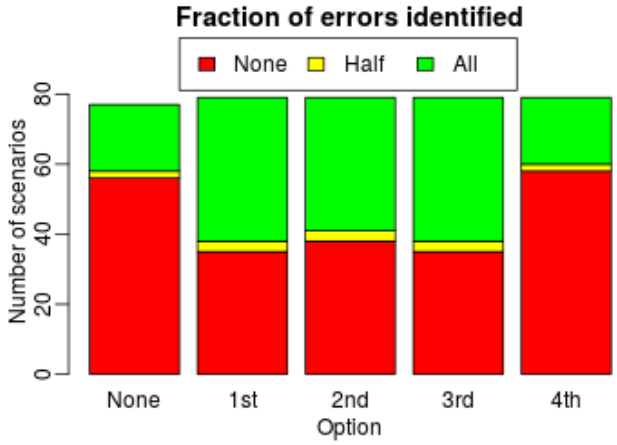


Figure: When we include computation formulas and perform slicing and/or minimization, at least one error is properly included in the unsat core for more than half of the scenarios.

Source of Support: ☐ AHUM Div. ☒ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): National Science Foundation Grant

Research Fellow: Annalise Simons (2021) **Concentration: International Relations**

Faculty Mentor: Jennifer Hull **Department: History**

Title of Project: Colgate Bicentennial: Rewriting Colgate's History

Project Summary:

Colgate University will celebrate its bicentennial during the 2018 –2019 school year. This summer, I worked in Special Collections and University Archives where I researched and wrote contributions for the digital history web site that will accompany the bicentennial. This included general research as well as work on race- and gender-related topics that support the bicentennial goal of diversity inclusivity.

For my first summer project, I researched and wrote a short biography of Henry Livingston Simpson, one of the first students of color at Colgate University (class of 1853), who went on to become a respected Baptist minister and missionary. This research also contributed to documenting Colgate's history of one of a handful of university's that admitted African American students along with white students in the mid-19th century.

Additionally, I located statistics and helped research documentation of women attending Colgate prior to the university's establishment as a co-educational institution; specifically, information regarding the numbers of women that attended classes at Colgate following World War II. Although the University was not co-educational at the time, World War II veterans' wives took courses at Colgate in the post-war period.

I also contributed to more general sections of the digital history website, along with the other bicentennial summer fellow; I researched the university's presidents back to the early 19th century to provide the foundation for short biographies of each president. This entailed requesting, reading, and analyzing biographical files in Special Collections and University Archives. The presidential biographies will be pertinent for the bicentennial website but also for general access to Colgate's archival holdings on the university's history.

To help make the bicentennial digital history a true multimedia experience. I used archival photographs and audio files to create a video, using iMovie, documenting the 1968 sit-in. This important moment of student activism followed an incident with a gun at Sigma Nu and upset over the ethnically restrictive national bi-laws for Phi Delta Theta. The sit-in, which occurred days after the assassination of Martin Luther King, Jr., included hundreds of students from many different backgrounds. The sit-in itself lasted over 100 hours until the president agreed to revoke the charter of Phi Delta Theta and to immediately remove Sigma Nu from the Colgate campus. For the video, I organized and clipped pictures and audio clips from the sit-in to create a coherent representation of the event. This video will appear on the Colgate bicentennial website alongside a summary of the event.

Along with the individual projects I completed for the website, I worked on an independent project throughout the summer that focused on the development of women's athletics at Colgate. Initially, I intended to research the history of the baseball team at Colgate because the baseball team ceased to be a varsity team in 1996 after 110 years of varsity play, which I found intriguing. As I researched, however, I discovered that the baseball team grew upset over the decision to remove varsity baseball and blamed the lawsuit that the women's ice hockey club team filed against Colgate around the same time. After I realized this correlation, I decided to expand my research to the growth of the women's athletics department. By analyzing the impact of Title IX, I better understood the lawsuit between the women's club ice hockey team and Colgate as well as the extent to which the university had to make compromises in order to accommodate the expansion of the women's athletics department. I am very grateful for this opportunity to partake in history research over the summer. I gained new skills in critical reading, research, analyzing documents, and creating written projects from compiled research. I concluded my independent research by writing a paper with footnotes as a final product.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☒ SOSC Div. ☐ UNST Div.
☐ Other (specify):

Research Fellow: Xinni "Ginni" Song (2020) **Concentration(s): Music; Computer Science**

Faculty Mentor: Michael Hay **Department: Computer Science**

Title of Project: DPComp: Realistic Data Mining Under Differential Privacy

Project Summary:

Project Summary: The aim of the research project was to come up with an easy way to implement better data privacy (in the form of differential privacy) in a data analytics platform called MacroBase.

Differential privacy: Differential privacy is a strong, mathematical definition of privacy in the context of statistical and machine learning analysis. The goal is to achieve a state where whether a particular privacy object's (i.e. the entity whose privacy we are trying to protect) data are included or not does not affect the result. Differential privacy can be attained in multiple ways, often including adding a calculated amount of noise to the output of the algorithm. An algorithm $\mathcal{M}$ is ϵ-differentially private if for any two datasets D_1, D_2 that differ by one record,

$$\frac{\Pr(\mathcal{M}(D1)=O)}{\Pr(\mathcal{M}(D2)=O)} \leq e^{\epsilon} \text{ for all } O \in Range(\mathcal{M}).$$

Sensitivity: Macrobase pipeline adds noise to outputs to realize differential privacy. The noise is calibrated to the sensitivity of input queries. To informally define sensitivity, consider databases D1 and D2, which differ only by one record, and a set of queries Q, sensitivity is the difference between the number of records in results of Q on D1 and D2. It measures by how much the differing record can change the response to Q in the worst case, and therefore, to what extent the response has to be perturbed in order to hide the difference introduced by this record, i.e. to preserve differential privacy.

The sensitivity of a set of queries on a database is equal to the maximum number of queries in this set that intersect with each other. We implemented two approaches to compute sensitivity. The first approach is to use a graph representation of queries: each query is a vertex, and two vertices are connected by an undirected edge if the two queries have an intersection. Thus, the upper bound of sensitivity is equal to the size of max clique in the graph. This approach has a relatively high running time. The second approach is branch-and-bound: we divide the query region into buckets. The number of queries intersecting a bucket is denoted by the "count" of the bucket. We find the bucket with greatest count. If all of its queries intersect with each other, the count of this bucket gives the maximal sensitivity; if not, we split the bucket and repeat the process above. This approach is faster than the max clique approach in that it avoids comparing each pair of queries.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): National Science Foundation Grant

Research Fellow: Trey Spadone (2020) **Concentration: Anthropology**

Faculty Mentor: Elana Shever **Department: Anthropology**

Title of Project: Exotic Specimens: Why Dinosaurs Will Never Go Out of Style

Project Summary:

This summer I worked with Professor Elana Shever as a junior collaborator on her current project. Based on ethnographic fieldwork done over four years in the American West, Professor Shever's work focuses on the impact of dinosaurs in American society in both popular culture and the scientific community. Analyzing dinosaurs allows us to see how the intersections of race, gender, age, class, and location surround this cultural icon. This summer, I transcribed and coded various interviews, tours, and interactive fossil sessions with museum volunteers, hotel owners, and field camp leaders. These recordings have shown how so many people are intrigued and fascinated by dinosaurs. My project: *Exotic Specimens: Why Dinosaurs Will Never Go Out of Style* seeks to examine some of dinosaurs' defining attributes and how those contribute to their popularity.

Dinosaurs appear in popular culture from the blockbuster film *Jurassic Park,* to the entertaining DinoLand USA in Disney World, to even the shape of chicken nuggets. When I was in kindergarten, there was a whole unit in which we "dug up" fossils and tried to figure out what part of a dinosaur they came from. Why are dinosaurs so popular in the United States? My research this summer has shown me that their popularity stems from what anthropologists call "exoticism." Many people are captivated by a world that appears to be starkly different from the one they know today. Dinosaurs are conceived to be massive savage beasts that were bigger and stronger than any modern animal. Because they are extinct, we can be in awe of dinosaurs, but never in real danger. Dinosaurs provoke our imagination as they straddle the fine line between reality and fantasy. Their size, dominance, and overall grandeur astound many of us. As a teacher from Colorado put it, "here's the thing: dinosaurs are almost unbelievable."

Dinosaurs' popularity is connected to how people talk about them. Size is an immediate descriptor with "big" being the word of choice. However, not all dinosaurs were the size of *Apatosaurus ajax*, which averaged 72 feet long and 36,000 to 49,000 pounds. *Compsognathus longipes* grew to roughly the size of a turkey. *Hesperonychus elizabethae* clocked in at about 4.2 pounds and 3.3 feet in length. However, when visitors to a dinosaur park were asked: When you think of dinosaurs, what are the first words that pop into your head? 55% of them responded with "huge," "massive," "enormous," or some other synonym for big. For many people, the word "dinosaur" immediately conjures up images of enormous beasts. They find the reality that there were once humongous creatures taller than buildings and heavier than helicopters awe-inspiring or even mystifying. Furthermore, some dinosaurs' immense size gives them an aura of power and dominance that draws people in.

When discussing dinosaurs, their diet is the most common topic that is brought up. "This is a (insert dinosaur name here) and it is a meat/plant eater" is a sentence museum volunteers have repeated again and again. Moreover, discussion of dinosaurs' eating consistently focuses on the hunt. There's no talk of dinosaurs needing particular nutrients; it's the means, not the end that matters. They discuss hunting and killing as the main event, eating is just a bonus. The idea of these massive animals hunting each other attracts people.

Tyrannosaurus rex exemplifies Americans' exoticization of dinosaurs. It is arguably the most well-known dinosaur in the world. T-Rex is the quintessential dinosaur; it's huge, powerful, dead, and its name literally translates into "tyrant lizard king." Museum volunteers have also noted that T-Rex is most kids', especially boys', favorite dinosaur. When asked why, they have received responses along the lines of, "because of its [T-Rex's] ability to hunt, to take down other animals." People cite T-Rex's massive size, strength, ferociousness, and badness as reasons why T-Rex is their number one. The defining characteristics of T-Rex are what make it so exotic and by association, popular. A volunteer from DMNS noted that, "I think people flock to a movie like *Jurassic Park* just to see the T-Rex. And they don't want to see T-Rex wandering the forest. They want to see T-Rex killing. They want to see it in action. And, so there's this fantasy about this whole thing."

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☒ SOSC Div. ☐ UNST Div.
☐ Other (specify):

Research Fellow: Kaitlin "Katie" Stansbury (2019) **Concentration: Natural Sciences**

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

Title of Project: Polar Marine Diatoms and Antarctic Paleoclimate

Project Summary:

In this study, we use phytoplankton samples collected along a transect from Australia to East Antarctica, as well as a focused group of samples from the Sabrina Coast continental slope, to map the distribution of different species of diatoms. The data from this study will provide a baseline for the distribution of diatoms across a broad latitudinal gradient. Creating this baseline provides insight into how diatom assemblages change from temperate to subpolar to polar water masses and between open water versus a sea ice covered ocean. This will help us to compare the changing distribution of fossil diatoms to the distribution of modern diatoms; these paleo-data provide a longer-term perspective on the range and rate of oceanographic and climatic change.

During January to March 2017, Cruise IN2017 sailed between Australia and the Sabrina Coast, East Antarctica. Water samples for diatom analysis were collected via the uncontaminated seawater system starting around 50°S and were taken at every latitudinal degree. Once the ship reached our field area, a denser set of samples were collected. At all sites, between 30-200 mL of water were collected. Each water sample was filtered dry through a gridded 25-mm diameter HAWG 0.45 µm cellulose acetate filter, which was then transferred into a labeled petri dish. These filter papers were allowed to continue to dry for 24 hours and then mounted onto a 3"x1" microscope slide where they were placed on top of four drops of immersion oil. The slides were dried for another 24 hours after which two more drops of immersion oil were added, and the slide was then covered with a 25 mm coverslip. At each of our sample locations, additional water was analyzed for the following analyses: hydrochemistry (dissolved oxygen, salinity, temperature, and nutrients), chlorophyll a, DNA, virus, and HBI analysis (highly branched isoprenoids which are produced by diatoms).

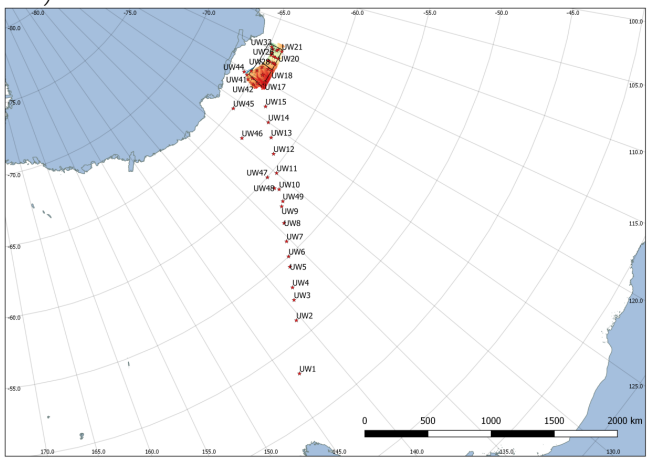


Figure 1: Map of survey locations taken by Underway Antarctic Cruise in 2017. Each survey location had a slide created from water samples. (Created in qgis by Kelly-Anne Lawler, March 2017).

Once these slides were made, diatoms were counted and identified using an Olympus BX40 microscope. Each slide was counted two times, once in 400x magnification and once in 1000x magnification. Counts and identifications under 400x magnification were completed in four grid boxes. Higher magnification (1000x) counts and identifications were completed when > 400 specimens were counted along non-overlapping, adjacent transects in a single grid box.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Bob Linsley/James McLelland Fund; Norma Vergo Prize

Research Fellow: Samuel "Sam" Stuttard (2020) **Concentration: Art and Art History**

Faculty Mentor: Joshua "Josh" Finnell **Department: University Libraries**

Title of Project: 3D Modeling Case-Geyer: A Pilot Project Immersive Technology Summer Institute 2018

Project Summary:

The purpose of this project is to produce a virtual 3D model of the Case-Geyer Library using the computers and 3D-modeling software available at the Ho Tung Visualization Laboratory ("VisLab") for several potential future uses. The model will test the feasibility of creating other such models of current campus buildings for the purpose of historical preservation, and for creating models of historic campus buildings no longer extant. Secondly, a virtual library environment may be able to further aid current students in navigating the real Library so as to find books and other resources more easily. Finally, it can be used as a substitute for touring the actual Library for interested prospective students or incoming first-year students for whom distance, finances, and scheduling prevent them from visiting the campus itself.

Figure 7: North Façade of the Library, looking South (towards Colgate).

3DS Max is the software used to build the model, chosen for its ability to import *AutoCAD* plans, generate doors and windows, and build out walls, floors, ceilings, and other features in fine detail. *Maya* will likely be used in the future to add the Library model into another, larger model of the entire campus that will be used in "VisLab" shows for the Bicentennial celebrations. *Unity* will serve as the software for converting the model into a 3D virtual environment capable of being explored by those with 3D headsets and goggles.

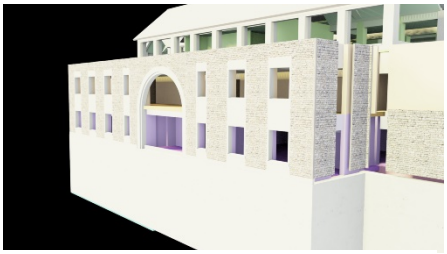


Figure 8: West Façade (Little, Persson, and Student Union side), looking northwest.

The process of building the model included acquiring the *AutoCAD* plans from Joseph Bello, Director of Planning, Design & Construction at Colgate. Plans of the individual floors were imported into *3DS Max* to use as a reference for the layout of walls, ceilings, doors, windows, and furniture. They were scaled to 8.19% or 8.2% of their imported size and the heights of each floor were determined from other *AutoCAD* plans at a scale of 1 *3DS Max* unit to 1 ft. Construction of the model began with the walls of the first floor and proceeded to the fifth floor. Floor slabs followed with subtracted openings for double or triple height ceilings and stairwells. Exterior walls, windows, and roofs were added, and textures were experimented with, but not yet fully applied. Unfortunately, the model remains only partially complete.

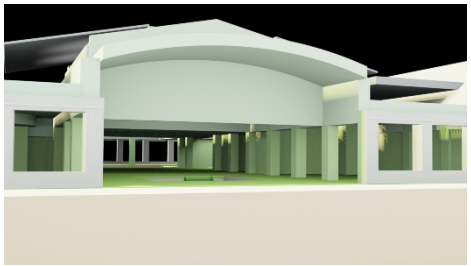


Figure 9: Unfinished South Entrance vestibule and terrace on the 5th Floor.

This project also included a week-long institute at Hamilton College for collaboration with other groups working on similar 3D models and immersive technology projects. The institute included teams from Hamilton College itself, Gettysburg College, and Occidental College. These other teams were generally far advanced in their projects and gave great insight on the wide applications, feasibility, and preservation of immersive technology creations. Overall, the institute provided us with many good ideas and new possibilities for collaboration as our respective universities and fields expand to include immersive technologies.

Fortunately, this project will continue in the fall semester of 2018 and possibly be resumed in the summer of 2019. Further applications of the model and other models of campus buildings continue to be explored and, hopefully, this project has opened the door for many new summer research projects in immersive technology and architectural modeling for the future.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☒ UNST Div.
☐ Other (specify):

Research Fellow: Samuel "Sam" Timothy (2019) **Concentration: Geology**

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

Title of Project: Contact Metamorphism and Ore Formation During Intrusion of Adirondack Anorthosite

Project Summary:

Aim and Regional Geology:
My research involves the origin of hydrothermally altered rocks, silicate ore known as wollastonite, and the emplacement of each within the northeastern section of the Adirondacks outside of Lake Placid, New York. Relatively uncommon, wollastonite is mined in four distinct localities within the Adirondack High Peaks- The Lewis, Willsboro, Deerhead and Oak Hill mines. At Lewis, wollastonite ore is sandwiched between distinct belts of skarn rocks high in garnet, diopside, and clinopyroxene. Common rocks associated with the ore deposit in the 15' Ausable Forks quadrangle are calcitic marbles, calc-silicates, and varieties of gneisses. Skarns form as igneous bodies are emplaced in the crust; the heat of the rising pluton creates a thin zone of hybrid rocks at the border with calc-silicate country rocks. Within the Adirondacks, the Marcy Massif, emplaced during the final stage of the Grenville orogenic cycle, is commonly associated with peripheral zones of skarn belts, a product of pluton heat and crustal fluids (Valley and O'Neil, Nature 1982).

Procedure:
Using a variety of instruments, I crushed, analyzed and studied collected field samples from the Lewis wollastonite Mine in the northeastern section of the Adirondacks. wollastonite (chemical formula $CaSiO_3$) is an important industrial ore used in ceramics, plastics, and friction products (brake pads). It is a possible ingredient in carbon sequestration, as evidenced by the reaction $CaCO_3 + SiO_2 \Leftrightarrow CaSiO_3 + CO_2$. My research this summer has been aimed at understanding the original country rock; in this way, I can test models of sedimentary and igneous origin of wollastonite skarn (through a variety of a procedures) which may inform the occurrence or absence of wollastonite ore at ideal localities.

Collected field samples were subject to a variety of instruments including the Inductively Coupled Mass Spectrometer and Frantz magnetic separator. ICP-MS procedures were undertaken to determine light rare earth elements and heavy rare earth elements contents to constrain a possible geologic origin of the skarn material (either sedimentary or igneous). Samples were crushed using a ball mill and dissolved in a hydrogen flouride solution. Precise weight measurements were recorded prior to dissolving, and non-reactant teflon containers were used to dissolve the samples. Thin sections of the skarn were produced and analyzed for mineral composition and grain textures. Using skarn samples from the New York State Museum (collected and catalogued by Phil Whitney) I aim to find or locate zircon grains to be dated by U-Pb methods. Constraining an age via zircon analysis will provide parameters for my samples that will either agree or disagree with the ages proposed by McLelland (AJES, 2016).

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Doug Rankin '53 Endowment-Geology Research

Research Fellow: Araven Tiroumalechetty (2019) **Concentration(s): Physics; Molecular Biology**

Faculty Mentor: Rajinikanth "Raj" Mohan **Department: Biology**

Title of Project: Identification of Novel Genes Involved in Effector Triggered Immunity (ETI) via Programmed Cell Death in Arabidopsis

Project Summary:

Arabidopsis is a model organism used to study plant biology. This is especially important in the modern world as knowledge gained from such model organisms be applies to crops, as it can be used to improve yields, characterize new drugs, prevent famine due to diseased outbreaks amongst others. Plants undergo two forms of immune response, PAMP Triggered Immunity (PTI) and Effector Triggered Immunity (ETI). ETI is characterized by a Hypersensitive Response (HR) in which individual plant cells undergo programmed cell death (PCD). The aim of the project was to characterize a newly discovered Arabidopsis mutant that was defective in PCD, ap1. The mutant was found by comparing microarrays from PCD mutants, rcd1 and tf57. We analyzed RNA levels of PCD-related genes, optimized and carried out experiments to quantify the extent of PCD in the mutant and used a bioinformatics approach to posit the potential localization and function of the protein encoded by our gene of interest. The gene was found to be downstream of transcription factors known to be required for PCD, showed an intermediate extent of PCD compared to the regular (WT) and tf57 plants and was posited to be an enzyme localized to the membrane of the cell.

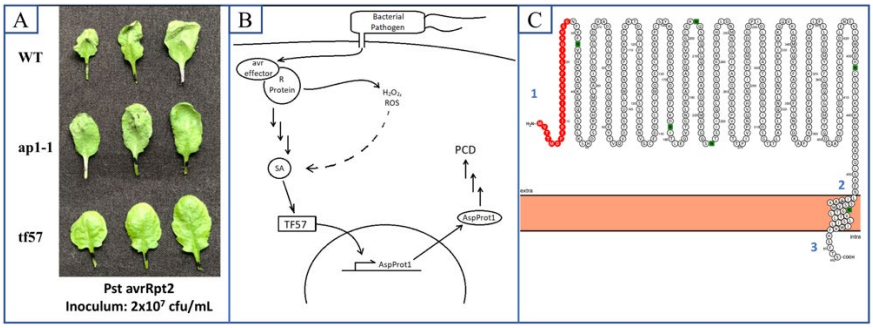


Figure 1: (A) ap1-1 mutant shows intermediate PCD compared to WT and tf57 (positive control) after infection with avirulent pathogen (B) Model of gene and protein interactions based on qPCR of Pathogen treated and SA treated tf57 and ap1-1 mutants (C) Protter model of AP1. 1: Red section indicates signal peptide; 2: Membrane anchor composed of hydrophobic amino acids; 3: C-terminal domain containing multiple serines and threonines which can be phosphorylated to modulate activity.

Avirulent pathogens produce secrete effector proteins which are recognized by Resistance (R) proteins of the plant. This initiates a defense response, leading to ETI and HR. The exact mechanism of the PCD response are not well researched and investigating the protein microarrays of tf57, a known positive regulator of PCD, as well as that of rcd1, which has runaway cell death phenotype, have allowed us to narrow down the genes responsible for PCD via TF57. AP1 was selected as its mutant, ap1, was found to have be defective in PCD. The working model of interactions of TF57 and AP1 was developed by comparing RNA levels of TF57, AP1 after avirulent pathogen infection and salicylic acid (SA) treatment. The bioinformatics analysis also allowed us to identify another closely related enzyme, AP2, which might share functional redundancy with AP1.

Future directions would include showing quantitatively that PCD is reduced in ap1-1 and an ion leakage assay was optimized for such use over the summer. Additionally, there is a need to confirm the different domains predicted by site directed mutagenesis and analyzing the effect on the protein activity. Additionally, investigating protein and RNA levels in an ap1-ap2 double mutant, due to potential functional redundancy and exacerbated PCD phenotype would help solidify the current model of interactions downstream of TF57 in *Arabidopsis* ETI.

Source of Support: ☐ AHUM Div. ☒ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☐ Other (specify):

Research Fellow: Jordan Tockstein (2020) **Concentration(s): Astrogeophysics; Applied Math**

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

Title of Project: Field Work: Earthquakes and Subduction On- and Off-shore of the Alaskan Peninsula

Project Summary:

For four weeks at the beginning of the summer, I was a part of a three-person team installing seismometers along the Aleutian peninsula. We were a part of a larger project, the Alaska Amphibious Community Seismic Experiment (AACSE), which had other teams installing both land based and ocean bottom seismometers along the Aleutian coastline. Our team was based out of two locations; first in Sand Point, a fishing village on Popof Island, and later in King Salmon, another fishing town, just west of Katmai National Park. The larger goal of the project is to get a better understanding of the subduction zone along the Aleutian Peninsula, where the Pacific plate is being subducted under the North American plate. This area is the site of both North America's largest recorded earthquake and its largest recorded volcanic eruption, leading to a greater interest in understanding the area and its geologic processes. One of the more pressing questions that researchers hope to answer deals with why there are areas of very high seismicity butting up against areas of very low seismicity, and what makes them go one way or the other.

My part in the project was much less research based and more field work; the data from the project will not even be available until Fall 2019. Our team installed a total of 17(check me please) stations, ranging from King Cove in the southwest up to Igiugig, north of Katmai. A number of those stations also included accelerometers to augment the data from the seismometers.

Installing a station took anywhere from one to three hours, depending on how much experience we had with the process and the location. Our first station was located up a slight hill and past a wall of brambles, so much of our time was spent lugging the equipment-sensors, batteries, shovels- from the boat we were based in to the spot we were digging in. Digging the holes for the equipment was also difficult, as there was a layer of thick vegetation before you could even reach the dirt. One of our later stations was a much different story; we took our equipment off the plane and started digging in the loose soil just off the runway, leading to a much quicker and easier installation.

Besides physically carrying around our equipment and digging the holes, we were also setting everything up so it could start recording data. Once the holes were dug, the seismometer (and accelerometer, depending on the station) had to be oriented north and leveled. Seismometers record motions of the earth using springs, so the leveling part is especially important. For each station we had a box that went in the ground and contained all the electrical equipment besides the sensor itself. In each box we wired up six three volt batteries to power the Q330 and Baler, which are the pieces of equipment that actually record and store the data from the sensor. The Q330 would be connected to the sensor and the clock, which was responsible for the GPS data for the station. Sometimes after everything was installed and we were ready to begin burying the box we would have to wait for the clock to lock or the sensor to center itself.

When it came to picking where exactly we would put the sensor, there were a few different factors involved. First, we usually only had a certain area in which the property owner had signed off on for an installation. If possible we wanted a space that was relatively flat, to make the leveling portion of the process easier. The best spots for the equipment would be out of any heavy traffic zones (whether it was planes, cars, or people) to avoid as much excess noise-unwanted data that only hinders study-as possible. In a few locations we also had to make sure we stayed some ways back from the side of a hill, because that type of geography would also negatively affect the data. In one case, we actually had to take an archaeologist with us to the site, which was in Katmai, because the place we were trying to install the seismometer at was on undisturbed ground. The archaeologist was there to ensure that there was nothing buried in the soil at the site that could be harmed during the installation process.

Once installation was finished, we would cover anything sticking out of the ground with a tarp and sign asking that the equipment not be disturbed (for the people), and bury everything as much as we could so it was as unobtrusive as possible (for the bears). Since we were in Alaska, bears are a concern when installing stations. Before we had even left the state, we received news that bears had already dug up a station the other land based team installed. There's no way to ensure that bears won't go poking around a station, as they are curious creatures, but we can at least make it a little more difficult for them to completely dig one up.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): National Science Foundation Grant

Research Fellow: Jordan Tockstein (2020) **Concentration(s): Astrogeophysics; Applied Math**

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

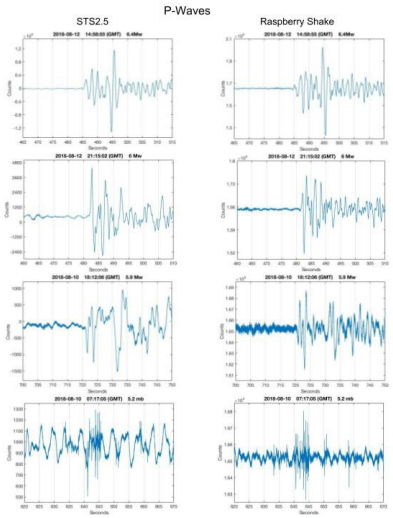
Title of Project: Field Work: Earthquakes and Subduction On- and Off-shore of the Alaskan Peninsula

Project Summary:

The goal of this project was to examine two different seismometers-the STS2.5 and Raspberry Shake-and determine how the two compared to each other. The STS2.5 is the standard seismometer in use, and while it is very good at its job, it is extremely expensive. The Raspberry Shake (based around the Raspberry Pi computer, which was created by a Colgate alumnus) is a "hobby seismometer." It does not claim to take data as well as the STS2.5 or comparable seismometers, but it sells for a fraction of the price. Seismometers sell for tens of thousands of dollars, so depending on how well the Raspberry Shake performs it could offer seismologists a much cheaper way of collecting data.

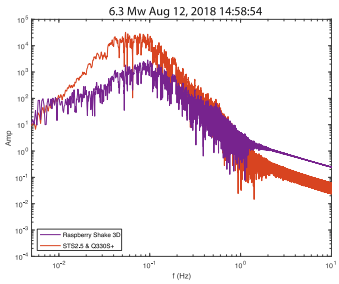
We ran the two seismometers for a total of four days, from August 10th to August 13th. During that time there was a 6.4 M_w earthquake in northern Alaska as well as a 6 M_w aftershock. These, along with other magnitude 5 or greater earthquakes around the world during the four-day span offer a chance to compare the seismometers collection of earthquakes at varying distances and magnitudes.

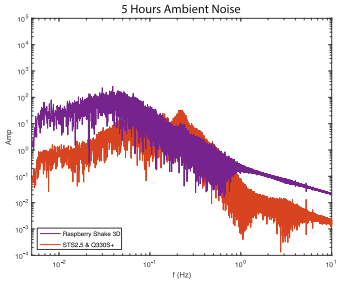
The Raspberry Shake picked up both the P-wave and the surface waves of the Alaska earthquakes remarkably well. When zooming in on the P-waves, it is as easy to pick the arrival time as it is on the STS2.5. There is a slight discrepancy in the amplitude and phase, but overall the arrivals look extremely similar. Even on the smaller earthquakes examined (5.9 M_w in the Sea of Okhotsk and 5.2 m_b off the coast of Brazil) the P-waves were very defined in the Raspberry Shake data.



The Raspberry Shake seemed to pick up P-waves better than surface waves. In the 5.9 M_w and 5.2 m_b it only picked up the P-waves. Interestingly, on first glance the STS2.5 did not pick up anything for the 5.2 m_b, but upon zooming in on the expected arrival time the P-wave was discernable about as well as on the Raspberry Shake, if with a smaller amplitude compared to the surrounding noise.

The Raspberry Shake struggled to detect long period signals overall, leading to less accuracy in recording surface waves. The STS2.5 experienced noise in the form of daily temperature changes, which created very long period signals that could easily be filtered out. Without the filter the data was not centered as linearly as expected. The Raspberry Shake did not see this kind of noise, presumably because of its difficulty in picking up long period signals.





Besides visuals of the actual data we also produced frequency spectra from the data: one from the large earthquake in Alaska and another for five hours of ambient noise. We got rid of the instrument response for the data and applied a .05-10 bandpass filter, and used this cleaned data for the spectra. For the ambient noise plot, the Raspberry Shake had a higher amplitude than the STS2.5 for both high and low frequencies, but the two were comparable, with the Raspberry Shake even having a lower amplitude at some points, for mid-range frequencies (.1-1 Hz). For the earthquake plot the Raspberry Shake generally had lower amplitude, although the two seismometers were again similar in the mid-range frequencies.

These plots are consistent with previous observations, mainly that overall the STS2.5 is the better seismometer, as was expected. Although the STS2.5 is the better instrument, the Raspberry Shake did better than expected, especially with regards to the P-waves and their arrival times. Depending on what the researcher in question is looking for, the Raspberry Shake performs well and is a suitable, cost-effective substitute for other more expensive seismometers.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Doug Rankin '53 Endowment-Appalachian Research

Research Fellow: Alicia Violette (2019) **Concentration: Biology**

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

Title of Project: Madison County Council on Alcoholism and Substance Abuse, Inc: The Landscape of Substance Use and Abuse in Madison County

Project Summary:

This summer I worked with BRiDGES: Madison County Council on Alcoholism and Substance Abuse, Inc., whose mission is to provide advocacy and services to the local community, through the workplace, families, and individuals in order to improve the quality of life. They focus on those affected by addiction and the abuse of alcohol, tobacco, and other substances. They mainly focus on these issues as they are occurring in Madison county, but they also address these issues in the wider Central New York region as well. One of the main ways in which they do this is by implementing prevention and intervention programming in the community in order to promote change and work toward building a healthier community. Some of the programs that they implement address issues like substance abuse (including alcohol and other drugs), gambling, LGBTQ awareness, and suicide prevention.

My project this summer was to assess the issues that are being seen in adults as well as in youth in the community. I attempted to determine what gaps exist in the services related to substance use as well as suicide prevention and the LGBTQ community in this area. I did this by surveying people in Madison County about what they believed to be the most pressing issues in their area, asking about youth and adults separately. I also analyzed the results of some of the programming that BRiDGES has been doing in the community in order to determine if it has been successful and should be continued. One of the programs I was looking at was their alcohol literacy program where they would teach the kids in Madison County schools about the dangers of alcohol use in order to see if their knowledge on the topic would improve after the lesson. They captured this information by giving a pretest before the lessons and then the same test as a posttest after the lessons.

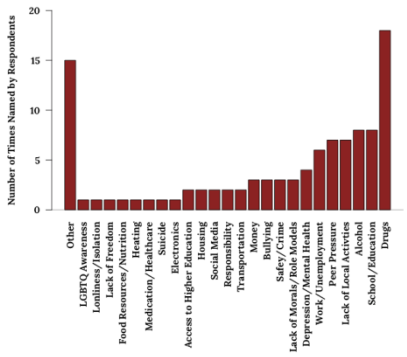


Figure 1. Data I collected on issues identified by Community members as being prevalent with the youth in the community.

Based on the survey that I took of the community I found that people in Madison County were most concerned about drug related issues in youth, and about education on alcohol related issues (Figure 1). Based on this data, BRiDGES will be able to better understand what community members view to be pressing issues in the area. This will allow them to develop initiatives that reduce these risks because the community provided input; we hope that the community will be more willing to help with these things. Along with this, the data that I analyzed from the Alcohol Literacy pre and posttests showed that student's scores generally increased after they were given lessons on the dangers of alcohol (Figure 2). This data allowed us to conclude that this Alcohol Literacy program is making a difference in relation to the local youth's knowledge about alcohol and its risks, and thus that it makes sense to keep this program going in the schools. Both of these projects positively affect the capacity of BRiDGES because they allow them to identify the needs of the community so that they aren't focusing on the wrong things. They also make sure that their programing is successful.

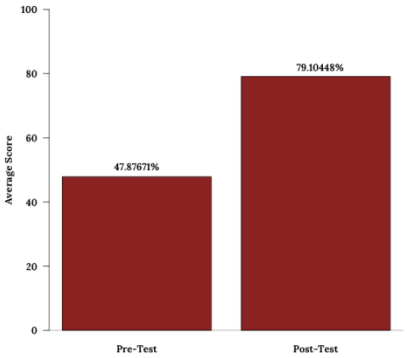


Figure 2. Average scores from Canastota and Cazenovia High Schools on alcohol literacy tests that BRiDGES administered before and after completing lessons.

Through this Fellowship, I have learned that while BRiDGES' main focus is alcohol and substance abuse, the programs that they introduce in the community have a much wider reach. This fellowship gave me a much greater appreciation for the Madison County community, as I got to meet people directly and talk to them about what issues they are seeing in their area. This work also allowed me to learn more about myself and what I would like to do in the future. As I am thinking of going into the field of Public Health this project has allowed me to see the different pieces that go into creating a program within a community, from identifying issues, to implementation, to analyzing the results to determine if the program was successful.

I think that I will be able to use this experience in my future studies when thinking about public health issues that I identify, or that other people do, and the best ways in which they can be addressed.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Upstate Institute

Research Fellow(s): **William "Max" Waller (2021)** **Concentration: Economics**
Douglas "Doug" Whelan (2019) **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"

Project Summary:

This summer, we worked with Professor Barry Shain on research for an annotated anthology he is writing, entitled "Revolutionary-era American Pamphlet Literature in Context: a Documentary History, 1764-1776." As its name suggests, the book will include 85 historically significant pamphlets (about 1/3rd of those published on the topic) from the time during and immediately prior to the American war for independence. Research for this project has allowed us to gain a fresh perspective on the issues surrounding the events of this critical period in history. Furthermore, working closely with rarely studied primary sources has helped illustrate the richness and complexity of the various intellectual perspectives that competed with one another on the eve of the colonies break with Great Britain.

The research itself has had a number of different components. Much of our time was spent editing and improving the contextual introductions, the "headnotes," that the book will include for each individual pamphlet, building on the work of past students who worked on the project. Doing this often required substantial outside research in order to fill in missing information. From seeking out further biographical knowledge of a given historical figure to learning more about the nuanced distinctions between two alternative points of view on a given issue relevant to the time, the sum of our efforts was not just the accumulation of knowledge about the pamphlets themselves, but also a strong contextual analysis of the events and personalities surrounding them.

Perhaps most illuminating about the entire research experience was our discovery that most of the myths and stories concerning the American Revolution are often misunderstood today. To say nothing of the various competitive interests and hotly-debated issues that surely seemed all-important at the time and yet have largely been forgotten; the overall image of the Revolution we have come away with is one that deeply complicates and often contradicts American national myths. Rather than the monolithic, infallible paragons of republican virtue and individual liberty that they are so often portrayed as, the founders were in fact flawed figures whose sharp disagreements and intellectual inconsistencies make it nearly impossible to establish a consistent, simple, and definitive portrait of them. As for the pamphlets themselves, many of those that were most influential at the time are not those read or consulted today, nor are the philosophers and intellectuals whose thought most deeply shaped them the same as those studied most carefully now. Overall, the research project has been both enlightening and deeply rewarding, reshaping our view of a pivotal period of American history in the process.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☒ SOSC Div. ☐ UNST Div.
☐ Other (specify):

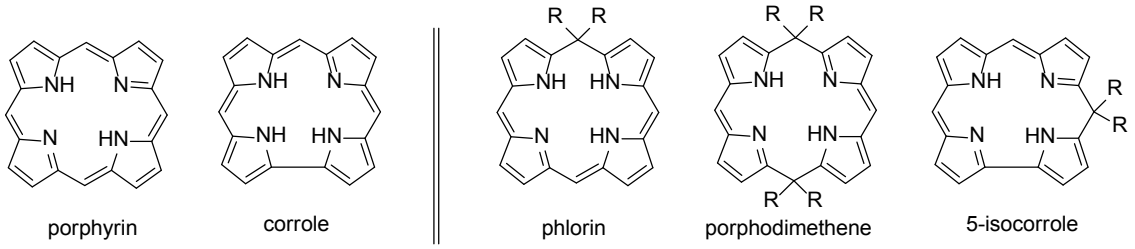
Research Fellow: Katie Wasurick (2019) **Concentration: Chemistry**

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

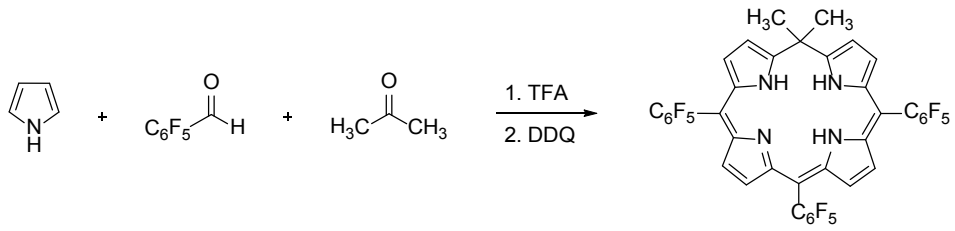
Title of Project: Investigation of the Distribution of Porphyrinoid Products in a Two-Step, One-Flask Reaction of Pyrrole, Pentafluorobenzaldehyde, and Acetone

Project Summary:

This summer we have been investigating a streamlined synthesis of calixphyrins (e.g., phlorin, porphodimethene, and 5-isocorrole), members of the porphyrinoid family. Calixphyrins are generally produced by multi-step syntheses. We are examining whether calixphyrins can be obtained from a simpler approach via a two-step, one-flask reaction.



Previously, the two-step, one-flask reaction of pyrrole, pentafluorobenzaldehyde, and acetone was investigated by our research group. Reaction mixtures were monitored for the five porphyrinoids shown above. Reaction conditions were found that produced phlorin in a yield of 20-21%. We are presently seeking to determine if altering the choice of acid catalyst and acid catalyst concentration can lead to the production of other calixphyrins in good yield.



20-21% yield

We began this summer by successfully reproducing the synthesis of phlorin on a preparative and an analytical scale. We then confirmed that our previously developed HPLC method can be used to separate and identify the five porphyrinoids shown above. Next, control and reproducibility experiments were performed to determine that all steps in sample preparation from aliquots of reaction mixtures, as well as the HPLC analysis can be done accurately and reproducibly. These experiments included examination of solvent evaporation, the transfer of solvent with an adjustable pipetter, the amount of residual solvent on pipets filled with silica gel, and the determination of phlorin yield from within a single reaction and between different reactions performed under the same conditions. Analytical-scale reactions exploring different acid catalysts and acid catalyst concentrations are underway to determine the impact of these reaction parameters on the porphyrinoid product distribution.

Source of Support: ☐ AHUM Div. ☒ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☐ Other (specify):

Research Fellow: Jacob Watts (2021) **Concentration: Biology**

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

Title of Project: Role of Plant Functional Traits in Structuring Epiphytic and Terrestrial Fern Communities

Project Summary:

This summer I worked on several projects. I initially spent two weeks in Costa Rica with professor, Eddie Watkins. We stayed at biological research stations across the country, driving between different elevations which have varying ecosystems that support a diverse set of ferns. Every day we would hike into the rainforest and Professor Watkins would personally teach me how to identify each genus and species of fern. Costa Rica was such a biodiverse place that we could not hike for more than a minute without finding something new or notable. We collected fertile fern leaves in Ziploc bags to be taken back to the lab at Colgate where they would be used for a project on stress physiology. On days that we were not collecting ferns, we were in the rainforest running experiments on the epiphytic ferns- the ferns that grow on trees. After two weeks of fern collection and experimentation, we brought the spores back to be sown (planted) on a media for growing in the growth chambers at Colgate. In the lab for the next five weeks, I worked with two other Colgate students on a personal research project and on measuring the velocity of fern sperm in different pH mediums.

While we were in Costa Rica we stumbled across a never before discovered lifeform of the specific genus *Asplenium* sect. *Hymenasplenium*. This population was exhibiting a hemiepiphytic habit, meaning that its gametophytes were epiphytic, growing a few feet above the soil, and its sporophytes were terrestrially rooted. The gametophyte is fertilized and forms a small sporophyte, and then uses all its energy to grow a feeder root down to the soil from which it can get its nutrients and water. Once the roots hit the soil, the fern can then grow to its mature, fertile stage from which it can distribute spores. This is a very rare lifeform in nature, and scientists have hypothesized that hemiepiphytes act as evolutionary bridges for ferns that have radiated into the canopy. Because the lifeform is not fully epiphytic and not fully terrestrial, it is logical that evolutionarily the hemiepiphytic lifeform would act as intermediary state between full epiphytism and terrestrial habitats, which have completely different water and nutrient availabilities.

We took pictures of the fern and brought gametophytes back for laboratory examination. We collected a fern and made a dried specimen to be referenced at the Las Cruces biological station where it was found. I am currently writing a Short Note on the discovery to be published in the *American Fern Journal* later this year. In addition to this project, I worked on an independent study of ferns that we collected in Costa Rica. Certain species within the genus *Elaphoglossum* at high elevation rainforest live on the soil as well as on rocks and on trees. Having such varied habitat preference is quite unusual in ferns and this group may offer insight into the evolution of epiphytism in a manner similar to *Hymenasplenium*.We collected tissues from multiple individuals growing across these three habitats and brought them back to the lab at Colgate to do Nitrogen and Carbon isotopes analysis. We hypothesized, that C and N percentage and isotopic signatures will be different from each other within the same species based on where they grow. This will give the scientific community insight into how these habitats differ and the ways that plants adapt to new habitats. Further analysis of their stomata and vein density will allow us to assess how these plants from the same species are adapting to the different habitats. This project is ongoing in the lab.

Along with analyzing videos of fern sperm, we did some local collection of ferns as well. We spent a few days driving to local state parks and state forests learning, identifying, and collecting New York ferns. We also spent a considerable amount of time searching for a very rare fern to track of its population, but we were unsuccessful after multiple full day excursions. We characterized, identified, and made dried specimens for a large number of *Dryopteris* species for Professor Watkin's work on the hybridization network of *Dryopteris*. He is going to send in DNA samples from each *Dryopteris* that we collected this summer so that he can better understand the degree of hybridization that is occurring amongst species in New York.

Overall, my summer research experience at Colgate was extremely beneficial and productive. I enjoyed my days in the rainforest with Professor Watkins very much. I loved spending all day studying ferns, so much so that I am using a portion of my AMS funding to return to Costa Rica this winter to take an OTS (Organization for Tropical Studies) Tropical Ferns and Lycophytes course for two weeks.

Source of Support: ☐ AHUM Div. ☒ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☐ Other (specify):

Research Fellow: Alexandra "Alex" Weimer (2020) **Concentration: English**

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

Title of Project: Eco-Arts in New York State

Project Summary:

Ecological sustainability in this day and age is permeating society as the world around us changes. Artists around the globe have begun to find intersections between art and ecology and have begun questioning the nature-society binary. Ecological arts can take on many forms, addressing subjects such as politics, society, community, aesthetics, and ethics. This summer I worked alongside my art advisor Margaretha Haughwout to bring ecological arts to the local Colgate and Hamilton community as well as researched ecological arts practices and artists in the New York State area.

My Research Fellowship was divided into three main parts: researching existing agro-ecology and ecological artist established in the New York State Bioregion, help to pioneer new tree/ human/ ecological networks within the state, and lastly to develop ecological art making processes and develop and Eco-Art garden located at Schupf Art Studios in Hamilton, NY. The research I gathered ranged from various Eco-Artists and their practices to listing natural dye plants and how to use them. I compiled my research into various posts that I published on our working website- http://mhaughwout.colgate.domains/ ecoartsinNY. However, beyond the scope of my computer, the research and work I have been establishing this summer is going towards identifying and strengthening networks within the Eco-Arts community. This research creates a foundation for the Colgate community, and local area to grasp how to support and aid in the circulation of ideas and resources.

In addition to this, I was also involved in hands on work in experimenting with various ecological art practices such as moss graffiti, seed bombing, as well as directly involved with constructing an ecological art garden at Schupf Studio. The Studio Garden itself gives Colgate and the larger Hamilton community a stage to open a dialog about ecological art practices in the modern world. The garden project started with my advisor and I working from a greenhouse where the plants were originally grown and housed, shoveling and removing the lawn grass, shaping the garden beds, to eventually being able to bring the plants from the greenhouse into their new home. The garden is comprised of all medicinal and edible plants and fruits.

My ecological arts experiments such as moss graffiti, and creative seeding techniques were all recorded and documented in order to provide replicable results for those in the future who wish to work with ecological arts aesthetically.

Source of Support: ☒ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☐ Other (specify):

Research Fellow: Emma Wellington (2019) **Concentration(s): Asian Studies; Neuroscience**

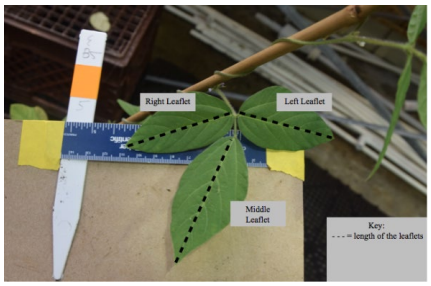
Faculty Mentor: Frank Frey **Department(s): Biology; Environmental Studies**

Title of Project: Fluctuating Asymmetry as a Result of Temperature Stress in Glycine Max

Project Summary:

Plant fitness is commonly associated with levels of symmetry in bilateral plants (Alados et al., 2001; Bjorksten et al., 2000). These variations from bilateral symmetry are termed fluctuating asymmetry and are theorized to be reflective of environmental quality and developmental noise (Beasley et al., 2013; Pennisi, 1995; Graham et al., 2010). Fluctuating asymmetry in plant leaves is commonly used as an indicator of stress, both natural and induced (Freeman et al., 2003). While most researchers have concluded that deviations from perfect symmetry are a reliable means to quantify fitness, there is still some opposition to this claim (Anne et al., 1998). Most of this debate regards the methods of measuring asymmetry rather than the ability of stress to alter leaf shape, length, or position (Anne et al., 1998).

Last summer, we tested the influence of drought stress on the leaf symmetry of *Glycine max* plants (soybeans). Soybean plants have short life cycles, are self-pollinating, and have an entirely sequenced genome. Drought stress was chosen as the stressor because there is previous literature supporting drought as a reliable means to induce fluctuating asymmetry in plants (Alados et al., 2001).



We modeled this summer's research after the experiments performed last summer, while choosing to study temperature stress conditions instead. Previous literature has indicated that heat stress induces asymmetry in soybeans and other grain/legume plants (Jha et al., 2017). 252 soybeans were planted and allowed to grow until they reached the V4 stage. At the V4 stage, the Envy and Tohya plants were separated into control and stress groups (n=126 per treatment). Any plants that did not reach this stage, at the same time as the majority, were disposed of. Remaining plants had their fourth leaflets photographed before treatment ensued.

At this time, the greenhouse temperature was raised from the prime growth set point of 84 degrees Fahrenheit to 95 degrees Fahrenheit for 10 hours a day. After approximately two weeks, the treatment was discontinued. Each new leaflet was photographed during the treatment, as well as after the treatment. Images were uploaded to ImageJ32 software. Leaf lengths, areas, and angles were measured. The deviation from perfect symmetry was also quantified using the equilateral triangle method cited in literature (Frey et al., 2007).

At the end of the summer session, we found qualitative evidence supporting higher leaf rate production in the stress room compared to the non-stress control room. There was also significant evidence that for leaf 5, as stress increases, the asymmetry also decreases for both varieties. From leaves 5 to 6, when both leaves are in the stress treatment, the stress increased asymmetry in Envy, suggesting a delayed stress response. When Leaf 6 was not in the stress treatment, Envy still increased in its asymmetry measurements while Tohya decreased in asymmetry.

Further directions for this research include analyzing more leaves in both varieties and testing other stressors, such as light or soil pH.

Citations:
Aldos C.L., Navarro T., Escos J., Cabezudo B., & Emlen J.M. (2001) Translational and Fluctuating Asymmetry as Tools to Detect Stress in Stress-Adapted and Non-Adapted Plants. *International Journal of Plant Sciences* 162: 607-616. Anne, P., Mawri, F., Gladstone, S., & Freeman, D. C. (1998). Is fluctuating asymmetry a reliable biomonitor of stress? A test using life history parameters in soybean. *International Journal of Plant Sciences* 159: 559-565. Bjorksten, T. A., Fowler, K., & Pomiankowski, A. (2000). What does sexual trait FA tell us about stress?. *Trends in Ecology & Evolution* 15: 163-166. De Anna, E. B., Bonisoli-Alquati, A., & Mousseau, T. A. (2013). The use of fluctuating asymmetry as a measure of environmentally induced developmental instability: A meta-analysis. *Ecological Indicators* 30: 218-226. Freeman, D. C., Graham, J. H., Tracy, M., Emlen, J. M., & Alados, C. L. (1999). Developmental instability as a means of assessing stress in plants: a case study using electromagnetic fields and soybeans. *International journal of plant sciences* 160: S157-S166. Frey, F. M., Robertson, A., & Bukoski, M. (2007). A method for quantifying rotational symmetry. *New Phytologist* 175: 785-791. Graham, J. H., Raz, S., Hel-Or, H., & Nevo, E. (2010). Fluctuating asymmetry: methods, theory, and applications. *Symmetry* 2: 466-540. Jha, U. C., Bohra, A., Parida, S. K., & Jha, R. (2017). Integrated "omics" approaches to sustain global productivity of major grain legumes under heat stress. *Plant Breeding* 136: 437-459. Pennisi, E (1995). Not Simply Symmetry. *Science News* 147: 46-47.

Source of Support: ☐ AHUM Div. ☒ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☐ Other (specify):

Research Fellow: Qianhui "Eva" Wen (2021) **Concentration: Undeclared**

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

Title of Project: Abraham House: Promoting and Funding End of Life Care

Project Summary:

I worked with Abraham House in Utica, New York as a Field School Fellow this summer. Abraham House is a comfort home for people with terminal illnesses. Abraham House aims to provide a home-like environment along with medical assistance for our guests in their final days. Our caretakers provide medical assistance to our guests, and we also provide space for guests' family members to stay upon their wish. Abraham House's patient admission is solely based on patients' need. We admit patients who expect fewer than three months of lifetime, and we do not require payment from the patients. Our support and funding come from small grants, donations, a thrift shop, fundraising events, and volunteers. Therefore, the people who could potentially be served are not limited by economic conditions. Abraham House serves a wide range of population for it is the only comfort home in this area. Because Abraham House has limited space, we often have to make difficult decisions about admission. Upon admission, Abraham House provides the best care possible. Abraham House recognizes how people and their families can be vulnerable, both physically and emotionally in their last days together. Therefore, the Abraham House provides a space for them to find comfort while receiving medical assistance. The staff and volunteers here are all very caring and form good relationships with the guests and their families.

I worked to help Abraham House in their funding efforts by promoting their fundraisers. The goal of my project is to develop their social media presence as platforms for advertisement and fundraising. Fundraising is essential for Abraham House's effort to support the patients and their families, and to allow Abraham House to admit patients without consideration for their ability to pay for the service. In addition, I helped the staff organize new fundraising events like a golf tournament. Through my work, Abraham House was able to use the help of social media to gain publicity and attract more donations, which can in turn help Abraham House provide better support for their patients.

I think organizations like Abraham House are crucial in their very existence because they allow people to die well, in a place like home surrounded by their families. I learned more about the mechanisms of social work and nonprofit organizations; I also got to know people and hear their life stories. Not only had I met all the wonderfully kind people and learned about how nonprofit organizations work, I also was welcomed there like a family. In the process of organizing fundraising events and doing small things for their thrift shop, I learned how, step by step, we can accomplish big things with small actions.

My project fits into my studies and interests because I have always wanted to learn more about the needs of the society and in what ways we could provide for those needs. I have always had an interest in social work. That drew me to community-based research and partnerships. Although I have not declared a major yet, I have an interest in sociology. I have always been interested in the people's welfare and happiness, and I think this experience definitely allows me to explore this on a real-life basis.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Upstate Institute

Research Fellow: Lindsey Wiley (2020) **Concentration(s): Mathematics; Physics**

Faculty Mentor: Beth Parks **Department: Physics and Astronomy**

Title of Project: Analyzing Air Pollution Sources from Uganda

Project Summary:

This summer I worked with Professor Beth Parks on atomic analysis of air pollution sources from Uganda. Ambient, or outdoor, air pollution poses a large health threat worldwide, especially in developing countries such as Uganda. Because of rapid urbanization and industrialization, air quality in Uganda is at unhealthy levels. This project seeks to create methods for determining the elemental composition of particulate matter, which are suspended particles in the air pollution. Specifically, I am analyzing particulate matter with a diameter less than 10 micrometers (PM_{10}), a cutoff selected because particles of this size reside longer in the atmosphere, reach the lungs when inhaled, and can be transported far distances, further increasing their threat to human health.

Professor Parks, working with a PhD student in Uganda, collected PM_{10} on filters at three different locations, sampling a variety of factors that could potentially influence air pollution. These samples were then sent back to the US and weighed, revealing extreme pollution at all locations, in comparison to air quality standards. The World Health Organization advises immediate intervention when pollution levels exceed such published guidelines. However, it is difficult to take action if the sources of the pollution are not known, which is where my research becomes relevant. The ultimate goal of this project is to perform a source apportionment study on the air pollution samples from Uganda to hopefully drive policy. In short, we aim to quantify the amount of each element present on the filters and relate the chemical components to various sources, some of which may be biomass combustion, traffic, dust, etc.

To do so, I have been primarily using total reflection x-ray fluorescence spectroscopy (TXRF), which works by exciting inner orbital electrons via an x-ray radiation source, creating a transition in energy levels in the atoms. As a result, the atoms eject photons, known as a fluorescence, which is characteristic of the atom present in both energy and wavelength. Thus, we are able to quantify concentrations of various elements in our prepared samples. The majority of my research has been spent developing as well as testing methods to assess quantifications of each element present in the samples. While TXRF was able to detect most elements successfully, silicon, a component of dust from soil, posed a challenge. Thus, I read many relevant papers, contacted their authors with questions, and tried new approaches. We are still working on this problem, but I was able to make progress in understanding which techniques might be successful.

I used a different method for carbon analysis since carbon and other lighter elements cannot be identified via TXRF. We traveled to Columbia University Comer Geochemistry Lab and used an integrated sphere spectrometer with halogen and deuterium lamps to measure light absorption, which is characteristic of the amount of black carbon present. The future of this project will include an in-depth analysis of the black carbon quantifications, relating results to qualitative information about the weather and sampling location of each filter. We will also work with the total organic carbon analyzer at Colgate and compare results.

This project allowed me to combine my understanding of and curiosity about physics with my passion for health and the environment. I have been very grateful to witness the direct application of physics to the betterment of human health, and I am hopeful to continue work like this in the future!

Particulate matter collected on Teflon filters

Smoke from outdoor combustion in Uganda

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Justus '43 and Jayne Schlichting Student Research Fund

Research Fellow: Xiyu "Cici" Wu (2021) **Concentration: Educational Studies**

Faculty Mentor: Sandra Jackson **Department: Computer Science**

Title of Project: New Architectures for Low-Power Complex Processing

Project Summary:

The biggest deterrent to the use of low-power, high-performance asynchronous circuits in mainstream chip design is the lack of well developed, widely available, and easy to use tools that aid in the design process, like those that exist for synchronous circuit design. Professor Jackson from Colgate University collaborates with Professor Manohar and his group from Yale to provide that tool functionality for asynchronous circuits. This summer research project at Colgate is a part of their collaboration to develop a program which automatically constructs logical gates by drawing transistors with layers of different material in Magic Layout Editor. We parsed through netlists provided by Professor Manohar which represent logical behaviors and tried to improve their efficiency.

Since we had to parse a netlist into cells, we needed a data structure that can represent these cells and at the same time keep track of the hierarchy of the cells and circuit as a whole. We also wanted to make sure as we generated cells that we did not create duplicate cells. While, signals have names that are different to help show what connects to what, two signals can be the result of the same cell. For instance, if u and v are both outputs of an inverter - we don't want to generate two inverter cells, we would use two copies of the same cell.

In the first several weeks, I learned some simple concepts about logic design, such as important vocabularies and a basic idea of how stages of design relate to each other. I started with concepts like the logical behavior of an inverter such as fundamental logical gates. I got familiar with truth tables that explain the behavior of gates and symbols they are drawn with. I also learned how to put together multiple gates to make another logic equation. Since these are concepts currently taught in 201, I read some relevant parts in the text of that course.

In the last half of the research, we were able to log onto the grace cluster at Yale to access the netlists. We started to look through the code to understand how it works and check the algorithms. We identified areas of the code that would need improvement for clarity and memory performance. Most of the algorithms for the beginning parts (parsing the netlist) was cleaned up by removing global variables. In the part that takes the cells and generates layout (the rectangles), we did a lot of rewriting.

Source of Support: ☐ AHUM Div. ☒ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☐ Other (specify):

Research Fellow: Yuyou "Pomelo" Wu (2021) **Concentration: Psychology**

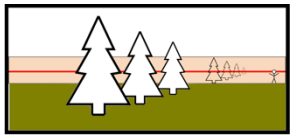
Faculty Mentor: Elodie Fourquet **Department: Computer Science**

Title of Project: Representing Depth for 2D Images Perception Experiments

Project Summary:

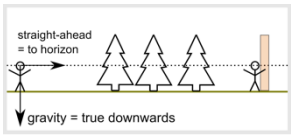
Depth interpretation of pictures (2D) and real world (3D) remains mysterious, as illustrated by the Ponzo and Mueller-Lyer illusions. Understanding the visual information process has interested artists, cognitive psychologists, and computer graphic researchers. How in pictures people utilize local depth information to form a global interpretation of spatial relationship is still unclear. Sedgwick, a perceptual psychologist, noted the significance of the horizon in images as a nested source of information of size, distance, direction, and slant of surfaces. Rogers and Costall further examined the effectiveness and availability of the horizon, concluding that the horizon influences the perception of spatial relationships among objects. Even when horizon is not explicit in a picture, people seem to imagine it.

Since then, researchers categorized three types of horizons in images. One horizon is the perspective horizon, a horizontal line containing the point at the infinity on the picture. Next is the"mock" horizon. It is the line intersecting the ground with the vertical plane that blocks our visual field in the image. The last one is "eye-level" horizon. It corresponds to the eye levels of the main characters in the picture. Outside the picture the eye-level horizon of the observer is usually between the perspective horizon and the mock horizon. Each of these horizons generates different layers of information. Our research goal is to examine which horizon type is dominantly used and how each horizon may influence a particular layer in the nested visual information.



perspective horizon

mock horizon



eye-level horizon

To investigate this research question, we designed a 2*4 factorial experiment. We generated stimuli to be presented to participants on the web. The experimental framework is developed using Python, Java, and Javascript. Each image is composed of a foreground and background. The foreground is the same object, congruent either in 2D height, 3D height or incongruent. They simulate conditions when objects merely conform in 2D information or in 3D representation, using perspective. The background contains some or no horizon information to provide ground spatial reference. Four background conditions are considered in this experiment.

		Foreground	
		Object Type 1	Object Type 2
Background	Nothing		
	Perspective Horizon		
	Mock Horizon		
	Scrambled Horizon		

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Picker Interdisciplinary Science Institute

Research Fellow: Kexin "Tracy" Xu (2019) **Concentration(s): Mathematical Economics; PSYC**

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

Title of Project: Overjustification in the Chinese Work Place: Do Bonuses Motivate Work?

Project Summary:

My summer research is centered around "Gift Exchange" model in Economics and "over-justification effect" in Psychology. Akerlof (1982) developed the "Labor Contracts as a Partial Gift Exchange" model in which companies pay their employees above-market wages, and employees respond by working harder for the company. Companies are incentivized to pay higher wages because they expect their employees to "reciprocate", which is aligned with the social norm of "reciprocity". The literature on the "gift exchange theory" grew after this groundbreaking work, and most of it provides supporting evidence and arguments for the theory. However, Lepper, Greene & Nisbett (1973) found evidence that receiving external monetary rewards can cause the intrinsic motivation of workers to fall, for people often infer causes of their behavior based on salient external factors (Aronson, Akert & Wilson, 2006). If a large monetary reward is offered as an incentive for working, people will conclude that they are doing the work solely for the money, not out of their genuine interests and desires. As a result, when the incentive no longer exists, workers have lessened motivation to work and therefore performance worsens, which is what over-justification effect predicts. On the contrary, if the "gift" is not big enough for people to justify their behavior solely externally, the "gift" will not diminish their intrinsic motivation—the "gift" size matters.

Since most of the research was done in a western cultural setting, I did an experiment in China to examine if gift exchange and over-justification effect are present in the Chinese workplace. In my experiment, I recruited 40workers from a manufacturing firm and 36 from a beauty salon firm in Changzhou, Jiangsu Province. They were recruited for the cause of making paper cranes for the sick children in hospitals (paper cranes are frequently used as presents for the sick and are a sign of peace and health in China), so they have intrinsic motivations to start with. All participants were informed that they would receive 20 yuan (about $3) for their participation in the consent form. I also made it clear in the consent form that even after he/she agrees and signs the consent form, he/she can withdraw from the experiment at any time (and still get 20 yuan). The experiment was divided into two phases, with 15 minutes for each phase. After the first 15 minutes, there will be a 5-minute break before the second phase of the experiment begins. On the first day, 40 workers from a manufacturing firm were randomly assigned to two rooms. At the beginning of the second 15 minutes, participants in room 1 were offered 20 yuan before the work begins. However, participants in room 2 were given 30 yuan, with 10 yuan as a surprising "gift". Similarly, on the second day of experiment, 36 beauty salon workers were randomly assigned to room 3 and room 4. They were given 40 yuan and 60 yuan respectively. At the end of the second phase, each participant in room 1 was given 40 yuan. Likewise, each participant in room 2 and room 3 was given 30 yuan and 20 yuan respectively. Note that each participant regardless of his/her assigned group received the same 60 yuan in the end. A written and oral debrief was given to each participant to explain that individuals were told up front that they will get 20 yuan for their participation in the experiment, but in the process, three groups were given different amounts; however, everybody received equally 60 yuan in the end.

	Control (20 yuan)	Treatment 1 (30 yuan)	Treatment 2 (40 yuan)	Treatment 3 (60 yuan)
1st phase	3.895	3.571	4.278	4.389
2nd phase	3.632	3.524	4.333	5.722
Difference	-0.263	-0.048	0.056	1.333

From the results, we can see that monetary compensation has a positive effect on workers' productivity, with all treatment groups have more positive difference than the control group, which supports the Gift Exchange theory by Akerlof (1982). Moreover, the difference of Treatment 3 is more positive than Treatment 2, and Treatment 2 is more positive than Treatment 1, so the Gift Exchange Theory by Falk (2007) is supported. In comparison, the over-justification effect is not supported by the experiment results. Moreover, as the gift size increases, the positive effect of the gift increases. Overall, the experiment suggests that monetary compensation can indeed promote worker's productivity in Chinese workplaces. More detailed econometric analysis of the data confirms the results.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Lampert Institute for Civic and Global Affairs

Research Fellow: Gabrielle "Gabby" Yates (2019) **Concentration: Geography**

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

Title of Project: Partnership for Community Development: Increased Walkability in the Hamilton Community

Project Summary:

This summer I had the opportunity to work with the Hamilton Partnership for Community Development. The Partnership (PCD) has served the Hamilton area since 1998 as an economic development non-profit. It works to promote sustainable economic opportunities and a sense of community through fostering community-based projects. More specifically, they help existing business and farms thrive, attract new community-minded businesses to the area, develop the downtown area all while preserving the small-town character and fostering civic involvement through research and administer grants to serve these purposes. My project with the PCD compounded this mission, as I conducted research and a walkability audit in order to understand opportunities to improve walkability in Hamilton and surrounding areas.

Given the goals of the Partnership for Community Development stated above, and the unique nature of Hamilton, the organization works with a diverse set of community actors in order to serve the community. Some of the achievements from the past year have been administering grants to homeowners for improving building exteriors, improving a section of the Chenango Canal Towpath Trail, creating a recreation website for recreation in Southern Madison County, conducting a study of the Hamilton Airpark and assisting local businesses such as Kreimhild Dairy Farm, HeartStone Bakery, Fojo Beans, Good Nature Brewery and more with grants for expansion.

Improving the walkability of a community encourages active transportation, which in turn means improvements to the economy, health, safety, environment and social aspects of the local area. More people walking means more people visiting local shops, getting their daily exercise, meeting their neighbors and it reduces reliance on cars. Being a small, rural town, Hamilton already has a vibrant downtown with many amenities within walking distance, however, it could benefit greatly from improvements to sidewalks, intersections, and other walking and cycling infrastructure. My project was to conduct an extensive walking audit through the CDC Walk Audit and Microscale Audit of Pedestrian Streetscapes in order to identify and map problem areas, and then recommend improvements in Hamilton, Poolville and Hubbardsville. The outcome of the project will be for the PCD to use this data to apply for state and national grants for infrastructural improvements.

Working with the PCD on this project has been a fantastic opportunity for me to improve my research and writing skills and better understand the world of planning. As a geography major, I have always been interested in place based issues, and after spending a semester in Copenhagen studying European cities and interning at an urban design firm, I have become interested in urban planning. Being from the CNY area, I am so thankful I have had the opportunity to apply the theories of livability that I learned abroad back to my community. It has been thrilling to be part of a project that hopefully improve the quality of life for all those who spend time in Hamilton.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Upstate Institute

Research Fellow: Saiyang "Sylvan" Zhang (2019) Concentration(s): Astronomy/Physics; Applied Math

Faculty Mentor: Walter Tangarife Garcia Department: Physics and Astronomy

Title of Project: Phenomenology of Self-Interacting Dark Matter

Project Summary:

This project is a preliminary study and exploration on Weakly Interacting Massive Particles(WIMPs) Capturing by hot and dense core inside a massive object. It will be continued throughout the upcoming fall semester in the form of PHYS410 research. During the summer, I studied some basic knowledge regarding the Theory of General Relativity and some Cosmology with the assumption of the flat space. To explain the discrepancy between the theoretical simulation and the observational results, the model of Weakly Interacting Massive Particles(WIMPs) was introduced as one of the candidates. This kind of particles are influenced by the gravitational interaction; however, as its name indicates, it hardly interacts with the regular matter.

First, I started with the theory of general relativity, by assuming a flat space going through an isotopic expansion. Here, the scale factor a was used to characterize the expansion of the space. Since the goal is to understand how a evolves with respect to the time or the temperature after the Big Bang, a series of calculation s were made to obtain the Friedman Equations from which we directly get the relationship between a and time. Before I started this project, I self-studied Mathematica where I use to plot the graph. Since curvature, radiation, and matter have different influences on the expansion rate, the following plot describes the expansion history of this universe. From fig.1, we find that the universe was first dominated by radiation, then matter until the nearly flat space today dominated by the dark energy.

After this, we want to reproduce the calculation of the relic abundance of the dark matter. We can accomplish this by using the methods from statistical mechanics in an expanding universe. We both considered the situation for Fermions and Bosons, relativistic and non-relativistic, and separately verified the expressions for the number density, energy density, and pressure. Since we are interested in the evolution of the number density of dark matter particles, we used the non-relativistic methods($m >> T$) which reduced the particle distribution to Boltzmann Distribution. Finally, we find the approximate expression for the *number density* vs *temperature*.

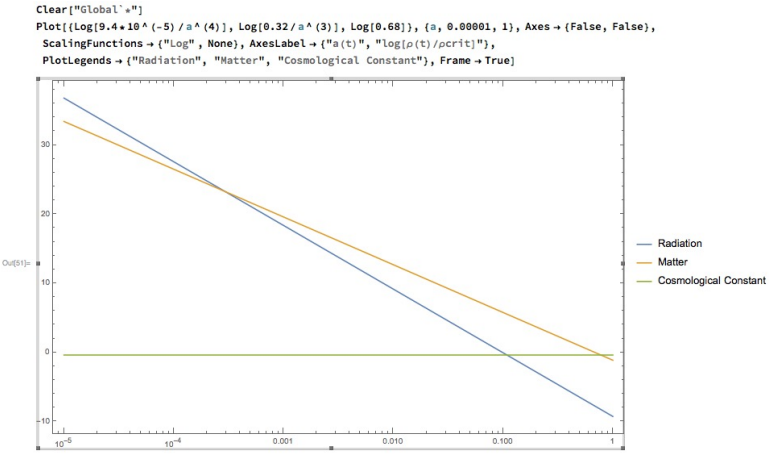


Fig.1 Mathematica coding for the evolution of the energy densities in the universe

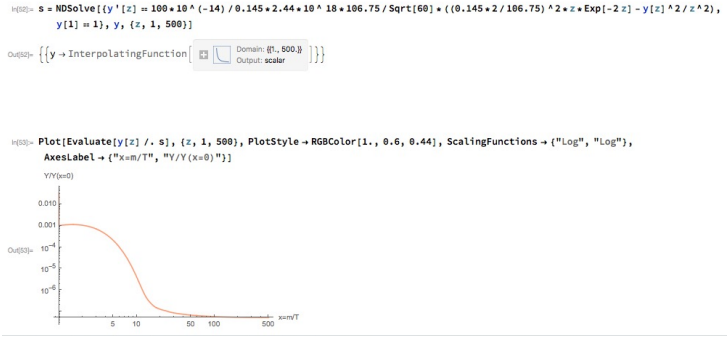


Fig.2 Abundance of dark matter particles as the temperature drops below the mass

Fig.2 shows that as the temperature drops, the number density of the cold relic approaches a constant. This constant would differ for separate annihilation cross-sections. After I learned some basic facts and models for dark matter particles, I will continue my study during the next semester into dark matter capturing by massive bodies. In the literature so far, this has only been done for WIMPs. We plan to generalize it to other models of the dark matter particles that are consistent with the experimental bounds.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Justus '43 and Jayne Schlichting Student Research Fund

Research Fellow: Youhan "Carrie" Zhang (2020) **Concentration: Economics**

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

Title of Project: Regional Variations in China's One Child Policy

Project Summary:

Quantity quality tradeoff theory states that an increase in the quantity of children in a household will lead to a decrease in the quality of children measured by educational attainment.

Since introduced by Gary Becker and his collaborators, it has undergone various examinations. On the one hand, researchers including Rosenzweig and Wolpin (1980), Stafford (1987) and Cáeres-Delpiano (2006), Lee (2008) and Millimet and Wang (2011) find there is a negative relationship between family size and children's outcomes, supporting the theory. On the other hand, researchers including Angrist and Schlosser (2010), Black et al. (2005) and Fitzsimons and Malde (2014) find no obvious relationship between family size and the quality of children, in Norway, Israel, and Mexico. One important concern in testing the validity of the theory is endogenous family size---the household may determine the number of children and the amount of educational investment on each child together, and some unobserved underlying household characteristics such as cultural background determine both. My study uses One Child Policy (OCP) in China as a natural experiment to overcome the endogeneity problem and explores regional variance of quantity quality tradeoff across China using both income and educational attainment as quality measures. Through this study, I can shed new light on whether quantity quality tradeoff works differently for households with different levels of income and wealth, and varying household characteristics.

I use IV (instrumental variable) estimation to solve the endogeneity problem. Specifically, I choose policy fertility rate and abortion rate at the provincial level as instruments. Policy fertility is constructed by Gu et al. (2007). It summarizes the local fertility level if all married couple had births at the levels permitted by local policy, and thus measures the enforcement intensity of OCP in each province. Abortion rate is constructed as the number of abortions in each province divided by women aged 15-49 (of child-bearing age).

I use 2010 China Family Panel Studies (CFPS), China's first large-scale longitudinal household survey, to study quantity-quality tradeoff in China. CFPS is a national longitudinal general survey that covers 25 provinces in China and represents 95% of its population. The 2010 CFPS baseline survey interviewed 14960 households and 42590 individuals. The data contains information about individuals' age, gender, ethnicity, type of Hukou, Hukou province, educational attainment, annual income, number of siblings, parents' age, parents' education.

Using an IV regression analysis, I find:

1. A more stringent OCP does lead to a decrease in the number of siblings.
2. Quantity-quality tradeoff is present in economically developed regions. In the most developed region (Shanghai, Beijing, Zhejiang, Tianjin, Jiangsu, and Guangzhou), an additional sibling results in a decrease in the child's years of schooling by 1.13 years and income by 18 percent.
3. There is no causal relationship between quantity and quality in less developed regions.

In conclusion, there exists a causal relationship between quantity and quality in the most developed regions, while there is no such relationship in less developed regions. My study suggests that the beneficial effect of China's OCP on human capital accumulation is limited to those in most advanced provinces.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Walter Broughton '63 Research Fund

Research Fellow: Zhelun Zhou (2020) **Concentration(s): History; Philosophy and Religion**

Faculty Mentor: John Crespi **Department: East Asian Languages and Literatures**

Title of Project: "The Great Wall" and "Wolf Warrior 2": China Soft Power in its Recent Films

Project Summary:

In this project, I focused on two recent Chinese films: *The Great Wall* directed by Zhang Yimou in 2016 and *Wolf Warrior 2* directed by Wu Jing in 2017. My goal was a comparative study that sought to understand what these two films attempt to convey to their audiences, and how they were received by the same audiences.

At the beginning of the research project, I read works that concentrated on the style of Zhang Yimou's film, such as Wendy Larson's *Zhang Yimou: Globalization and the Subject of Culture* and also Xiaolin Zhou's *Globalization and Contemporary Chinese Cinema: Zhang Yimou's Genre Films*. From those two works, I became aware of Zhang Yimou's concern for filmic language and his engagement with culture. In viewing the two films I noticed that they are both, though to different extents, co-productions with American film companies. Therefore, I also delved into the topic of Sino-Hollywood co-production through the reading of scholarly monographs such as *Hollywood Made in China* by Aynne Kokas and many other scholarly essays that touch upon the problems of the Sino-Hollywood co-production film. I found that the term "soft power" is frequently mentioned by those scholars. Hence, I also explored the concept of soft power in Joseph S. Nye, Jr.'s book *Soft Power: The Means to Success* and Professor Bruno Lovric's discussion of soft power in one of his journal articles. Regarding the reception of the films, I reviewed Yuqing Chu's essay about "politics of reception," different "horizons of expectations," and Terry Flew's essay about "distributional bias." Those two exceptional essays, along with other essays that address the audience's reception of the two films, provided me with great insight: researchers and scholars should not take for granted that message delivered by the film as the film reception itself. Instead, they should delve deeper of the audiences' real response to the film after viewing it.

I also explored the two films' relation to Chinese entertainment media, in particular, the representation of Africa in the Chinese media. *Wolf Warrior 2* portrays a generalized image of Africa as a foil to the image of a strong, prosperous contemporary China. I looked at Megan Ferry's book chapter on China's television representation image of the African nation in the edited volume *China and New Left Visions*. I also read the online compilation of essays entitled *Wolf Warrior II: The Rise of China and Gender/Sexuality Politics*, since gender and sexuality also figure significantly in both *Wolf Warrior II* and *The Great Wall*. To understand the representation of monsters in *The Great Wall*, I read *Monster Cinema* by Barry Keith Grant. His categorizations of cinematic monsters helped me understand the portrayal the "Taotie" creatures in *The Great Wall* and to comprehend how audience received the representation of monsters in *The Great Wall*. Furthermore, I also perused books such as *The Politics of Chinese Media: Consensus and Contestation* by Bingchun Meng as well as many scholarly articles on Chinese censorship. This literature review led me to speculate on the potential messages the two films want to convey, and the mechanism and channels they employ to convey these messages.

It is important to pinpoint the help I received this summer for my research project. My principal gratitude is reserved for Professor John Crespi from East Asian Language and Literature. He provided tremendous advice on my reading lists, my preparation for the poster presentations, and also my crafting of the thesis statement for my research project. I thank Debbie Krahmer, our lovely librarian at Case-Geyer Library, for help in locating articles, organizing my poster, and also for the sweet candies! I appreciate and thank the advice and suggestions of my proposal I received from Professor Ray Douglas of the Department of History and Professor Brenton Sullivan in the Department of Religion. I also thank the friends and everyone else who come to my poster session and gave me feedback. I express my gratitude to everyone for their support.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): J. Curtiss Taylor '54 Endowed Student Research Fund

Research Fellow: Shimiao Zuo (2021) **Concentration(s): International Relations; Psychology**

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

Title of Project: Mohawk Valley Resource Center for Refugee's Office of New Americans

Project Summary:

This summer I was fortunate enough to have the opportunity to work as an Upstate Institute Summer Field School Fellow with the Mohawk Valley Resource Center for Refugees (MVRCR). MVRCR is a local nonprofit organization that serves Utica, NY. MVRCR assists refugees, immigrants, and Limited English proficient (LEP) individuals by providing services in many areas: refugee resettlement, health access, community programs, job placement, adult learning, immigration and citizenship assistance, and interpretation and translation. MVRCR also collaborates with other community partners, such as Midtown Utica Community Center and Mohawk Valley Community College, to gather meetings, host cultural events, and offer educational opportunities. MVRCR is unique amongst refugee resettlement agencies because it has a "one-stop shop" model that allows newcomers to access information, services, meetings, medical appointments and classes in one location where resettlement case managers also have office space.

The research of my project mainly addresses the issue of cultural integration. MVRCR serves to build a community with many cultures. It has evolved and expanded to provide services not only to refugees but also to immigrant communities such as the growing Dominican population and the broader community with linguistic and cultural support. Throughout the integration process, MVRCR facilitates self-sufficiency among refugees and immigrants, assists them in their efforts to fulfill personal goals, and empowers them through information. With the efforts of the staff at MVRCR, newcomers feel warmly welcomed and they will find it easier adjusting to their lives in the United States.

Specifically, I am working on the Enhanced Cultural Orientation (ECO) program, which is a standard curriculum addressing a number of topics and issues suited for refugees who have been in the United States for more than 30 days but fewer than five years. ECO consists of many modules, such as traffic safety, bus tours, budget and financing, community conversations and health care. Participants join in a series of educational presentations on these topics and learn accurate information about life in the community. As a Health Access Intern, I have successfully designed three specific new ECO modules in addition to its current curriculum: substance abuse, vaccination, and pregnancy in the US. These topics aim to familiarize our clients with important things they must know about health care and with the New York State medicine regulations. By developing new modules for an expanding ECO program, I work alongside MVRCR to help refugees establish knowledge and attitudes that will facilitate their adjustment and well-being.

This summer with MVRCR has expanded my understanding of NGOs and knowledge that coincide with my studies. I am an International Relations and Psychology major, and through this experience I have acquired a broader sense of federal immigration and refugee policy. This project allowed me to work at a local non-governmental agency and to gain knowledge about this field, which further deepens my interest in engaging in advanced studies in Public Policy after Colgate. As an international student, this summer program also gave me the opportunity to fully appreciate and experience the Upstate New York region, where I will be studying and living for four years. I am glad that I was able to expand from Hamilton to other parts of Upstate New York.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Upstate Institute

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. Faculty holding joint appointments are listed by the department/program which most closely matches the subject of the research project supervised (source of funding consulted for interdisciplinary projects). 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: 214

Distribution of Students by Concentration (students with double majors are included twice)

Anthropology	4
Applied Math	4
Art and Art History	2
Asian Studies	2
Astrogeophysics	6
Astronomy/Physics	3
Biochemistry	10
Biology	12
Chemistry	14
Classical Studies	1
Computer Science	15
Economics	7
Educational Studies	4
English	10
Environmental Biology	3
Environmental Economics	1
Environmental Geography	1
Environmental Geology	2
Environmental Studies	5
French	3
Geography	8
Geology	8
German	1
History	10
International Relations	10
Japanese	3
Mathematical Economics	6
Mathematics	8
Molecular Biology	13
Music	1
Natural Sciences	3
Neuroscience	13
Peace and Conflict Studies	4
Philosophy	1
Philosophy and Religion	1
Physics	14
Political Science	4
Psychology	17
Religion	1
Social Sciences	1
Sociology	6
Spanish	4
Undeclared	14

Arts and Humanities	**28**
Art and Art History	2
Classical Studies	1
English	10
French	3
German	1
Japanese	3
Music	1
Philosophy	1
Philosophy and Religion	1
Religion	1
Spanish	4
Natural Sciences and Mathematics	**146**
Applied Math	4
Astrogeophysics	6
Astronomy/Physics	3
Biochemistry	10
Biology	12
Chemistry	14
Computer Science	15
Geology	8
Mathematical Economics	6
Mathematics	8
Molecular Biology	13
Natural Sciences	3
Neuroscience	13
Physics	14
Psychology	17
Social Sciences	**54**
Anthropology	4
Economics	7
Educational Studies	4
Geography	8
History	10
International Relations	10
Political Science	4
Social Sciences	1
Sociology	6
University Studies	**18**
Asian Studies	2
Environmental Biology	3
Environmental Economics	1
Environmental Geography	1
Environmental Geology	2
Environmental Studies	5
Peace and Conflict Studies	4
Undeclared	**14**

Distribution of Students by Faculty Division and Department:

(Number is greater than total number of participating students due to jointly supervised projects)

Arts and Humanities	**13**
Art and Art History	3
Classics	2
East Asian Languages and Literatures	2
English	4
Romance Languages and Literatures	2
Natural Sciences and Mathematics	**128**
Biology	29
Chemistry	23
Computer Science	17
Geology	23
Neuroscience	4
Physics and Astronomy	16
Psychological and Brain Sciences	16
Social Sciences	**41**
Anthropology	3
Economics	10
Educational Studies	3
Geography	6
History	7
Political Science	7
Sociology	5
University Studies	**7**
Environmental Studies	5
Film and Media Studies	2
Other	**44**
Center for Freedom and Western Civilization	2
Ho Tung Visualization Laboratory	2
Lampert Institute for Civic and Global Affairs	12
New York Six Liberal Arts Consortium	1
Research Council	2
University Libraries	1
Upstate Institute	24

Distribution of Students by Funding Source

Internal	**131**
Career Services	1
Center for Freedom and Western Civilization	2
Division of the Arts and Humanities	11
Division of Natural Sciences and Mathematics	49
Division of Social Sciences	21
Division of University Studies	6
Ho Tung Visualization Laboratory	2
Lampert Institute for Civic and Global Affairs	12
New York Six Liberal Arts Consortium	1
Research Council	2
Upstate Institute	24
Endowed	**52**
Bob Linsley/James McLelland Fund	2
David Hubbell Colgate Dennis Fund	1
Doug Rankin ’53 Endowment-Appalachian Research	3
Doug Rankin ’53 Endowment-Geology Research	6
Hackett-Rathmell 1968 Memorial Fund	2
Holden Endowment Fund	2
J. Curtiss Taylor ’54 Endowed Student Research Fund	2
Justus ’43 and Jayne Schlichting Student Research Fund	14
Michael J. Wolk ’60 Heart Foundation	6
Miller-Cochran Fund	1
Norma Vergo Prize	4
Oberheim Memorial Fund	2
Picker Interdisciplinary Science Institute	4
Walter Broughton ’63 Research Fund	2
Warren Anderson Fund	1
External	**38**
American Chemical Society Petroleum Research Fund	5
Beckman Scholar Program	3
NASA / New York Space Grant	6
National Institutes of Health (NIH) Area Grant	5
National Science Foundation Grant	19

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Distribution of Faculty by Division and Department:

Arts and Humanities	**10**
Art and Art History	3
Classics	2
East Asian Languages and Literatures	2
English	2
Romance Languages and Literatures	1
Natural Sciences and Mathematics	**43**
Biology	11
Chemistry	6
Computer Science	6
Geology	5
Neuroscience	2
Physics and Astronomy	7
Psychological and Brain Sciences	6
Social Sciences	**25**
Anthropology	2
Economics	5
Educational Studies	2
Geography	4
History	5
Political Science	3
Sociology	4
University Studies	**3**
Environmental Studies	2
Film and Media Studies	1
Other	**18**
Center for Freedom and Western Civilization	1
Ho Tung Visualization Laboratory	1
Lampert Institute for Civic and Global Affairs	11
New York Six Liberal Arts Consortium	1
Research Council	2
University Libraries	1
Upstate Institute	1

Distribution of Faculty by Funding Source

(Faculty with more than one funding source are counted multiple times)

Internal	**68**
Career Services	1
Center for Freedom and Western Civilization	1
Division of the Arts and Humanities	9
Division of Natural Sciences and Mathematics	25
Division of Social Sciences	13
Division of University Studies	3
Ho Tung Visualization Laboratory	1
Lampert Institute for Civic and Global Affairs	11
New York Six Liberal Arts Consortium	1
Research Council	2
Upstate Institute	1
Endowed	**35**
Bob Linsley/James McLelland Fund	1
David Hubbell Colgate Dennis Fund	1
Doug Rankin ’53 Endowment-Appalachian Research	3
Doug Rankin ’53 Endowment-Geology Research	2
Hackett-Rathmell 1968 Memorial Fund	2
Holden Endowment Fund	2
J. Curtiss Taylor ’54 Endowed Student Research Fund	2
Justus ’43 and Jayne Schlichting Student Research Fund	8
Michael J. Wolk ’60 Heart Foundation	4
Miller-Cochran Fund	1
Norma Vergo Prize	2
Oberheim Memorial Fund	1
Picker Interdisciplinary Science Institute	3
Walter Broughton ’63 Research Fund	2
Warren Anderson Fund	1
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